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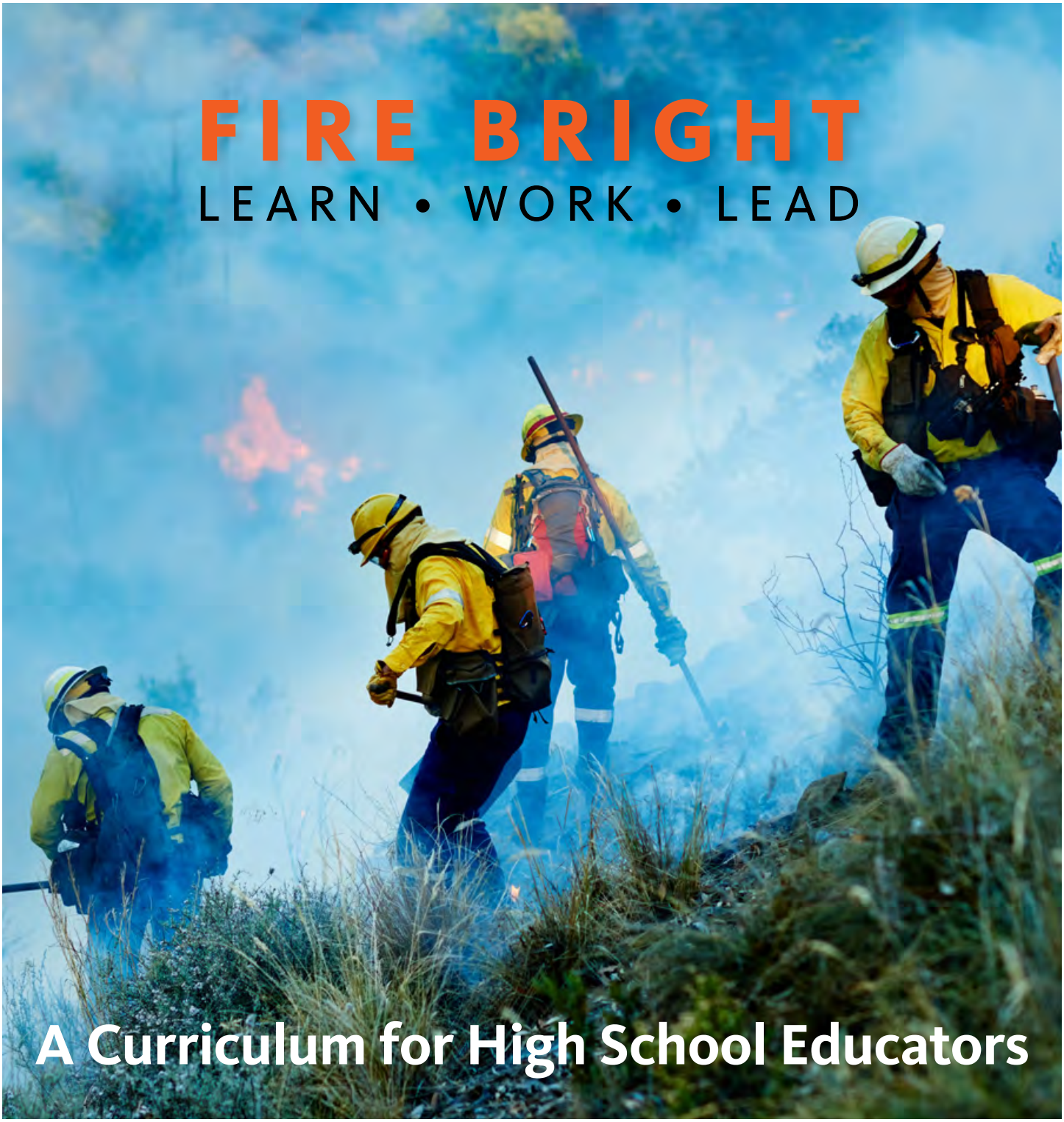

Oregon State University

EM 9416 | MARCH 2024
View online: https://extension.oregonstate.edu/catalog/pub/em-9416-fire-bright-learn-work-lead

FIRE BRIGHT
LEARN•WORK•LEAD

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Supplemental materials

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Published March 2024

PREFACE

A word about wildfire and trauma

Dear educator,

Welcome to the Fire Bright curriculum!

Before you dive into the modules, we would like to offer you some information on how you can promote good mental health as you guide students through this curriculum.

The topic of this curriculum — wildfire — may cause discomfort for students and teachers. Some educators and students may have direct experience with fire, they may have family or friends who have been affected, or they may become worried about the threat fire can pose. Some people may have previously experienced unrelated adverse circumstances, such as houselessness or physical injury, that could recur in the event of a fire. Whatever the cause, it can be helpful to be aware of the emotional impacts and have some tools to address it. Also consider that students and educators could be dealing with traumatic stress for any number of reasons on any given day, not just when doing a lesson on wildfire.

We encourage you to draw upon resources, knowledge and training opportunities available to you on trauma-informed approaches. We have provided a short lesson on introducing trauma and trauma-informed tools and strategies to your students in Modules 1 and 5. While it does not replace any in-depth training or knowledge gathering, it will hopefully be a helpful brief overview.

Below are some recommendations and examples of strategies that may support you and your students as you navigate Fire Bright:

- Peruse Oregon State University Extension's publication *Trauma-informed Toolkit — A Resource for Educators*. This toolkit contains extensive background information on trauma, including the neurobiology of trauma, common trauma symptoms and practical trauma-informed strategies and tools for educators. The second half of the toolkit contains an example of applying a trauma-informed lens to a lesson plan on fire. We encourage you to familiarize yourself with it and apply trauma-informed strategies and tools as you are comfortable to the Fire Bright lessons when implementing them.
- Give advance notice to students, families, caregivers, school counselors and any other involved parties that you are planning on implementing Fire Bright. We have drafted a template letter for families and caretakers that you are welcome to modify.

- Consider involving school counselors or social workers throughout the curriculum. If your school does not have the resources to provide trauma-informed support, consider reaching out to any of the contacts listed in Appendix A.
- Check in with students at the beginning and end of each of the lessons to assess their well-being. If needed, take appropriate action to support students. For example, talk to parents or refer them to school counselors.
- Give students trigger warnings for all videos, activities, field trips, guest speaker presentations and any other materials. If you are about to show a video that depicts a house on fire, tell students ahead of time and invite them to take care of themselves. For example if a student does not want to see a house on fire, give them the option to step outside, close their eyes or look out the window.
- A trauma response is a result of feeling like we have no control over our well-being. To counteract this, give students agency by inviting them to take care of their needs (whether that is taking a break at any time, doodling, taking a sip of water, etc. Offer them choices for how they want to interact with the content of this curriculum. Some may want to silently write in a journal instead of participating in a group discussion.
- Build in plenty of processing activities to give students a chance to digest the information and any uncomfortable emotional reactions they may experience, including verbal processing, physical processing and creative processing.
- Most importantly, take care of your own nervous system before, during, and after lessons through grounding activities, calming exercises, conscious deep breathing, verbally processing with a trusted person or any other method that resonates with you. The same is true in this situation as what we are told in a plane; put the oxygen mask on yourself first before helping others. In this case, regulate your own nervous system before helping your students regulate theirs.

For examples of all of the above see the *Trauma-informed Toolkit — A Resource for Educators*, https://catalog.extension.oregonstate.edu/em9348.

We hope this curriculum will provide your students a stepping stone to become active participants in mitigating the negative impacts of wildfire on our communities.

— The Fire Bright team

INTRODUCTION

Wildfire impacts nearly every corner of the state of Oregon. Historically, humans on this landscape have had a variety of responses to wildfire, from the intentional setting of fires by Indigenous cultures to the strict fire suppression of the post-war era and beyond. As we have altered the way fire interacts with the landscape, we have started to understand what generations before us have: That this is a landscape dependent on wildfire. Without wildfire, the forest, high desert, coastal and grassland ecosystems that thrive in this beautiful state would not be able to persist. We must rethink our relationship with wildfire and come to understand that restoring and maintaining a healthy relationship with fire is a communitywide effort.

Recognizing that students are active members of the community and future professionals and homeowners themselves, this curriculum was designed to bring students into the conversation to help create a cultural awareness of our wildfire-adapted environment, while giving those students career path opportunities. Students are empowered when they help reduce fuels around their communities, develop skills needed for a career in wildfire risk management and help their communities come together to prepare for the next fire.

Learn more about this curriculum and view photos of its use in the classroom: https://sofrc.org/education/high-school-wildfire-curriculum/.

Why a high school curriculum on wildfire?

Fire Bright was designed specifically for high school students. High schoolers are well positioned to participate in the lessons and apply them in the near future as homeowners and voters. Helping students understand wildfire today fosters a foundational competency within the community on how to live with wildfire.

Additionally, Fire Bright provides tangible professional possibilities to students who are in the process of determining their future careers. With wildfire becoming more of an issue throughout the state, professions within all levels of wildland firefighting and management are in high demand.

Fire Bright goals and objectives

The overall goal of this curriculum is to provide Oregon high schools with engaging, standards-based lessons that build on existing natural resource courses. It provides students an understanding of the dynamics of wildfire in Oregon, and how they can help develop more wildfire-resilient communities.

Through these lessons, students will be able to:

- Recognize how wildfire is a natural process in Oregon, as well as how wildfire risk and intensity have increased over the years.
- Understand how local forest ecology depends on wildfire to survive and thrive.
- Determine wildfire risks related to forest structure.
- Describe the essential ingredients needed to start a fire.
- Describe what factors determine where a wildfire will move and with what intensity.
- Describe what a healthy wildfire regime looks like from a community and economic perspective.
- Explain scientific principles and economic constraints involved in managing wildfire.
- Identify the roles of agencies, governments and local fire districts in preparing for, mitigating the risk of and suppressing wildfire.
- Understand the qualifications required for a student wanting to start a career in wildland firefighting.
- Examine wildland firefighting and natural resource management career options.
- Describe barriers to wildfire preparation in wildfire-prone communities.
- Identify actions they can take to help ensure the fire resiliency of their communities.

How to use the curriculum

This guide outlines a high school curriculum focusing on Oregon forests and wildfire. It provides a set of lesson plans, resources and tools designed to help students gain a deep understanding of this topic. With both classroom and field activities, it enables students not only to learn about the occupational fields of wildland firefighting and natural resource management in Oregon, but how to build community fire resilience as well.

Fire Bright is designed to be integrated into existing natural resource courses. It is organized to align with wildland firefighting hiring season, as well as the optimal timing for community fire resiliency organizing to prepare for fire season.

This curriculum is divided into five modules. Each module contains from one to seven distinct classes, although teachers may wish to break up or blend classes to fit their school schedules. While it is structured to span a school year with each subsequent module building on the last, teachers may select lessons from each module to fit the needs of their educational program. Each module or lesson may be delivered alone or in order. Teachers may also supplement the curriculum to expand on concepts as suggested in the additional resources section.

Each topic within a module provides a list of materials — worksheets, videos and other multimedia included within this curriculum package; an in-depth background description of the content; key vocabulary for students to learn; an easy-to-read set of steps teachers can take to prepare and deliver lessons; and assessment opportunities to ensure students have understood the content.

In addition, a supplemental note taker is available for teachers to use to engage students during presentations and as a formative assessment tool.

The curriculum may be used:

- As the basis for a range of 55+ hours of integrated instruction.
- To teach a single unit on wildfire, fire-prone forests, wildland firefighting and natural resource careers, or community resiliency within other high school courses, such as natural resource science or environmental science.
- To teach students about career opportunities in natural resource management and wildland firefighting.
- To help students to participate in the National Wildfire Community Preparedness Day, which takes place annually on the first Saturday in May.

Curriculum overview

Each of Fire Bright's five modules focuses on a different topic related to wildfire management in Oregon. It begins with the big picture of wildfire in the West and the forests of Oregon where wildfire is an intrinsic part of the ecology and fire science. It provides a focused introduction to careers in wildfire management and suppression, and strategies in community risk mitigation.

1 **Living in the era of megafires**

This introductory module provides students with an overview of contemporary wildfire issues, including the threat of megafires, and how they impact forest health and communities.

2 **Forests in a wildfire-prone environment**

This module helps students understand the ecological and historical basis of the current wildfire dilemma. Students learn some of the skills forestry professionals use to assess fire risks and forest health.

3 **Exploring wildfire**

This module provides students with a better understanding of the causes of wildfire and the importance of mitigation strategies.

4 **Wildland firefighting and natural resource career pathways**

This module exposes students to the skills needed for careers in wildfire fighting and natural resource management, as well as pathways to these careers.

5 **Protecting your community from wildfire**

This module explores wildfire from the perspective of the community. It provides students with the knowledge and tools to help their community prepare for wildfire.

Materials

For each lesson, links to relevant resources are embedded in the lesson itself. In addition, worksheets, videos and digital files created for this curriculum are available on the OSU Extension website, at https://extension.oregonstate.edu/catalog/pub/em-9416-fire-bright-learn-work-lead.

Tips

Fire Bright relies on guest speakers, hands-on activities and field visits. Accordingly, we recommend the following tips to ensure smooth delivery:

- The Fire Bright curriculum is best implemented with support from firefighting and wildfire education organizations and agencies, especially a Firewise coordinator. Firewise coordinators are often housed within your local fire district, fire department or Oregon Department of Forestry/ Forest Protection Association, depending on your location. Their purpose is to help communities prepare for wildfire via the Firewise Communities program. Partnership with a classroom using the Fire Bright curriculum can help in that effort.

  If you plan to complete all five modules, Firewise coordinator support will be invaluable in helping students develop a meaningful and effective final project.

  Additionally, consider contacting your local Oregon Department of Forestry or Forest Protection Association office as well as your local OSU Extension Office for potential guest speakers and resources. Appendix B lists contacts for local ODF, FPA and OSU Extension offices.

- Map out a schedule for all the modules you intend to deliver prior to the start of the school year. (See Fire Bright chart for the curriculum at a glance.)

- Plan ahead when contacting guest speakers to schedule, determine sites, obtain permissions, reserve tools, etc.. Collaborate with other teachers to maximize use of professionals' time.

- Identify potential field visit sites early on. Contact your local OSU Extension office for recommendations.

- Ensure you have ample water and a safe spot for the live-fire activities — either a hooded indoor lab or a fire-free outdoor location such as a parking lot.

Suggested time frame

This curriculum is designed for approximately 55 hours of combined class, field time and final project with the following suggested time frame.

1. **Wildfire risk — living in the era of megafire:** 3 hours of class time
2. **Fire ecology – forests in a wildfire-prone environment:** 7 hours of class time + 1 field day
3. **Fire behavior – exploring wildfire:** 7 hours class time + 1 field day
4. **Wildland firefighting and natural resource career pathways:** 7 hours class time + 1 field day
5. **Protecting your community from wildfire:** 3 hours class time + 0.5 field days + 4 hours final project preparation and presentation

With the integration of this curriculum into existing natural resource science courses, educators will expand or de-emphasize content according to their students' needs. Guidelines for time per lesson are only suggestions. Time allotted to class and field lessons will vary depending on specific course design.

Standards connections

Each lesson in the curriculum lists the most relevant connections to Next Generation Science Standards, Common Core State Standards — English/Language Arts, and Oregon Career and Technical Education Standards. Please note that for any given lesson, we have listed only standards that relate directly to the main lesson (not extensions) and that are a clear focus of the lesson. In addition, we have provided a cross-reference table at the back of the curriculum.

Please feel free to revise or extend activities to enhance connections to any standard you choose.

Field investigations

Each module requires at least one full field lab day, except for the first module, which serves as an introduction to the curriculum. Field days include:

- **Module 2:** Collecting stand data
- **Module 3:** Fuel reduction
- **Module 4:** Wildland firefighting
- **Module 5:** Visit a firewise community, and creation or maintenance of a firewise community

Follow-up opportunities

There are many opportunities to enrich and supplement this curriculum. Some ideas for high schools include the development of demonstration sites for community education and outreach. A permanent site for students to use to demonstrate their knowledge of fire resiliency strategies provides students with the opportunity to serve as ambassadors and educators for their own communities.

With school support, student groups can pursue mini-grants for continuing firewise work. Funding requests for demonstration sites may be integrated into proposals. Teachers may work with Firewise Community coordinators for funding opportunity recommendations.

Countless outreach opportunities exist as well. Student poster contests can garner national attention. Teacher- and student-created blogs and websites can raise public awareness and increase funding opportunities.

The first Saturday in May is National Wildfire Community Preparedness Day. This is an opportunity for students to connect their community resiliency work to a larger audience and showcase their work.

Developing internship pathways for students in partnership with agencies and nonprofits participating with this curriculum will provide more hands-on education opportunities for students as well as a career pipeline.

Resources

FireWorks!

FireWorks! provides students with interactive, hands-on materials to study wildland fire. It is highly interdisciplinary. Students learn about the properties of matter; chemical and physical processes; ecosystem fluctuations and cycles; habitat and survival; and human interactions with ecosystems. Students using FireWorks ask questions; gather information; analyze and interpret it; and communicate their discoveries. The original FireWorks Curriculum was published in 2000 by the U.S. Forest Service, Rocky Mountain Research Station. New FireWorks curricula published in 2017 incorporate the latest science, additional topics, activities for high school students and updated national educational standards. Many activities in the FireWorks curriculum apply wherever wildland fires occur (particularly activities in Units II and III), while activities about fire ecology and fire history (Units I, V and VI) are applicable only in specific regions.
https://www.frames.gov/fireworks/home

Citizen Fire Academy

The Citizen Fire Academy program equips participants with the knowledge they need to improve fire preparedness and resiliency on their own properties and in their communities.
https://catalog.extension.oregonstate.edu/em9168

Inside Oregon's Forests

Inside Oregon's Forests, developed by the Oregon Forest Resources Institute, includes 12 weeks of lessons covering the history of Oregon forests; tree biology and forest types; the environmental, social and economic importance of forests; forest management; wildfire; and more. https://learnforests.org/resource_article/inside_oregon's_forest_a_high_school_forestry_curriculum

Forest Fact Break

This curriculum uses several videos developed by Oregon Forest Resources Institute. https://oregonforests.org/video-library

Southern Oregon Fire Ecology Education

An education and outreach collaborative centered on wildland fire science as a pathway into ecology, preparedness, and wildfire recovery for vulnerable populations and southern Oregon communities. SOFEE provides:

- Standards-aligned, trauma-informed curriculum for grades K–12 that uses fire as a lens for STEAM learning, land management literacy and entry into fire-related career pathways.
- Activities, resource networks and engagement opportunities to help individuals and families prepare for and recover from wildland fire.

SOFEE has adapted Units I, V and VI to Southern Oregon ecology. Once completed, the curriculum will be housed on the Southern Oregon Education Services website, https://www.soesd.k12.or.us/southern-oregon-fire-ecology-education-curriculum/

1. LIVING IN AN ERA OF MEGAFIRE

This introductory module will provide students with an overview of contemporary wildfire issues, including the threat of megafires and how they impact forest health and communities. As this topic can be traumatizing for some students, this lesson includes suggestions for inserting various trauma-informed strategies throughout, marked in red. These strategies are only included in Module 1, but educators are encouraged to use these strategies throughout the rest of the Fire Bright modules as appropriate.

Time considerations

Preparation: 45 min

Procedure: Two to three 50-minute in-class sessions

Learning objectives

Students will be able to:

1. Describe threats, impacts and risks of wildfires in local communities and statewide.
2. Describe the ecological role of fire in shaping forest ecosystems and how historically it was used as a tool to provide benefits for Native American communities.
3. Analyze the variables that determine how a community is resilient to wildfire. Compare and contrast two representative communities.
4. Describe the role of wildland firefighters and their importance to the community.
5. Identify high-risk or vulnerable communities in their area.
6. Explore the role of trauma in discussing and experiencing wildfire impacts.

Behavioral objectives

Students have completed:

1. Identification of community wildfire risks
2. Assessment of wildfire risk for their own home

In addition, they will have learned how to use trauma-informed strategies when needed to self-regulate while participating in this module.

Standards connections

Oregon Science Standards

Performance Expectations

- HS.ESS3.1: 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.

Disciplinary Core Ideas

- ESS3.B: Natural Hazards. Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations.
- LS2.C: Ecosystem Dynamics, Functioning and Resilience. A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Science and Engineering Practices

- 2. Developing and Using Models. Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems or solve problems.
- 7. Engaging in Argument from Evidence. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

Oregon English Language Arts Standards

- 9-10.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9–10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.
- 11-12.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 11–12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively.
- 9-10.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
- 11-12.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Oregon Standards for Literacy in History/Social Studies and Science and Technical Subjects

- 9-10.WHST.1. Write arguments focused on discipline-specific content.
- 11-12.WHST.1. Write arguments focused on discipline-specific content.

Oregon CTE Knowledge and Skills Statements

- KSS.H. Describe ecological concepts and principles; investigate and explain the relationships between these principles and natural resource environment development.
- KSS.L: Acquire the specific academic knowledge and skills necessary to pursue a full range of career and post-secondary opportunities within natural resources management.
- KSS.M: Use oral and written communication skills in creating, expressing and interpreting natural resource management information and ideas including technical terminology.

Preparation for module delivery, addendum

Prior to the delivery of this and subsequent modules, we encourage educators to peruse *Trauma-informed Toolkit: A Resource for Educators,* EM 9348. This toolkit contains extensive background information on trauma and practical trauma-informed strategies and tools. Below are a few highlights from the toolkit relevant to this lesson.

What is trauma?

The Substance Abuse and Mental Health Services Administration defines trauma as the adverse effects on a person's mental, physical, social, emotional or spiritual well-being that often result from experiencing a harmful event or set of circumstances.

Traumatic stress or a '"trauma stress response" refers to a normal neurobiological response commonly experienced as a result of a life-threatening or otherwise overwhelming experience (such as fire evacuation) that elicits the feeling of helplessness, hopelessness, terror and a loss of control.

Talking about fire or learning about fire risk and safety could cause high levels of stress for adults and youth alike, due to:

- **Direct experience with fire.** Students or educators may have lost their homes, possessions or livelihoods to fire. Their physical well-being may have been threatened by fire.
- **Indirect experience with fire.** Students or educators may have family, friends or community members affected by fire. They may have heard stories of loss and danger from fire through media or personal stories.
- **Similar circumstances unrelated to fire.** Students or educators may have experienced losses similar to those that occur due to fire. These could include illness, the death of loved ones, theft, etc.
- **Learning about fire in the moment and the threat it poses to human and animal life.** Fire has the capacity to threaten a number of our basic needs all at once: shelter, food, clean water, physical safety and access to medical care.

Types of traumatic stress

- **Individual trauma —** an event or circumstance experienced by an individual that causes a trauma stress response (such as getting a hand burned in a small campfire if no one else is harmed).
- **Collective trauma —** more than one person or groups of people experience the same event or circumstance affecting and changing the narrative, culture and psyche of a group (such as wildfire threatening a community or entire region).
- **Vicarious (or secondary) trauma —** can affect anyone who is closely connected to someone or multiple people experiencing a trauma response by listening to trauma victims recount their experience, reading reports, watching video footage or supporting the person in other ways. For example, hearing a family member recount losing their house to fire may elicit a trauma response.

Risk and protective factors

Certain cultural, biological, historical and systemic factors can increase or decrease the likelihood of a person's trauma stress response. These factors influence how long the response will last and the degree to which it will affect the person's daily functioning.

- **Risk factors** deteriorate their feeling of security, ability to thrive and control over life choices. Examples include pre-existing exposure to trauma, unstable family dynamics, lack of healthy relationships, marginalization, discrimination, limited availability and access to social supports (such as health care) and many more.
- **Protective factors** encourage stability, thriving, independence and safety, fostering resilience. Examples include feeling a sense of belonging, stable family dynamics, healthy relationships, a solutions-focused and strength-based belief system, feeling welcome and validated by service providers, and access to social supports (education, transportation, medical care, etc.), among others.

Classroom activities

Materials

- *Era of Megafires* — video (20 minutes), https://eraofmegafires.com/
- Communities in Wildfire Case Studies. (Choose your own or use the two provided.) Consider offering the option to use only text-based accounts to account for trauma-impacted students.
  - Camp Fire, Paradise, California. (2018) https://threedaysinparadise.tv/ and https://en.wikipedia.org/wiki/Camp_Fire_(2018)
  - Milli Fire, Sisters, Oregon. (2017) http://deschutescollaborativeforest.org/forest-restoration/fuels-reduction-slows-milli-fire/ and https://en.wikipedia.org/wiki/Milli_Fire
- *Getting the Fire Call* clip: https://www.pbs.org/video/wildland-getting-fire-call-clip-d7ll2w/
- Oregon Wildfire Explorer: https://tools.oregonexplorer.info/OE_HtmlViewer/index.html?viewer=wildfire
- Materials to help students regulate their nervous system during the lesson, such as fidget toys, doodling equipment, calming music, headphones, yoga mats, etc.

Background information

Wildfire is a fact of life, especially for the communities of the western United States. In recent times, more fires have ignited, more area has burned and more communities have come under threat. We are living in what is called the Era of Megafires.

Megafires are the result of ignitions (either from human or natural causes), drought stress

exacerbated by climate change, and an overabundance of fuels in crowded forests. From a community perspective, not much can be done about drought stress. Some types of ignitions will never be eliminated. But people can work on the third factor through effective fuel reduction that reduces the availability of material to burn both in forests, and around our homes and towns.

For those who live in the Wildland Urban Interface, a good place to start is to assess your home and community for wildfire risk. One useful tool in wildfire risk assessment is Geographical Information Systems. This is all a part of wildfire preparedness.

But not all fires do their worst in far-off forested wildlands. More and more, we are seeing wildfire threaten not just homes, but entire communities (like Blue River, Talent and Phoenix in the 2020 fire season alone). In the heart of communities, no amount of fuel reduction can reduce your risk because the fuels surrounding one's home are other people's homes and businesses. However, there are options for these communities. Here, as well as along the Wildland Urban Interface, it is crucial that communities come together and plan for wildfire by improving evacuation routes, establishing clear lines of communication with first responders and making evacuation plans. Some of this planning work can be accomplished through Firewise Community organizing and working with local fire departments and districts to stay up to date on evacuation protocols.

Trauma-informed strategy: It is important to balance out the challenges and risks of wildfire with hope and action steps to increase resilience. This includes advances in effective fire prevention and management, such as new technology, increased government budgets for fire management, learning from and working with Indigenous communities on implementing prescribed burns, public education campaigns, community-based proactive fire prevention programs (such as Firewise) and a host of cutting-edge research and tool development for public and private fire management.

Key vocabulary

Megafire

Wildland Urban Interface

Wildfire risk

Wildfire preparedness

Firewise community

Geographical Information Systems

Trauma

Trauma risk and protective factors

Preparation

1. **Trauma-informed strategy:** This topic has the potential to be uncomfortable and stressful for adults as well as youth. Refer to the Trauma-informed Strategies and Tools handout to assist in classroom delivery. Prior to class (as well as during and after), use a few strategies or practices to ground, relax and regulate your nervous system (for example, conscious deep breathing, yoga or a walk in nature.) Or, draw on community resources for support. Modify this lesson to make it manageable for you or ask for parent volunteers or other support as needed.
2. **Trauma-informed strategy:** Let students know at least a week in advance that you are planning on taking them through this module. Describe a brief overview of activities and videos in the module to give them an idea of what to expect. Encourage students to bring fidget toys to class or anything else that is not disruptive but supports their nervous system.
3. Review *Trauma-informed Toolkit: A Resource for Educators* prior to class to get a better grounding in trauma-informed approaches. Pull out any relevant figures or text to share with the class.
4. Ask a guest speaker (such as the school counselor, district social worker, etc.) who is well-versed in trauma-informed approaches to come speak to the class.
5. Prepare the *Era of Megafire* video for the in-class session.
6. Make copies of the Community Wildfire case studies to distribute to students.
7. Prepare the *Getting the Fire Call* video clip.
8. Review the Oregon Wildfire Risk Explorer prior to class to create a sample homeowner's report for wildfire risk.

Procedure

1. **Trauma-informed strategy:** Begin class by sharing with students that the topic of wildfire can be an uncomfortable topic for some, which is why this module will include basic information on trauma and how it affects us. Utilize the "Trauma-informed strategies and tools" handout during class. Invite students to take care of their needs and participate in whatever capacity is available to them, knowing that the content will affect everyone's nervous system differently. Some examples are to take a sip of water, use a fidget toy, doodle, take a break when needed, put their head on the table and close their eyes for a bit, etc.
2. **Trauma-informed strategy:** Emotional well-being check-in. Engage students in an activity that encourages them to tune into their current emotional state and share it either with the whole class, in small groups or with a partner. Or, they could silently write or draw. For example, share three words that describe how you are doing this morning. Always give students the option to pass or skip when sharing with others.
3. **Trauma-informed strategy:** Offer an opportunity for students to reset their nervous systems

before diving into the first activity. Some suggestions:

- **a.** Slow, conscious breathing (belly breath, longer exhale than inhale, etc.)
- **b.** Physical movement (jumping jacks, running in place, push-ups, yoga)
- **c.** Singing or any other vocalization (growling, animal sounds, sounding out how they are feeling, etc.).
- **d.** A few minutes of quiet time with calming music. Students could close their eyes, look out the window, or do a guided mindfulness activity or meditation.
- **e.** Journaling or drawing.

6. Discuss key vocabulary for Module 1.
7. Invite students to watch the *Era of Megafires* video with Paul Hessburg. Assign one or more follow-up questions as an in-class discussion or take-home essay.
   - **a.** **Trauma-informed strategy:** How did this video make you feel? What comes up for you when you think about megafires? (Check in to help students process emotions.)
   - **b.** *The Era of Megafires* talks about a dilemma brought on by excluding fire from landscapes and ecosystems where it occurred historically. How can we create forests and landscapes that are less prone to megafires?
   - **c.** Who is responsible for reducing the risk of wildfire? Should homeowners bear the largest costs of reducing fuels on their property?
   - **d.** What is the role of communities, including yours, in reducing the risk of wildfire and being prepared for when fire comes? Should community governments restrict where people can live when they choose to live in high-risk areas? Should they be able to force forest landowners to reduce hazardous fuels on their properties, even when it is expensive to do so?
   - **e.** Should we put out all fires? Are there ever circumstances when wildfires should be allowed to burn? If so, when and why? What role does prescribed fire or controlled burning play in reducing the risk of megafires?
6. **Trauma-informed strategy:** Offer a quick processing activity or break to digest the information from the video and discussion. For example, invite the class to take a few slow, deep breaths, do a few stretches or other movements together or alone, journal, or anything else that is appropriate.

   Review the two case studies of one community that successfully survived wildfire and of another that sustained damage and casualties. **Trauma-informed strategy:** Offer students the opportunity to use text-based resources or step away when viewing graphic or video resources with stories and images that could elicit a trauma stress response. Another option is to summarize video and graphic depictions of wildfire incidents into bullet points that students can compare.

   Have students divide into groups to compare the wildfire experiences of the communities of Sisters, Oregon, and Paradise, California.

Invite students to discuss the questions below. **Trauma-informed strategy:** Offer an alternative to group discussion in case some students don't have the capacity to discuss with others. This could involve silent writing or drawing the answers:

- **a.** What were the conditions of the communities prior to wildfire? (Consider: prior fuel reduction treatments, evacuation plans, etc.)
- **b.** What was the cause of the fire?
- **c.** How much time was there between the start of the fire and when it threatened the community?
- **d.** How does the speed of fire spread after initial ignition differ between the two case studies?
- **e.** Were evacuation orders called?
- **f.** What was the extent of the wildfire's impact on the community?
- **g.** **Trauma-informed strategy:** What could the community that sustained damage and casualties have done differently to increase its resilience? (This emphasizes a solutions-focused approach)

8. Bring the groups back together to report their answers.
9. Have students review the *Getting the Fire Call* video clip and invite them to discuss or write an in-class essay on the following question:
   - **a.** Would you like to become a wildland firefighter? Why or why not? Why do you think some people are called to become wildland firefighters?
10. Ask students to log in to the Oregon Wildfire Risk Explorer. This exercise is an opportunity for students to manipulate maps to analyze pertinent information. This is a skill set relevant to many career paths. Have students answer questions about their local fire district, Firewise communities and their risk level.

    Trauma-informed strategy: Some students may discover that their community is at a high-risk level, which could be stressful. Allow time for students to process and discuss. Focus on solutions and strengths and talk through action items that students and community members can take to increase their resilience.
11. **Trauma-informed strategy:** Share with students that it is completely normal for humans to experience uncomfortable emotions. They may feel stress, panic, anxiety and sometimes trauma when learning about fire. For this reason, this lesson and subsequent modules will include information and activities on trauma and trauma-informed practices.

    Guest speaker (such as school counselor or district social worker) presentation:
    - **a.** What is trauma?
    - **b.** Trauma resilience, including trauma risk and protective factors.
    - **c.** Types of traumatic stress.
    - **d.** Neurobiology of trauma.
    - **e.** Practical trauma-informed strategies and tools students and educators can use to regulate their nervous systems.

12. **Trauma-informed strategy:** End the lesson by giving students an opportunity to process and regulate their nervous systems.

    Processing: Invite students to reflect and share (whole group, small groups, journaling, drawing, etc.). Let them know they can pass, or share one-on-one with the teacher privately after class:

    a. How are you feeling about wildfire now at the end of this class?

    b. What are some things you and your community can do to increase wildfire resilience?

    Nervous system regulation: Let students know that it is normal to feel heightened emotions or stress thinking about megafires and fire risk, even after class. Encourage them to talk to a trusted person about it, including the teacher and other school staff. Tell them to let an adult know if they would like some extra support.

    a. Invite students to join you in taking a few slow, deep breaths to end this module. Or, they could try any technique for regulating the nervous system that resonated with them.

13. **Trauma-informed strategy:** If possible, check in with students again in the following class and perhaps a week later to get a sense of how they are doing and if anyone is having trouble processing the information and their emotions. Take appropriate action if needed to support students. (Talk to their parents or refer them to a school counselor).

Assessments

1. **Era of Megafires essay questions —** Use an essay grading rubric to assess student work, with a focus on critical thinking points that correlate with the background information provided. Students will demonstrate an understanding of the civic engagement required to mitigate wildfire risk.
2. **Case study questions —** Within their groups, students will respond with accurate information on the differences between the two communities' preparedness and responses to wildfire. Students will provide a clear oral presentation on the impacts of those differences.
3. **Student homeowner's report using the Wildfire Explorer —** After completing the homeowner's report and forming conclusions, students write a response to their risk level. Students include a description of the factors that determine their risk level and ideas for how to reduce that risk. Encourage students to think about their group's discussion on the community case studies and incorporate applicable ideas. Remind students that some actions that will reduce risk are collective actions, even as they concern individual homes and properties. Alternative option: Students create two illustrations, one that portrays their risk level and one that portrays recommended actions to improve their risk level.
4. **Trauma-informed strategy:** When possible, practice a trauma-informed approach to assessment. This approach takes into account that students whose nervous systems were

dysregulated by the content and activities in this lesson may not have had the capacity to participate fully. A trauma-informed approach understands that students did the best they could and does not assess their performance based on their ability to participate. Instead, target the assessment on the behavioral objective (did the student try out self-regulation tools) or the student's own objectives if you invited them to state them at the beginning.

It is important not to penalize students if they cannot participate fully. They could have been experiencing a trauma stress response, and disciplinary measures could be traumatizing or re-traumatizing. Make sure to check in with those students one-on-one to assess how they are doing and determine if any further supports are needed.

Trauma-informed strategies and tools for engaging with firewise community members

Care of self

The most important strategy of all is to apply the oxygen mask to yourself first before helping others, as we are told when we fly in a plane. Making sure our own nervous system is regulated first and our needs are met are crucial to being able to provide effective trauma-informed care for others.

- Build your stress-resilience muscle by engaging in healthy habits on a regular basis. Eat a healthy diet, exercise, practice mindfulness and engage in creative hobbies.
- In times of high stress, practice healthy coping activities such as listening to music, taking a deep breath, doing yoga, talking to (or texting) a trusted person, etc.
- Remember you are not alone — draw on community care when you need it. (We don't always have the capacity for self-care.) Examples of community care are seeking support from mental health professionals, social networks, teachers and so on.
- Practice actively caring for members of your community by checking in with people you know are struggling, providing compassion and empathy, and let them be there for you when you are struggling.

Co-regulation

Using calm body language, tone of voice, soothing words, touch when appropriate, empathy and compassion when interacting with someone who is experiencing a stress response. These are all cues the brain picks up on, telling them they are safe, which helps their nervous system come back into balance.

Voice, choice and agency

Trauma responses come from feeling like we have no control over our well-being. To counteract this:

- Use inviting language instead of directive. (For example, say "I invite you to ..." instead of "now you will. ...")
- Express empathy (not sympathy) in response to someone sharing a difficult situation or emotion.
- Validate and normalize feelings. ("It makes sense that you are scared. I would be scared, too, in this situation.")
- Provide choices. ("We could either talk about it together or you could write a plan on your own.")
- Collaborate to share power, such as through joint problem-solving and collaborative decision-making instead of top-down approaches. ("I would be happy to brainstorm solutions together" instead of "I think you should do this.")

Setting up the space

If someone has previously been impacted by fire or any other trauma they may not always feel calm and settled in certain spaces. Whether meeting with one person or many mindfully set up the space, for example:

- Make sure there is a clear path to the exits and point out where they are
- Let the person or people sit wherever they want in the room, rearranging chairs if needed. Some people may want to sit close to the exit or window, others with their back against the wall, etc.
- If weather permits, give the choice of being indoors or outdoors, with windows and doors open or closed. We don't always know what will help someone feel safer and relaxed, so giving them agency over making these decisions gives them control over their own well-being.

Strength- and solutions-focused approach

Emphasize what a person's personal strengths are or what the house or community's strengths are in preventing fire risk. If possible, make sure there is a balance between pointing out risks and pointing out strengths.

- Focus on solutions, the best possible outcome, vs. what could go wrong and what the current risk is.
- Point out that people are resilient and ask how individuals overcame obstacles in the past and what inner or external characteristics, strategies, or tools they used. Remind them that they can draw on those tools again in the future.

This approach gives people hope and courage, and reminds them that they are resilient and can overcome obstacles, which are all important in trauma prevention and recovery.

Processing

Offer opportunities for processing emotions and difficult information before, during and after a conversation, interview or presentation. For example:

- Offer to take a deep breath together.
- Engage in physical movement such as stretching, or offer to talk while going for a walk.
- Take breaks to take care of needs such as drinking water, eating a snack, giving the brain a break, getting a fresh breath of air, etc.
- Practice verbal check-ins or checkouts. (This could be a simple "how are you doing?" or "how are you feeling about what we just talked about?" or "what are you concerned about/hoping for/looking forward to, etc.?")

Oregon Wildfire Risk Explorer — Homeowner's Report

Lat/long: **42.4922 N 123.062 W** Report date: January 4, 2022

Weather and vegetation conditions vary daily and seasonally. For current local fire restrictions, contact your local fire district or visit: www.keeporegongreen.org/current-conditions/

THE FIRE ENVIRONMENT IN YOUR LOCATION

To evaluate a home's wildfire ignition risk, a homeowner must consider the home ignition zone, which includes the home and its immediate surroundings, and the fire environment, which is the landscape surrounding their home's location This report is designed to provide homeowners with information and resources to help adapt to their fire environment and resources to help them manage their home ignition zone. See the second page of this report for more information about reducing your risk in the home ignition zone. The information below describes the fire environment, which is important because wildfire can move quickly and embers can travel miles ahead of a fire.

Nearly all areas in Oregon experience some level of wildfire risk. Conditions vary widely with local topography, fuels, and weather, especially local winds. In all areas, under warm, dry, windy and drought conditions, expect higher likelihood of fire starts, higher fire intensities, more ember activity, a wildfire more difficult to control and more severe fire effects. Be aware of ember travel or spot fire potential from fires anywhere there are burnable fuels nearby.

The aerial view of your location shown here may help determine your defensible space needs in the home ignition zone. Compare the photo to the diagram and guidelines on the next page.

This report is not a substitute for an on-the-ground site assessment from a professional forester or fire personnel. Contact your local Oregon Department of Forestry office, forest protective association or fire department for an assessment.

Three major elements of the Fire Environment in your area are summarized below by the values in your sub-watershed. Sub-watersheds encompass an area of roughly 10,000-40,000 acres around a home where fire movement may occur.

Burn probability

Humans are the most common cause of fires in Oregon. There are an average of 22 fire starts each year in your area, caused by both people and lightning. The average probability of a large wildfire (>250 acres) is **High** , meaning the chances of an ignition that spreads to a large size are generally between 1 in 1,000 to 1 in 500. Some areas may experience a burn probability of **Moderate**.

Fire intensity and flame length

The intensity of a fire indicates how difficult it will be to control and can be measured by expected flame lengths. Under high fire intensities, a fire is more difficult to control and will likely have higher impacts to property and risk to lives. Average flame lengths in your area are expected to be **> 11-feet** , but flame lengths may be much higher in some places and under severe weather.

Hazard to potential structures

Hazard to potential structures depicts the hazard to a hypothetical structure anywhere on the landscape (not just existing structures) if a wildfire were to occur. If a fire were to occur in your area, the average hazard to a potential structure is **Low**, with some areas experiencing **High**. Note that this rating reflects the broader fire environment around the home and not building materials of your home (see next page).

LOCAL INFORMATION

Oregon Department of Forestry Office
Medford Unit Office
5286 Table Rock Road
541-664-3328

Structural Fire Protection District	District #1)
Rangeland Protection Association	None
City or town	None
Urban Growth Boundary	Outside Urban Growth Boundary
Community Wildfire Protection Plan	Jackson County CWPP
Wildland Urban Interface	YES, Hazard Rating: High
Firewise Sites	

Oregon Wildfire Risk Explorer — Homeowner's Report

Lat/long: **42.4922 N 123.062 W** Report date: January 4, 2022

CREATE DEFENSIBLE SPACE IN THE HOME IGNITION ZONE

The home ignition zone primarily determines the home's ignition risk. Maintain defensible space in the home ignition zone by following these guidelines to improve the chances your home will survive an approaching wildfire. First consider the home and its surroundings within 30 feet, then assess vegetation and other materials within 30-100 feet of your home to minimize high intensity burning.

Begin with the home. If you are building or modifying your home, *use fire-resistant construction materials*. For roof materials, consider asphalt, metal, slate, clay tile or concrete. Box in eaves and screen roof and attic vents.

Make sure any attachments to your home, such as porches, decks and fences, are made of fire-proof material. In addition, use fire-resistant siding such as brick, fiber-cement, plastic or stucco, and tempered or double-paned glass windows.

Remember the embers! Embers or firebrands carried by the wind are a common cause of home ignition. Clear tree needles, leaves, and debris from roofs and decking. Make sure embers cannot enter structures through eave vents.

Remove ladder fuels

Remove low-hanging tree branches and crowded shrubs and small trees that allow fire to climb up into the forest canopy.

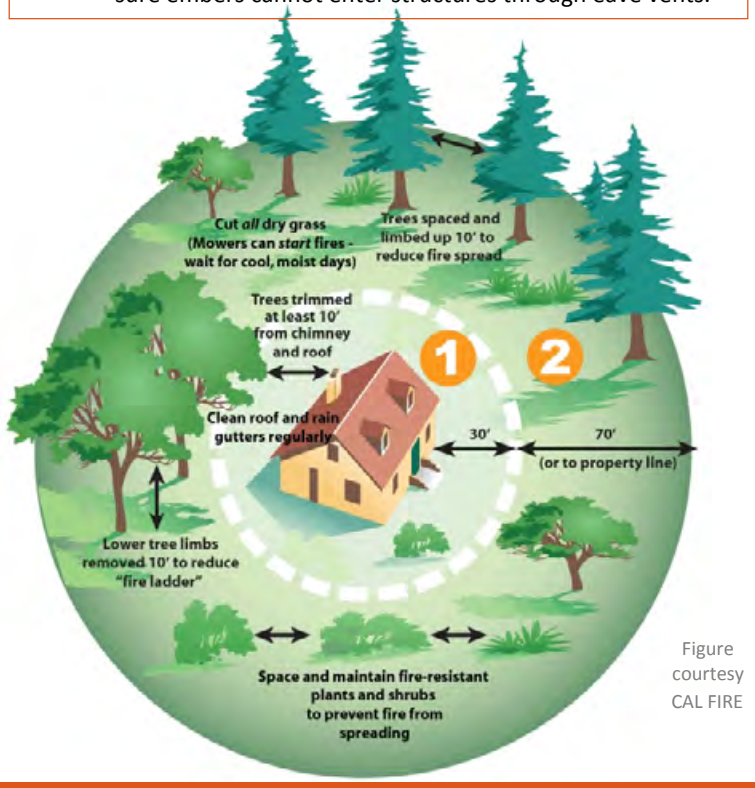


Figure courtesy CAL FIRE

In addition to the guidelines in the diagram, maintain a *5-foot fire free zone* around your home. Remove *all* burnable material and use non-flammable landscaping.

From the outside edge of your home, deck or outbuilding, *widely space and prune vegetation* for a distance of approximately 100-200 feet. Homes on steep slopes should extend defensible space out to 200 feet.

BE PREPARED FOR A WILDFIRE

Be prepared with a disaster plan in case you need to evacuate during a wildfire. Develop, discuss and practice an emergency plan with everyone in your household. Include plans for pets and livestock. Know two ways out of your neighborhood and determine a meeting place. Program your phones with emergency numbers and maintain an emergency water source. Ensure emergency responders can access your home by making your driveway 12 feet wide with 15 feet vertical clearance.

MORE RESOURCES

Oregon Ready Set Go! www.oregonrsg.org
Firewise firewise.org
Keep Oregon Green keeporegongreen.org
Oregon Department of Forestry www.oregon.gov/ODF
OSU Forestry and Natural Resources Extension extensionweb.forestry.oregonstate.edu

INSTITUTE FOR NATURAL RESOURCES
PYROLOGIX

Report generated from https://tools.oregonexplorer.info/OE_HtmlViewer/index.html?viewer=wildfire. Wildfire risk data is from the USDA Forest Service 2017 Pacific Northwest Quantitative Wildfire Risk Assessment and the 2013 West Wide Wildfire Risk Assessment. *The information is being provided as is and without warranty of any kind either express, implied or statutory. The user assumes the entire responsibility and liability related to their use of this information. By accessing this website and/or data contained within, you hereby release the Oregon Department of Forestry, Oregon State University, Oregon State University Libraries and Press and all data providers from liability. This institution is an equal opportunity provider. This publication was made possible through grants from the USDA Forest Service.*

2. FORESTS IN A WILDFIRE-PRONE ENVIRONMENT

The module will help students understand the ecological and historical basis for the current wildfire dilemma. Students will learn some of the skills used by forestry professionals in assessing fire risk and forest health.

Time considerations

Preparation: 3+ hours including travel time

Procedure: Seven 50-minute in-class sessions

A. Forest types and fire regimes (one class session)
B. Trees of our forests: tree physiology and tree identification (1.5 class sessions)
C. Forest structure and the relationship to wildfire (one class session)
D. Forest threats contributing to wildfire risk and hazard (one class session)
E. Career paths in forestry and environmental science (one class session)
F. Tools of the trade (one class session)

One full-day field trip

1. Collecting stand data (1)

Learning objectives

Students will be able to:

1. Describe forest types and fire regimes.
2. Describe the characteristics of fire-prone and fire-resistant vegetation (leaf characteristics, bark, etc.).
3. Compare various forest structures to determine forest health and fire susceptibility.
4. Use some of the tools needed to assess forest health.
5. Analyze how different species adapt to and depend on wildfire.
6. Compare and contrast different perspectives on how to manage forests to reduce fire risks and improve forest health.
7. Examine some of the many forest and natural science career path options.

Behavioral objectives

Students have completed:

1. Tree identification in a forest setting.
2. Collecting data in forests using common forest measurement tools.

Standards connections

Oregon Science Standards

Performance Expectations

- HS.ESS3.1: 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. [Activity D]
- HS.ESS3.3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations and biodiversity. [Activities E, F and Field Trip]

Disciplinary Core Ideas

- ESS3.C: Human Impacts on Earth Systems. The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. [Activities E, F and field trip]
- LS2.A: Interdependent Relationships in Ecosystems. Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from challenges such as predation, competition and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. [Activities C, D and field trip]
- LS4.C: Adaptation. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. [Activity D and field trip]

Science and Engineering Practices

- 3. Planning and Carrying Out Investigations. Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. [Activities A, B, C, D and field trip]
- 3. Planning and Carrying Out Investigations. Select appropriate tools to collect, record, analyze and evaluate data. [Activity F and field trip]
- 6. Constructing Explanations and Designing Solutions. Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [Activities C, D and field trip]
- 7. Engaging in Argument from Evidence. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. [Activity E and field trip]

Oregon English Language Arts Standards

- 9-10.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9–10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activities A, D, E]
- 11-12.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 11–12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activities A, D, E]
- 9-10.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. [Activity E and field trip]
- 11-12.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. [Activity E and field trip]

Oregon Standards for Literacy in History/Social Studies and Science and Technical Subjects

- 9-10.WHST.1. Write arguments focused on discipline-specific content. [Activity E and field trip]
- 11-12.WHST.1. Write arguments focused on discipline-specific content. [Activity E and field trip]

Oregon CTE Knowledge and Skills Statements

- KSS.A: Survey and measure natural resource environments. [Activities A, B, C, D and field trip]
- KSS.H: Describe ecological concepts and principles; investigate and explain the relationships between these principles and natural resource environment development. [Activities A, B, C, D and field trip]
- KSS.L: Acquire the specific academic knowledge and skills necessary to pursue a full range of career and post-secondary opportunities within natural resources management. [Activities A, B, C, D, E, F and field trip]
- KSS.M: Use oral and written communication skills in creating, expressing and interpreting natural resource management information and ideas including technical terminology. [Activities A, D, E and field trip]
- KSS.O: Know and understand the importance of employability skills for careers in natural resources. [Activities E, F]

Classroom activities

A. Forest types and wildfire regimes

Materials

- *Forest Types — Forest Fact Break*, https://oregonforests.org/forest-fact-break-forest-types
- Forest type photos worksheet

Background information

There are 12 *forest types* in the state of Oregon. A forest type is dependent on the climate, elevation, precipitation, soil and temperature, and is often named after the dominant tree species in the forest type. The nine most significant forest types in Oregon are: *spruce hemlock*, *mixed conifer*, *juniper woodlands*, *ponderosa pine*, *Douglas-fir*, *subalpine*, *western larch*, *lodgepole pine* and *oak woodlands*.

A *fire regime* describes the natural pattern of fire activity in a particular forest type based on weather patterns and includes factors such as the frequency, intensity and pattern of fire behavior. Depending on where they occur, these forest types may have the same or a different fire regime. A Douglas-fir forest near Portland may have a different fire regime than one near Bend or Medford because of the pattern of lightning, the normal precipitation, the density of the forest and the temperature regime.

Spruce hemlock forests are dominated by Sitka spruce and western hemlock. They thrive on the high moisture content of coastal fog, mild temperatures and wet and overcast weather patterns at lower elevations. Soils are usually coarse, deep and porous, composed of marine shale and basalt. These forests have long fire intervals, meaning that they burn infrequently. But when they do burn, they burn hot and can be a stand-replacing fire regime.

Mixed conifer, in southwest Oregon, is highly diverse and complex where no one tree type dominates the forest. Typically, you will find sugar pine, ponderosa pine, incense cedar and Douglas-fir

intermixed with hardwoods such as oak and pacific madrone. On serpentine soils Jeffrey pines thrive, while on higher, moister sites Port-Orford cedar and bigleaf maple are common. Higher in elevation, the mixed conifer forest type becomes dominated by more conifers, including white fir and grand fir, and fewer hardwoods. Elevation and aspect play a major role in soil moisture content and sun exposure, which impacts the types of conifers and hardwoods in this forest type. This forest type is also well adapted to fire, with many species relying on a frequent fire regime to reduce the understory vegetation to provide room to grow.

Juniper woodlands survive where water is scarce all year round and temperatures range from high heat to freezing cold. Western juniper usually grows alongside sagebrush, bitterbrush, grasses and sometimes Ponderosa pine. Western junipers are typically well spaced due to competition for moisture and sunlight. Historic ranges of Western juniper were limited to shallow soils. But with the exclusion of wildfire, juniper has begun to encroach on grasslands.

The *ponderosa pine* forest type occurs much more frequently in the eastern part of the state and southwest Oregon. Pure ponderosa pine forests are often found on volcanic pumice east of the Cascades. They outcompete other conifers in areas with short, dry summers and cold, snowy winters. Ponderosa pine forests depend on soil moisture, full sun and low competition to regenerate. Too many other surrounding trees can be detrimental to forest health and increase susceptibility to pine beetles, diseases and a higher risk of wildfire. A frequent, low-severity fire regime, however, is a healthy part of ponderosa forests, as it clears out understory fuels and opens up space for new saplings.

The *Douglas-fir* forest type is primarily dominated by Douglas-fir, the Oregon state tree. Douglas-fir appears in many forest types, but in a Douglas-fir forest type this species dominates. This forest type is the most important in Oregon for timber production. Douglas-fir forests typically grow dense with robust understory vegetation while drier sites have sparser trees. Douglas-fir is an opportunistic species that sprouts after a disturbance like a wildfire or other activities such as timber harvest. In moist forests, Douglas-fir requires full sun to grow. In other forest types, Douglas-fir will grow in the shade of pines and oak trees in the absence of disturbances like wildfire.

The *subalpine* forest type forests occur at higher than 4,500 feet above sea level and contain a variety of different species depending on location. These are the forests of the Cascade, Siskiyou and Wallowa mountain ranges. They experience heavy snow and short growing seasons. Colder winters with more snow can stunt and warp tree growth. Wildfire return intervals in this forest type are long, but if wildfire does occur, it can be severe depending on whether it is heavily forested or interspersed with rock, meadows and lakes.

The *western larch* forest type grows above 3,000 feet in northeast Oregon with a narrow band on the east side of the Cascades. Western larch is often mixed with firs, pines and spruce. It is the only deciduous conifer native to Oregon, meaning its needles change color and fall every year. Western larch does not grow well in shade, so it requires disturbance to grow, such as wildfire that exposes seeds to bare mineral soil. Without disturbance, it will be outcompeted. Western larch is managed for timber, as its wood is highly resistant to rot.

The *lodgepole pine* forest type occurs mainly east of the Cascade Mountain Range and is sometimes mixed with Ponderosa pine. Lodgepole pines grow in dense clumps, tall and straight, in marginal growing sites, such as extreme dryness, extreme moisture and extreme cold. They also can occur on sites with high levels of volcanic pumice and ash. Lodgepole pine depends on wildfire to propagate. Lodgepole pine also grows in coastal forests, where it is called shore pine and grows more bushy than straight.

Oak woodland forest type is typically found in the Willamette, Umpqua and Rogue River valleys. Oregon white oak is the most common oak species in the state, but along the southern coast and in the southwestern portion of the state, canyon live oak and California black oak are common as well. Historically, oaks in these woodlands were spaced out and intermixed with grasses. They experienced frequent fire, both naturally occurring and intentionally set by Native Americans. With fire suppression of the past 100 years, oak woodlands today are often invaded by conifers like Douglas-fir and Incense cedar. Oaks, along with other hardwoods like Pacific madrone and bigleaf maple, can also be found in Siskiyou mixed conifer and Douglas-fir forests.

In the past 200 years, the structure, composition and distribution of our forests have changed dramatically from forests prior to European-American colonization. Major changes include:

- Harvest of much old growth forest (forests 200+ years old). Most old growth on private lands has been harvested; some old growth remains on public lands.
- Large, high-severity wildfires have removed older forest.
- Many areas are dominated by young and middle-aged forests that have been planted or grown back naturally after harvest or fire.
- Decades of exclusion of fire in Oregon's dry forests have resulted in greatly increased tree densities and fuel loads. Each of the forest types has experienced significant changes, which has changed their fire regimes.

Key vocabulary

Forest types
Spruce hemlock
Mixed conifer
Juniper woodlands
Ponderosa pine
Douglas-fir
Subalpine
Western larch
Lodgepole pine
Oak woodlands
Fire interval
Stand-replacing
Low-severity fire
Understory vegetation
Old-growth forest

Preparation

1. Prepare the *Forest Fact Break – Forest Types* video for the in-class session.
2. Consider delivering the content directly or identify an appropriate person to be the guest instructor. Ideal speakers include those from the Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management, Oregon State University Extension or another organization.
3. Guess the forest type activity — Use the photos included in the worksheet or select your own. Include the forest types: spruce hemlock, mixed conifer, juniper woodlands, ponderosa pine, Douglas-fir, subalpine, western larch, lodgepole pine, oak woodlands.

Procedure

1. Introduce key terms to students.
2. *Forest Fact Break — Forest Types*
3. Guest speaker: Forest types and wildfire regimes
4. Guess the forest type: Have students break into groups and review the different forest types by their characteristics and identify the forest type of each photo. Consider the following guiding questions when students are stuck:
    - **a.** Are the trees in the photo deciduous or conifers?
    - **b.** Is the canopy dense or are trees widely spaced?
    - **c.** Does the surrounding area look drier, or have more moisture?
    - **d.** What do you think the elevation of the photo is?
    - **e.** If fire were introduced to this forest, how do you think it would react?

Assessment

Guess the forest type questions: Students work in groups to discuss the questions. Each student records answers individually to questions a) through e) with clear justifications for their responses. Students answer question e) with three complete sentences that articulate critical thinking in their rationale for fire behavior (For example, dry surrounding area results in rapid fire spread; greater volume of fuel leads to intense fire, low fuel volumes result in low intensity/creeping fire.)

B. The trees of our forests

Materials

- *Forest Fact Break — Tree Biology*, https://oregonforests.org/video/Forest_Fact_Break_Tree_Biology
- Key terms worksheet
- Forest types and tree identification scavenger hunt worksheet

Background information

Trees are made up of various layers that all serve different functions. From the outside, the crown of

the tree is where leaves or needles on branches use photosynthesis to create energy for the tree by exposing chlorophyll to sun and producing oxygen as a byproduct. The root system is designed to hold the tree in place in the ground while absorbing water and minerals from the soil. Root systems can be shallow or deep, depending on the tree species.

The trunk of the tree transports water and minerals up and energy down the length of the tree. The trunk is made up of five distinct layers:

- *Outer bark:* This layer is not living but provides protection against cold, heat, disease, insects and wildfire. It also serves as an insulating role to keep the tree from drying out. It is constantly being regenerated by the inner bark, or phloem.
- *Phloem:* In this layer, energy from photosynthesis is sent down the tree from the leaves or needles to sustain the entire tree. As the tree grows and makes new phloem, the old phloem dies and becomes part of the outer bark.
- *Cambium:* The cambium cell layer is where growth occurs. The outer layers produce new inner bark and the inner layers produce new sapwood. The cambium also is responsible for delivering hormones throughout the tree, which stimulates bud growth. Growth of the cambium is responsible for the tree rings that foresters use to determine tree age.
- *Xylem:* The inner portion of the tree containing the sapwood and heartwood. Most of the xylem is composed of dead cells, but it serves a function in the transport of water and nutrients from the ground to the rest of the tree.
- *Sapwood:* This is the new wood created by the cambium cell layer. Sapwood is responsible for carrying nutrients and water up from the root system to all parts of the tree. As the cambium cell layer produces more sapwood, the inner layers of sapwood continue to and become heartwood. Sapwood, especially the living, most active portions, is vulnerable to attack and decay.
- *Heartwood:* This layer is not alive, but it serves a similar role to the skeleton in animals. It is composed of dead sapwood and is hard and resistant to decay. This layer is also the most valuable for timber production.
- *Pith:* The tissue of the tree in the center of the trunk.

Different trees make up different forest types, and each species reacts differently to wildfire. Knowing the difference between tree species is essential to understanding the forest landscape.

Foresters identify the species of a tree by examining key characteristics of the branches, leaves/needles, buds, flowers, seeds, bark and other features. Using a *dichotomous key*, foresters review the relevant characteristics and look at pairs of options in the key to narrow down possible species. Some key terms important to narrowing down the tree species are:

- *Conifer:* An evergreen tree that usually retains its needles and has cones containing seeds. Some conifers, however, like the Ponderosa pine, will lose a portion of their needles every couple of years.
- *Deciduous*: A tree that loses its leaves every fall. Deciduous trees are typically hardwood

(broadleaf) trees. However, some hardwoods like Pacific madrone are not deciduous, and some conifers, such as the Western larch, are deciduous.

- *Alternate branching:* Where branches from the stem alternate between one side and the other. This can also be used to characterize leaf or bud arrangement on a stem.
- *Opposite branching:* Where branches match in opposition to each other from one side of the stem to the other.
- *Compound leaf:* Where a leaf is made up of several leaflets rather than a single leaf.
- *Simple leaf:* Where a single leaf is attached to a woody stem.
- *Needle bundle:* Needles that are clumped in bundles instead of individually attached to a stem. The dichotomous key will ask about the number of needles in a bundle to help identify a tree species.
- *Smooth leaf:* Edges of the leaf are smooth.
- *Serrated leaf:* Edges of the leaf are jagged like saw teeth
- *Lobed leaf:* Edges of the leaf create distinct lobes that may be smooth or sharp.
- *Palmate-shaped leaf:* Where the lobes of the leaf are arranged from a central point.
- *Pinnate-shaped leaf:* Where the lobes of the leaf are arranged like a feather from a common axis.

Key vocabulary

Tree crown	Pith	Simple leaf
Root system	Photosynthesis	Needle bundle
Trunk	Dichotomous key	Smooth leaf
Outer bark	Conifer	Serrated leaf
Phloem	Deciduous	Lobed leaf
Cambium	Alternate branching	Palmate-shaped leaf
Xylem	Opposite branching	Pinnate-shaped leaf
Sapwood	Compound leaf	
Heartwood	Leaflets	

Preparation

1. Consider delivering the content directly or identifying an appropriate person to be the guest instructor. The instructor should know local tree species and understand how to use a dichotomous key. Guest instructors from your local OSU Extension, a private forester, watershed organization, Oregon Department of Forestry, the U.S. Forest Service or the Bureau of Land Management are ideal.
2. Make enough printouts of the key terms worksheet
3. Make enough printouts of the forest types and tree identification scavenger hunt worksheet. Find a location within walking distance of the school where students can complete the forest types and tree identification scavenger hunt. If no such location exists, consider bringing in numbered samples of tree branches from different species.

Procedure

1. Introduce students to key terms.
2. In-class lecture or guest instructor: Local trees and how to use the dichotomous key to identify them.
3. Forest types and tree identification scavenger hunt: Have students break up into groups of three to four and hand each group a copy of the worksheet. Each group should have a copy of *Trees to Know in Oregon and Washington*, EC 1450, https://catalog.extension.oregonstate.edu/ec1450. Ask your local Extension office for help locating copies if needed.

   Ask each group to find a sample of the tree in the worksheet. A couple of extra spaces are available for additional challenges. Instructors have the option of introducing a mystery tree sample outside of the local area, for which students will have to use the dichotomous key in the Trees to Know in Oregon and Washington.

   After successfully finding a sample of each species, students should identify a forest type where they would likely find the species.

Assessment

1. Forest types and tree identification scavenger hunt worksheet — Students use dichotomous key to correctly select sample tree types. Although students are working in groups, each student completes the worksheet and provides tree sample, accurate forest type and correlating fire regime information.

C. Forest structure and the relationship to wildfire

Materials

Tree assessment activity worksheet

Background information

The position of a tree within a forest has a large impact on the health and growth of that tree. Its position within the canopy or understory is referred to as crown class:

- Large trees whose crowns extend above the crowns of all the other surrounding trees are considered *dominant* in a stand. They receive sunlight from all sides of the upper crown.
- Trees that make up the average height of the canopy are considered *codominant*. The tops of these trees receive sunlight, but on the side, they may not receive any light.
- *Intermediate* trees are trees whose crowns do not exceed the level of the canopy. They receive little direct sunlight and may be young trees still growing or older trees that are unable to grow quickly due to limited sunlight.
- *Suppressed* trees receive no direct light as they are below the canopy.

Live crown ratio — the percent of the tree covered in green branches — can also indicate the health of a tree. All trees need light to grow, but many species can survive with less light than other species. The proportion of live retained branches is an indication of how well the tree is surviving with the amount of light it receives.

Whether or not landowners engage in managed succession or allow nature to take its course with natural succession, forest structure is not static. New trees come in as local conditions change. In primary succession, new land becomes available for trees to colonize where they had not been before. A major event like a volcanic eruption creating new land, and trees colonizing that new land, would be an example of primary succession. Those early species that first start to grow in a new landscape are called *pioneer species*.

Much more common is *secondary succession*, where a forest is impacted by disturbances, such as a wildfire or a timber harvest. The vegetation that comes in after that disturbance is secondary succession. In both types of succession, the species that first colonize an area may not be the same species that inhabits the area later on. As vegetation comes in, new opportunities arise for other species to come in as well. As an example, a disturbed area might first be populated with quick propagating grasses before shrub species are able to move in. Later on, trees may become established and shade out the shrubs and grass. When a forest ecosystem becomes stable and no longer sees significant vegetation changes over time, this is called a *climax community*. When a forest has evolved with regular disturbance such as flooding or wildfire, it may retain trees in the overstory but not the understory, or it may never reach this potentially stable community.

Key vocabulary

Canopy	Intermediate	Primary succession
Understory	Suppressed	Pioneer species
Crown classes	Live crown ratio	Secondary succession
Dominant	Managed succession	Climax community
Codominant	Natural succession	

Preparation

1. Consider delivering the content directly or identifying an appropriate guest instructor. Guest speakers from the Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management, OSU Extension or other organizations are ideal.
2. Make enough printouts of the tree assessment activity worksheet. Find a location within walking distance of the school where students can complete the tree health assessment worksheet. Flag four to six trees per group of five students. If no such location exists, consider bringing in numbered samples of increment cores and associated photos of the entire tree, including the crown. If possible, include the entirety of the core, from pith to bark, though it is not necessary for the exercise. Try to find a variety of crown classes for each group.

Procedure

1. Introduce key terms to students.
2. In-class lecture or guest instructor: forest structure and the relationship to fire.
3. Tree assessment activity: Have students break up into groups of five and assign them four to six trees to assess. Students will then measure each increment core and assess the crown of the tree, per the Tree Assessment worksheet. Heartwood and pith need not be present.

   Student groups will record their answers on the worksheet. Each student group will then measure the last 10 years of tree growth as determined by counting tree rings, the live crown ratio. Finally, student groups will determine which trees are relatively healthy, and which may be candidates for removal due to poor tree health.

Assessment

1. Tree assessment activity worksheet – Use group participation grading rubric. Students demonstrate engagement and correct application of tree biology terminology. When asked, groups respond with strong rationale for tree health assessment (i.e., well-developed crown with full leaves, branch decay, etc.). Students demonstrate an understanding of the connection between tree health and catastrophic fire vs. natural low-intensity fires.

D. Forest threats contributing to wildfire risk and hazard

Materials

- *Forest Threats — Insects*, https://oregonforests.org/video-library/Forest_Threats_Insects
- *Forest Threats — Tree Disease*, https://oregonforests.org/video-library/Forest_Threats_Tree_Disease
- Samples — Insect galleries in bark, insect samples and other tree malformations such as root rot, cankers and galls. (Guest speaker may be able to provide these samples.)

Background information

There are many ways trees can become unhealthy and die. In some cases, the cause is obvious. Wildfire, flooding, major weather events, drought, *windthrow*, can all contribute to dead trees in a forest. Sometimes less obvious are the diseases caused by pathogens specific to trees and insects

that prey on trees and cause them to suddenly die when they had previously seemed healthy.

Insect threats to trees generally come in one of three forms:

- *Bark beetles:* Insects that enter the tree through the bark and impact the outer and inner bark. Males and females will mate and create *galleries* within the outer bark to lay their eggs. When the eggs hatch, the larvae cut off the flow of energy to the tree by eating into the inner bark, or phloem. This is known as *tree girdling*, and the tree can die if too much phloem is destroyed. Each bark beetle species produces its own pattern of gallery, making it easy to determine the species of the attacker.
- *Defoliators:* Some insects attack a tree by cutting off the source of its energy by eating the foliage of the tree. Without leaves or needles, photosynthesis cannot occur, and the tree starves.
- *Wood borers:* These insects bore deeper into the tree to reach the sapwood, which cuts off the transport of soil and nutrients. Usually, wood-boring beetles attack trees that are already dead and dying, so they may not be the cause of the tree's death. Instead, they play a role in the decomposition of the tree.

Diseases that impact Oregon trees often fall into the following categories:

- *Foliage diseases:* Just like *defoliators*, these diseases kill a tree by destroying its ability to create energy through photosynthesis.
- *Root diseases:* Fungi or pathogens can enter and attack a tree's root system. While this may not kill the tree, it will stress the tree, often leading to insect attack. A weakened root system is also more susceptible to windthrow.
- *Rust disease* and *stem cankers:* Fungi that attack the bark on a tree may kill inner bark or create cankers. Like insect attacks that impact the phloem, this will cut off parts of the tree from its energy source.
- *Stem decay:* This is caused by fungi entering a tree through wounds or gashes to the bark, or through small branches.
- *Sudden oak death:* This non-native disease ravaging parts of California has made its way up to the southern Oregon Coast, where many species are hosts but it only kills tanoak. Currently, only Curry County is affected. But surrounding counties with populations of tanoak should keep vigilant so the disease does not spread. Despite its name, sudden oak death is thought to be carried by a variety of other trees and plants and can impact species including Douglas-fir.

There are also a number of cankers, parasites and diseases that are relatively harmless to the tree in the absence of other stressors like drought or insect attack. *Mistletoe and wasp galls* on oak trees may look harmful to the tree, but generally do not have a severe impact.

Note that these pathogens and insects are often native species that native trees have had to contend with for hundreds of years. Tree species have adapted to the presence of insects and pathogens to varying degrees and have defense mechanisms to repel them or survive an attack. Some mechanisms include thick bark, sap or resin to push out invading insects and chemical defenses.

Often, when an infected tree dies, the cause is not only the pathogen or insect. Other factors, especially drought or a recent fire, may have stressed the tree enough that an insect invasion or disease is able to kill it. Stressed trees are sometimes attractive to certain insects as targets of attack and are less able to employ defense mechanisms.

Regardless of how forests are impacted by disturbance, the forest will recover. New vegetation will replace lost vegetation. Forest land managers are often concerned with how the forest recovers after disturbance, from both a forest structure standpoint (how the forest grows back) to a forest composition standpoint (what grows back). Invasive species, such as gorse, blackberry, cheatgrass and even native plants such as juniper going beyond their traditional ranges can take an opportunistic role and fill in severely disturbed forestlands without careful management.

In the future, we are likely to see additional, unpredictable changes in patterns of disturbances in forests with the impacts of *climate change*. Extended wildfire seasons will likely result in more acres burned. Already we have seen the fire season extended by two months or more. Higher temperatures and drought will stress trees more and reduce their resistance to insects and pathogens. Changes in climate may also be more favorable to invasive species, resulting in more unwanted vegetation taking the place of native vegetation impacted by disturbance.

Key vocabulary

Windthrow
Bark beetle
Galleries
Tree girdling
Defoliators
Wood borers
Foliage diseases
Root diseases
Rust disease
Stem cankers
Stem decay
Sudden oak death
Mistletoe
Wasp galls
Insect and pathogen defense mechanisms
Invasive species
Climate change

Preparation

1. Prepare the *Forest Threats — Insects* video for the in-class session.
2. Prepare the *Forest Threats — Tree Disease* video for the in-class session.
3. Consider delivering the content directly or identify an appropriate person to be the guest instructor. An entomologist or pathologist is strongly recommended. Guest speakers from Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management, Oregon State University Extension or another organization would be ideal.
4. Working with the guest speaker, obtain samples of insect galleries in bark, insect samples and

other tree malformations such as root rot, cankers and galls. If a guest speaker does not have samples, consider contacting your local OSU Extension office, the U.S. Forest Service, Bureau of Land Management or Oregon Department of Forestry for resources.

Procedure

1. Introduce key terms to students.
2. *Forest Threats — Insects*
3. *Forest Threats — Tree Disease*
4. In-class lecture or guest Instructor: Forest threats: insects and disease
5. In small groups, have students view insect galleries, insect samples and tree malformations. Discuss the different galleries associated with the insects, then quiz students on other gallery samples by having them guess the insect that made each gallery. Discuss whether or not the insect was a cause for the tree's mortality or if the insect was breaking down an already dead tree. Next, discuss the samples of root rot, stem decay, rust diseases and cankers. Discuss the relationship between trees under insect and disease stress and wildfire threat.

Students examine insect galleries where pests laid their eggs. CREDIT: Jennifer Payne

E. Career paths in forestry and environmental science

Background information

The world of forestry and wildfire has a variety of potential career options for students. "Module 4: wildfire careers" covers career options in wildfire in depth. This class is dedicated to careers focused on forestry. Many of these careers intersect with wildfire careers, and in Oregon, all of them require an understanding of wildfire's impact on the landscape. Forestry-related careers might include but are not limited to: silviculturist, soil scientist, consulting forester, forest recreation manager, wildlife biologist, conservation scientist, forest logging manager and environmental compliance officer.

Key vocabulary

Silviculturist

Soil scientist

Consulting forester

Forest recreation manager

Wildlife biologist

Conservation scientist

Forest logging manager

Environmental compliance officer

Regardless of the career, students should consider learning how to document their experience and skills through a résumé. Résumés help future employers determine a student's capacity to fulfill the roles and responsibilities of a position. It is a document that can also help students plan out a career path as they determine the future schooling, internships and professional experiences they need to be competitive for their next position.

Preparation

1. Identify appropriate speakers for the panel discussion. Ideally, there will be four to five panelists for this class session, including a representative from the Oregon Department of Forestry and a representative from each federal agency engaged in forestry in the area, such as the U.S. Forest Service and the Bureau of Land Management. Additional panelists may include a forestry consultant and representatives from a nonprofit forest conservation organization or a timber company, depending on your area.
2. Have panelists develop a short, 10-minute presentation to discuss the following:
    - **a.** Their organization
    - **b.** Their position
    - **c.** The required skills for their position
    - **d.** The educational and professional experience that equipped them to gain those skills
    - **e.** Recommendations on how to get started in their career path. If their organization is currently hiring, describe how to apply.
3. Have students prepare questions in advance for panelists.
4. Optional: Have students develop a résumé as homework or in-class assignment before the panel. Panelists should be willing to look over student-generated résumés and provide comments.

Procedure

1. Introduce key terms to students.
2. Introduce each panelist, their organization and professional title.
3. Each panelist gives their 10-minute presentation. Follow up with student questions.
4. Break students into groups and have them pose their questions for each panelist, as the panelists rotate through the groups. Students take notes and record panelists' responses.
5. Optional: Break up into groups for each panelist, with ideally no more than three to five students per panelist. Students will pick a forestry career mentioned during the panel discussion. They will share their résumé with the panelist and discuss potential forestry-focused career interests. Panelists will make recommendations on the résumé of each student and provide suggestions on experiences and education that can help students achieve their selected career path. Or, students can interview the panelist(s) in small groups and record their responses.

Assessment

1. Revised resume: After panel presentation, students revise resumes and include objective, education and work experience that integrates panelists' presentation or individual suggestions. Use technical writing grading rubric to evaluate each student's word choice, organization, format, spelling and grammar. Note: Since most high school students do not yet have much education and work experience to add to a resume, students may create a mock resume for their career path of interest.

   OR

2. Panel response: Students write a paragraph that describes the most valuable career information learned from the panel and how it is influencing their own career goals. Evaluate students' paragraph organization and clear articulation of how the information is influencing at least one career goal.

F. Tools of the trade

Materials

- Diameter at breast height measuring tape
- Clinometer
- Increment borer
- Reel measuring tape
- Compass
- Densiometer

Tools may be provided by guest instructor.

Background information

In preparation for the field visit, students must learn the basics of some forestry tools. This includes the use of a *diameter at breast height measuring tape*, *clinometer*, *increment borer*, *reel measuring tape*, *a compass* and a *densiometer.*

DBH tape measures the diameter of a tree at approximately 4.5 feet from the ground, usually at around chest height. To take measurements, stand upslope of the tree. Using the diameter measurements, wrap the DBH tape around the stem at a point 4.5 feet from the ground. The point on the tape where the number "0" lines up with the wrapped tape is the diameter.

To use a clinometer to find the height of the tree, walk out 100 feet from a tree, measuring it with the reel tape measure. Then, with both eyes open, look through the clinometer and record the numbers on the right-hand side for the top of the tree and the bottom of the tree, keeping in mind that the bottom of the tree may be a negative number. Subtract the top reading from the bottom reading. In the case of a negative number on the bottom, this will become an addition to the entire height of the tree. Have students compare their answers with each other.

The densiometer and compass measure canopy cover, or the amount of sunlight reaching the ground floor of the forest. Keeping the arm out at a 90-degree angle from the body, hold the densiometer flat so the bubble on the lower right-hand corner is completely within the circle. Starting at north, have students orient themselves and take readings. For each of the 24 boxes on the concave mirror of the densiometer, have students record how much of those boxes are not open sky in quarters (0, 25, 50, 75, 100%). Repeat this step for each of the cardinal directions. Add up all of the shaded portions and divide that by 96. Multiply that number by 100 to get the percentage of shade cover.

An increment borer is used to determine the age and growth of a tree without cutting it down to count rings. To find the age of a tree, the core must include the pith. Proper technique with the increment borer takes time to develop. The increment borer must be held perpendicular to the stem while turning the drill. After boring through the bark, make approximately 10 rotations, depending on the size of the tree and measurement objectives. Insert the spoon of the increment borer and pull out the core, being careful not to drop it.

Alternatively, cores can be used to determine recent growth by measuring the length of the core from the youngest, outer ring, to the desired year. This is often measured for the most recent 10-year growth. Remove any residual outer bark and identify the first 10 lines (tree rings) from the outer bark inward. Mark that line with a pen. Measure the length of the boring from the outer bark to the marked line in 1/20th of a centimeter.

Key vocabulary

Diameter at breast height measuring tape	Reel measuring tape
Clinometer	Compass
Increment borer	Densitometer

Preparation

1. Borrow forestry tools from OSU Extension or an agency partner.
2. Identify a guest speaker if the instructor is unfamiliar with forestry tools. The local OSU Extension forestry agent, Oregon Department of Forestry stewardship forester or a forester with the U.S. Forestry Service or Bureau of Land Management may help with this class.
3. Identify a source for the forestry tools listed in the key vocabulary. Consider reaching out to your local OSU Extension forestry agent, if you have not already.
4. Identify some trees or a forested area within walking distance to practice using forestry tools.

Procedure

1. Introduce tools to students.
2. The instructor or guest speaker will explain the process using each of the tools.
3. Break students into groups and have each group take turns using the forestry tools.

Assessment

1. Use of forestry tools: Use a group participation grading rubric to evaluate student engagement, ability to follow directions, cooperation and effort.

Full-day field trip: collecting stand data

Preparation

1. Identify appropriate location for the described stand data collection activities and coordinate with land manager. Property can be public or private but should have a good representation of forest types in the area. For example, if your county typically has Douglas-fir forests and oak woodlands, select a property that has examples of both.
2. Work with the land manager, your local OSU Extension office or another local organization to gather needed tools for the work. These include: diameter at breast height measuring tape, clinometer, increment borer, reel measuring tape, compass, densiometer and a copy of Trees to Know in Oregon and Washington for each student group. A range finder may be used in place of a clinometer and reel measuring tape to measure the height of trees, You can also use a prism or cruiser's crutch in place of the reel measuring tape to determine trees within the plot and basal area if the trainer prefers.
3. Identify locations on the property for each represented forest type where students can take stand data. Locations should be easy to get to either by vehicle or walking. Flag potential plot centers in the stand for as many student groups of five to six as the class will have. Be sure to have each plot center no less than 50 feet away from another. Identify any additional stops for students and trainer(s) to discuss, but not collect data. This might include locations such as: forest in the riparian zone, ridgetops and landscape viewpoints, areas of extreme tree mortality, a recent timber harvest, a recent burn scar, any other anomalies that stand out to the instructor or trainer(s) as interesting or significant. Finally, identify a location for lunch. Record all stops with a GPS device to help find them during the field visit.

4. Identify at least one forester from the Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management or OSU Extension to serve as the main trainer for the day. Ideally, the trainer will visit the site with the instructor prior to the field visit with the students. Share worksheets with the forester prior to the field visit, as they may wish to use alternative equipment or data collection methods. Additional personnel may include the site land manager or owner and volunteer chaperones to help oversee the small groups. Plan to have at least one adult for every five to six students.
5. Make adequate printouts of the stand data sheets.

Measuring tree diameter at breast height.

CREDIT: Jennifer Payne

Procedure

1. Arrive at the site and make introductions. The land manager will discuss landowner objectives for the forest. Land managers use maps to show students where they will be working and how the land manager uses stand data to guide management operations.
2. Break students into groups of five to six and assign equipment to the students that they will be responsible for throughout the day. A checklist helps ensure that no equipment is lost. Each group should have one reel measuring tape, one to two DBH tapes, one increment borer, one compass, one densiometer and one clinometer.
3. Following the included worksheets, students will write up a narrative of the conditions of the plot. Next, they will identify every tree under the following parameters: 1/20th-acre radius for all trees greater than 8 inches DBH, a 1/100th-acre plot for all trees between 4 and 8 inches DBH. Each tree will have their species recorded, identified as being dead or alive, DBH recorded and basal area calculated. All trees between 1 and 4 inches DBH will be tallied under a 1/250th-acre plot according to their species and whether they are dead. Finally, students will select two 4-inch or greater trees to calculate the live crown ratio, the height and the 10-year growth of the trees, as described in the worksheets. Students should record all data in the stand data sheets.

1. Review groups' work before proceeding to the next stop.
2. At the last stop, reconvene students with the land manager. Have students present their findings to the land manager, focusing specifically on:
    - **a.** What species of trees were present at each stop?
    - **b.** How old were the trees generally at each stop?
    - **c.** How tall were the trees generally at each stop?
    - **d.** Based on live crown ratio, how healthy did the trees seem to be at each stop?

Assessment

1. Stand data sheets narrative — Each student records the stand data on the accompanying worksheets and completes a narrative of the conditions of the plot (density, vegetation diversity, tree health, mortality, fire susceptibility, etc.).
2. Student groups determine and present to the larger group whether the conditions of the plot meet the land manager's objectives presented at the beginning of the field lab. If not, the group makes recommendations to meet the objectives. Use group participation grading rubric to evaluate engagement, effort, cooperation, accuracy and articulation of rationale.

Module assessment, evaluation and feedback

Students respond to the following:

1. Was it difficult to learn how to use the tools during the field lab? What helped you to prepare for this field lab?
2. Were you able to identify the tree species you saw? What types of trees did you identify at this site?
3. Describe in your own words how tree health relates to catastrophic fire or natural low-intensity fire events.
4. What was your favorite tool to use?
5. Are you interested in a career in forestry?

Guess the forest type

Instructions: Look over the photos of different forest types. Discuss the characteristics and identify the forest type of each photo.

Refer to what you learned from the video, *Forest Fact Break – Forest Types*.

There are 12 forest types in the state of Oregon. A forest type depends on the climate, elevation, precipitation, soil and temperature. A forest type is often named after the dominant tree species in the forest type. The nine most significant forest types in Oregon are: *spruce hemlock, mixed conifer, juniper woodlands, ponderosa pine, Douglas-fir, subalpine, western larch, lodgepole pine and oak woodlands*.

Consider the following questions when discussing the different forest types in the photos:

a. Are the trees in the photo deciduous or coniferous?

b. Is the canopy dense or are trees widely spaced?

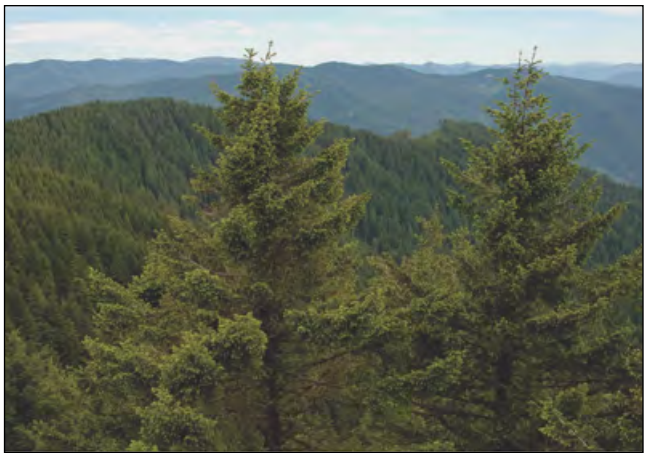
c. Does the surrounding area look drier, or have more moisture?

d. What do you think the elevation of the photo is?

e. Bonus: If fire were introduced to this forest, how do you think the forest would react?

PHOTOS: Edward C. Jensen, © Oregon State University

PHOTOS: Edward C. Jensen, © Oregon State University



CREDIT: U.S. Forest Service

CREDIT: Michael Scott

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b. Is the canopy dense or are trees widely spaced?

c. Does the surrounding area look drier, or have more moisture?

d. What do you think the elevation of the photo is?

e. Bonus: If fire were introduced to this forest, how do you think the forest would react?

Englemann spruce in spruce hemlock forest. Coniferous, dense, higher moisture content, low to mid-range elevation. Fire interacts more infrequently with this type of forest, but when it does burn, it burns at higher severity.

Western larch. Northwestern forests, typically mixed with ponderosa pine forests. Coniferous and deciduous (not evergreen). Low to medium density. Lower moisture. Fire interacts with this forest type with higher frequency and mixed severity.

Subalpine forest type , coniferous, low density, low moisture, low fire frequency and variable fire severity.

PHOTOS: Edward C. Jensen, © Oregon State University

Juniper woodlands. Coniferous, low density, low moisture, low to medium fire frequency and low fire severity.

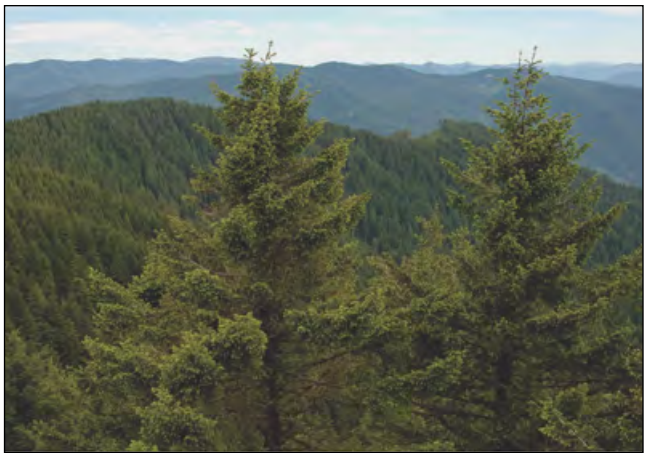
Oak woodlands, deciduous, low density, low to medium moisture, high frequency and low fire severity.

Lodgepole pine subalpine forest, coniferous, high density, lower moisture. Fire interacts with this forest type with variable frequency but high severity.

Ponderosa pine forest type , Low to medium density. Lower moisture. Fire interacts with this forest type with higher frequency and lower severity.

Aspen forest type , deciduous, high density, riparian species in low moisture environments. Fire-adapted species that depends on regular frequency and low-mid severity of fire to prevent conifer dominance.

Grand fir. Found along the coast and west of the Cascades intermixed with spruce hemlock, or intermixed with Douglas-fir forests, although there is also a subspecies east of the Cascades. Coniferous, high to moderate moisture content, medium to dense. Fire interacts with this forest with variable frequency and variable severity.



CREDIT: U.S. Forest Service

Douglas-fir forest. Coniferous, medium to high density, medium to low moisture. Medium fire frequency, medium to high fire severity.

CREDIT: Michael Scott

Spruce hemlock forest type, . Coniferous, dense, higher moisture content, low to mid-range elevation. Fire interacts more infrequently with this type of forest, but when it does burn, it burns at higher severity.

Forest types and tree identification scavenger hunt

Instructions: Look over the tree samples or photos of tree samples your instructor has brought into the classroom. Using the dichotomous key in the Trees to Know book, try to determine the species of each sample. Next, use the book to determine what forest type the tree can be found in, and use your knowledge of fire regimes in Oregon to determine how often that forest type is likely to see wildfire.

Tree species	**Things to look for**	**Sample number**	**Forest type and fire regime** *Hint: It may be found in more than one type.*
Douglas-fir	Blunt tip needles, spirally arranged around twig. Dark brown pointed buds. Look for the mouse tails/legs on cones.		
Incense-cedar	Scale-like leaves; set of four leaves is much longer than it is wide; shaped like a long-stemmed wine glass. Cones look like open duck's bill.		
Sugar pine	Five needles per cluster or bundle; bloom (whitish stuff) present on all three needle surfaces (but not always visible); very large and long cones.		
Ponderosa pine	Three needles per cluster or bundle; egg-shaped cones with prickles.		
Oregon black oak	Lobes of leaves are pointed; darker bark.		
Additional species			
Additional species			

Interview questions

In the next class, you will hear from forestry professionals. You will learn about their jobs, their organizations and the training, professional and academic experiences they needed to get their positions. We will also sit down with them, one on one, to learn more about how their careers are essential to forest management, forest health and healthy communities. Before we meet these professionals, consider questions to ask them in an interview and be prepared to record their answers, either in writing or through video. You will be asked to write an article or develop a short video clip based on your interview work. Try to write seven to 15 questions to ask the interviewee to get enough content.

Some things to consider when crafting your questions:

- The specifics of the interviewee's job.
  - Daily job duties
  - Is the majority of time spent indoors or outdoors?
  - Responsibilities (such as data collection, report writing)
  - Supervisory roles
  - Scientific data collected
  - Tools used
- The goals of the interviewee's company or organization.
  - Private company or public organization?
  - Does the company or organization have requirements, policies or mandates that it must follow? (These could include providing habitat for wildlife, supplying timber, contributing to clean water and air, providing recreation space, etc.)
- What the company or organization produces.
- The role of the interviewee's company or organization in the community. Include any volunteer work or sponsorships the company or organization contributes to the community.
- The skills the interviewee needs to do the work.
- Compensation for employees at the company or organization.
  - Starting wage versus current wage or salary
  - Other jobs the interviewee did within the company or organization and the salary range
  - Does the company or organization pay for additional training or education?
  - Benefits?
- The public opinion of the interviewee's job or company/organization.
  - Is the interviewee required to deal with the public?
  - Does public opinion affect the interviewee's ability to perform the job?
- Job satisfaction of the interviewee.
  - What are future opportunities that the interviewee could pursue from the path chosen? (These could include additional training or education, promotions, other agencies or companies.)

Tree health assessment worksheet

Recorder: _____ **Plot number:** _____

Other team members: _____

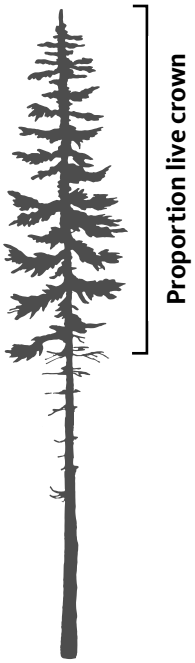
Date: _____ **Longitude:** _____

Instructions

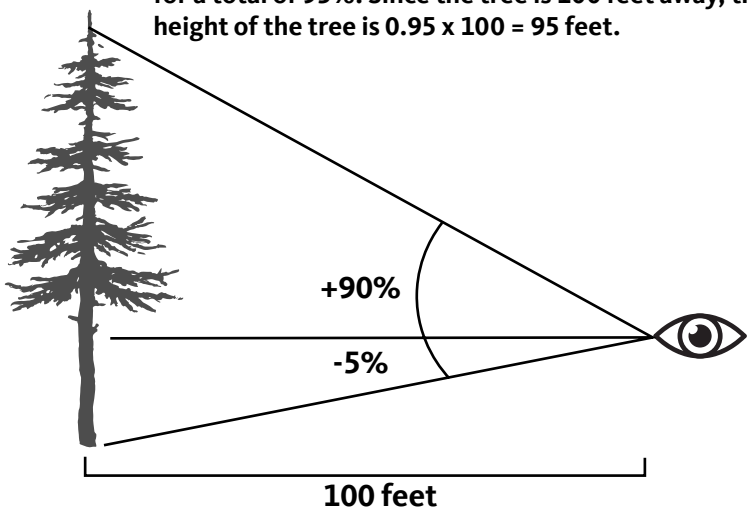
Select four to six trees to assess tree health. At each of the selected trees:

- Use the clinometer for this exercise if outdoors. Instructions below. If using tree photos, measure the photo with a ruler. Measure the height of the tree from the base to the top of the crown. Next, measure the height of the live crown, from the base of the live crown to the top.
- Using the clinometer: Starting at the point of the tree, have one person hold onto the measuring tape while walking out 100 feet. With both eyes open, look through the clinometer with one eye, and record the number visible at the base of the tree and the top of the tree. Subtract the percentage of the top of the tree from the base percentage. (If the base percentage is negative, this will mean adding!) Multiply the percentage by 100 to get the height. Next, use the clinometer to identify the bottom of the live crown. Subtract the top of the live crown from the bottom of the live crown. Trees with a live crown ratio of 30% or less are not healthy and may die soon.
- Take a coring of the tree. Look at the lines of the tree rings. Each ring represents one year of growth. Measure the distance between the last 10 lines (10 years) of growth. Then measure the 10 lines (10 years) of growth prior to that. Compare the two lengths. Has the rate of growth increased over the last 10 years, decreased or stayed the same? A decreasing growth rate may indicate a distressed tree.

The live crown ratio is the proportion of the tree that is green — in this case, approximately 50%.



A clinometer measures the percent slope between your eye and both the top and bottom of the tree. In this case, the clinometer reads 90% up and 5% down, for a total of 95%. Since the tree is 100 feet away, the height of the tree is 0.95 x 100 = 95 feet.



Tree health assessment recordings

Tree number	Species	DBH	Tree top percentage	Live crown base percentage	Tree base percentage	Tree height	Live crown ratio	10-year growth shorter than previous 10 years? Y/N

Helpful abbreviations

DF=Douglas-fir; PP=ponderosa pine; WF=white fir; IC=incense cedar; BO=black oak; WO=white oak

Stand data collection worksheet 1

Photo monitoring

Photographer: _____ **Latitude:** _____ **Longitude:** _____

Recorder: _____ **Date:** _____ **Plot number:** _____

Other team members: _____

Photo azimuth: _____ **Photo ID:** _____

Instructions

- Building the plot: Place a flag at the center of your plot and record coordinates.
- Place the meter board at plot center. Walk out 25 feet from plot center due south. Mark the date and plot number on the whiteboard.
- Take the photo with the whiteboard visible at the lower right-hand side of the photo view and the meterboard in the center. Fill in the plot narrative.

Plot narrative

Describe the conditions at the site (weather, any animal species, any unusual conditions such as a burn scar or recent logging, etc.).

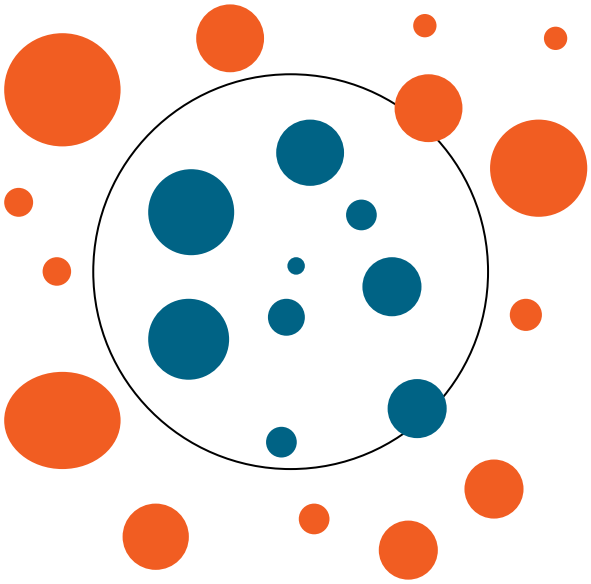
Stand data collection worksheet 2

Recorder: _____ **Date:** _____ **Plot number:** _____

Other team members: _____

Instructions

- Set up the plot by having one person hold the tape at plot center, and another person holding the end of the tape at 26 feet 4 inches. The second person should circle the first person at the plot center. Starting at north and going clockwise, count all the trees greater than 8 inches diameter at breast height (dbh). For trees on a slope, use the correction factor sheet to determine if in or out. If more than 50% of the tree is outside of the circle do not count it. If you are unsure, ask your instructors.
- As you progress from north, also record trees with dbh from 4 inches to 8 inches that fall within 12 feet of plot center. If there is slope, use the correction factor sheet to determine if the tree is in or out. Use the 50% rule here, too.
- Record each tree within the circle, starting from due north and going in a clockwise direction, including the species and DBH. If dead, note the decay class. Calculate the basal area for each tree by squaring the DBH and multiplying it by 0.005454.



A schematic of a fixed area plot. "In" (sample) trees are identified in blue, and "out" trees are shown in orange. Trees that fall along the plot boundary are determined "in" or "out" based on whether the center of the tree falls within the plot.

Worksheet 2 recordings

Tree number	Species	DBH (inches)	Basal area (square feet)	Dead/ decay class
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Trees per acre = (trees›8–20 inches) x 20 + (trees 4–8 inches) x 100

Percent mortality = (dead trees›8–20 inches) x 20 + (dead trees 4–8 inches) x 100 / trees per acre

Total basal area = (basal area of trees ›8–20 inches) x 20 + (basal area of trees 4–8 inches) x 100

Helpful abbreviations

DF=Douglas-fir; PP=ponderosa pine; WF=white fir; IC=incense cedar; BO=black oak; WO=white oak

Stand data collection worksheet 3

Recorder: _____ **Plot number:** _____

Other team members: _____

Date: _____ **Longitude:** _____

Instructions

- Set up the plot by having one person hold the tape at plot center, and another person holding the end of the tape at 7 feet 5 inches. The second person should circle the first person at the plot center. Starting at north and going clockwise, count all the trees greater than 8 inches diameter at breast height (dbh). For trees on a slope, use the correction factor sheet to determine if in or out. If more than 50% of the tree is outside of the circle do not count it. If you are unsure, ask your instructors.
- Minimum recordable tree size is 4.5 feet tall, 1 inch basal area (diameter at the base of the tree). Record living and dead separately — Douglas-fir 2, Dead Douglas-fir 1.

Trees greater than 4 inches in diameter

Species	Number of trees

Worksheet 3 recordings

Tree number	Species	DBH	Tree top percentage	Live crown base percentage	Tree base percentage	Tree height	Live crown ratio	10-year growth shorter than previous 10 years? Y/N

Helpful abbreviations

DF=Douglas-fir; PP=ponderosa pine; WF=white fir; IC=incense cedar; BO=black oak; WO=white oak

Stand data collection worksheet 4

Recorder: _____ **Plot number:** _____

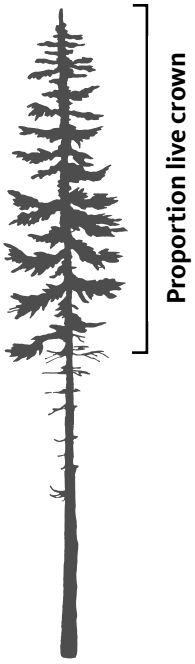
Other team members: _____

Date: _____ **Longitude:** _____

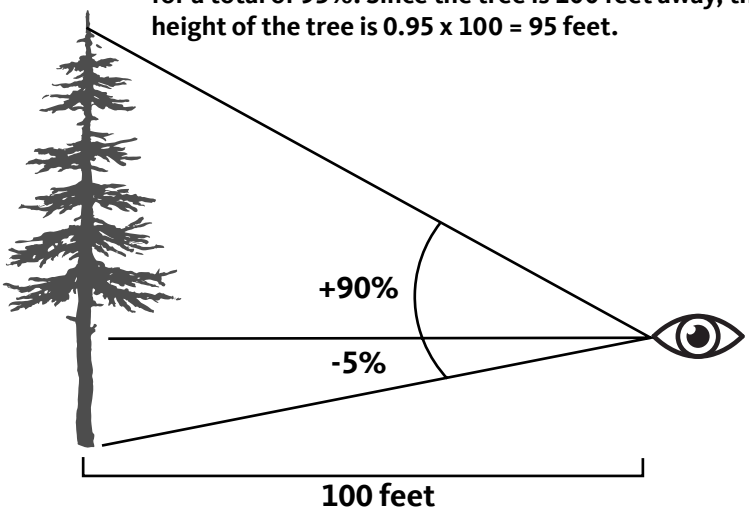
Instructions

- Select every fifth tree, starting with 1 (1, 6, 11, etc.). If there are fewer than four trees, select one and the highest number tree.
- Confirm with the other group the tree numbers or your selected trees. Measure the height of the tree from the base to the top of the crown. Next, measure the height of the live crown, from the base of the live crown to the top.
- Using the clinometer: Starting at the point of the tree, have one person hold onto the measuring tape while walking out 100 feet. With both eyes open, look through the clinometer with one eye, and record the number visible at the base of the tree and the top of the tree. Subtract the percentage of the top of the tree from the base percentage (in the base percentage is negative, this will mean adding!). Multiply the percentage by 100 to get the height.
- Next, use the clinometer to identify the bottom of the live crown. Subtract the top of the live crown from the bottom of the live crown.

The live crown ratio is the proportion of the tree that is green — in this case, approximately 50%.



A clinometer measures the percent slope between your eye and both the top and bottom of the tree. In this case, the clinometer reads 90% up and 5% down, for a total of 95%. Since the tree is 100 feet away, the height of the tree is 0.95 x 100 = 95 feet.



Worksheet 4 recordings

Tree number	Species	DBH	Tree top percentage	Live crown base percentage	Tree base percentage	Tree height	Live crown ratio	10-year radial growth (1/20 cm)
Get this data from "Tree health assessment worksheet"								

Helpful abbreviations

DF=Douglas-fir; PP=ponderosa pine; WF=white fir; IC=incense cedar; BO=black oak; WO=white oak

3. EXPLORING WILDFIRE

This module will provide students with a better understanding of the causes of wildfire, and strategies to mitigate wildfire risk.

Time considerations

Preparation: Four+ hours including travel time

Procedure: Six to seven 50-minute in-class sessions

A. Why do fires start and spread? (two class sessions)
B. Types of fire and fuel structure (two class sessions)
C. Wildfire ecology: Plant succession and species adaptations (one to two class sessions)
D. Options for wildfire management (one class session)
E. A long history of putting fire on the ground: Indigenous burning (one class session)

One to 1½ full-day field trips

A. Replanting in a burn (0.5)
B. Fuel reduction workday (0.5-1)

Learning objectives

Students will be able to:

1. Identify the elements of the fire triangle and fire behavior triangle.
2. Compare types of fire progression.
3. Identify and define different approaches to managing wildfire.

Behavioral objectives

Students have completed:

1. Replanting in a fire scar area.
2. Fuel reduction work on public lands.

Standards connections

Oregon Science Standards

Performance Expectations

- HS.ESS3.1: 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. [Activities A and E]
- HS.ESS3.3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations and biodiversity. [Activities D, E and field trips]

Disciplinary Core Ideas

- ESS3.C: Human Impacts on Earth Systems. The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. [Activities D, E and field trips]
- LS2.C: Ecosystem Dynamics, Functioning and Resilience. A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (that is, the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. [Activities A, B, C, D, E and field trips]
- LS2.C: Ecosystem Dynamics, Functioning and Resilience. Moreover, anthropogenic changes (induced by human activity) in the environment — including habitat destruction, pollution, introduction of invasive species, overexploitation and climate change — can disrupt an ecosystem and threaten the survival of some species. [Activities D, E and field trips]
- LS4.C: Adaptation. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. [Activity C and field trips]
- LS4.D: Biodiversity and Humans. Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. [Activities D, E and field trips]

Science and Engineering Practices

- 3. Planning and Carrying Out Investigations. Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. [Activities A, B and field trips]
- 3. Planning and Carrying Out Investigations. Select appropriate tools to collect, record, analyze and evaluate data. [field trips]
- 6. Constructing Explanations and Designing Solutions. Apply scientific ideas, principles and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [Activities A, B and field trips]
- 7. Engaging in Argument from Evidence. Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. [Activities A, B, D]

Oregon English Language Arts Standards

- 9-10.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts and issues, building on others' ideas and expressing

their own clearly and persuasively. [Activities A, B, D, E and field trips]

- 11-12.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 11–12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activities A, B, D, E and field trips]
- 9-10.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. [Activities A, B, D]
- 11-12.W.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. [Activities A, B, D]

Oregon Standards for Literacy in History/Social Studies and Science and Technical Subjects

- 9-10.WHST.1. Write arguments focused on discipline-specific content. [Activities A, B, D]
- 11-12.WHST.1. Write arguments focused on discipline-specific content. [Activities A, B, D]

Oregon CTE Knowledge and Skills Statements

- KSS.B: Assist in preparation and implementation of natural resource environment management plans. [Activities D and E]
- KSS.C: Supervise the protection of natural resource environments and woodlands. [field trips]
- KSS.H: Describe ecological concepts and principles; investigate and explain the relationships between these principles and natural resource environment development. [Activities A, B, C, E and field trips]
- KSS.L: Acquire the specific academic knowledge and skills necessary to pursue a full range of career and postsecondary opportunities within natural resources management. [Activities A, B, C, D, E and field trips]
- KSS.M: Use oral and written communication skills in creating, expressing and interpreting natural resource management information and ideas including technical terminology. [Activities A, B, D]
- KSS.O: Know and understand the importance of employability skills for careers in natural resources. [field trips]

Classroom activities

A. Why do fires start and why do they spread?

Materials

- *Forest Fire – Forest Fact Break*, https://www.youtube.com/watch?v=zNoqpqbeJ3M
- Materials for outdoor or in-lab live fire activity: Matchstick forest experimentation and demonstration: two aluminum cake pans lined with clay or Play-Doh per student group, wooden matches, wood shavings, a fan, a water mister, a nonflammable object with which to prop up the pans for slope (rock), fire extinguisher

Background information

Wildfires are fires burning in wildland areas. They can be ignited by either lightning or humans. Forests evolved with regularly occurring fire, but after years of suppressing fires, fuels have built up. A build-up of fuels combined with increasing temperatures and subsequent drought have made forest fires more dangerous than they were historically. Human activities that can cause wildfires include debris burning, campfires, equipment fires, smoking and arson. Not all wildfires are destructive and dangerous, though. When managed or controlled, they can be used as a tool to reduce fuels.

To sustain a fire, three elements are needed: heat or an ignition source, oxygen and fuel. Together, these elements are known as the *fire triangle*. Take one of these things away, and the fire will go out or won't start. For example, constructing a fire line down to the mineral soil removes fuel from the forest floor. Fires differ in terms of how fast they spread, how high their flames are, and how hot they burn (*fire intensity*). Once a fire ignites in forestland or rangeland, the manner in which a fire reacts to local conditions is known as its behavior.

The *fire behavior triangle* includes three elements: the amount and arrangement of fuel, the topography and the weather conditions. A change in any one factor during the fire alters its behavior and type (whether it's a *ground fire*, *surface fire* or *crown fire*). There is not much people can do about weather and topography. The one element in both of these triangles that we can do something about is *fuel*. Fuels include small trees, branches, grass, shrubs, litter and slash. By reducing the amount of fuel and changing its arrangement, we can influence a fire's behavior.

— Adapted from Chapter 9: Fire in the Forest online course draft, which was adapted for high school students by Rod Bardell from the Oregon State University Forestry Extension's Basic Forestry Shortcourse

Key vocabulary

Fuel	Topography
Fire triangle	Ground fire
Fire behavior triangle	Surface fire
Fire intensity	Crown fire

Preparation

1. Prepare the *Forest Fire – Forest Fact Break* video for the in-class session.
2. Prepare the fire triangle/fire behavior triangle worksheet.
3. Identify an appropriate guest speaker who can speak on the topics and key words identified in the background. Guest speakers from Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management, OSU Extension or similar organizations are ideal.
4. Outdoor or In-lab live fire activity: Matchstick forest experimentation and demonstration. For each group of five to six students, obtain: (2) Aluminum cake pans lined with clay/Play-Doh®, wooden matches, wood shavings, a fan, a water mister, a nonflammable object with which to prop up the pans for slope (such as a rock) and a fire extinguisher.

Procedure

1. Discuss key terms
2. *Forest Fire — Forest Fact Break* video
3. Guest speaker: Why do fires start and why do they spread?

4. Have students work on their own foldable fire and fire behavior triangles using the fire/fire behavior triangle worksheet. Students should write each side of the two triangles on each fold of the two cutout templates provided. Encourage students to be creative with the triangles. For example, they could draw examples of each triangle side and illustrations of fire.
5. Outdoor or in-lab live fire activity: Matchstick forest experimentation and demonstration. Divide students into six groups. Remind students of the fire behavior triangle. Each group will focus on one variable condition. Have students identify which side of the fire behavior triangle relates to the variable condition: stand density (fuel), surface fuels (fuel), slope (topography), ignition point (topography), wind (weather), moisture (weather).

   Each group will create two matchstick forests, identical except for the one variable condition: number of matches used (stand density), amount of wood shaving added (surface fuels), angle of the pan (slope), where to start the burn (Ignition point), using the fan (wind) or spraying the matchstick forest with water (moisture). Ask students to count the total number of matches and hypothesize which of their forests is likely to have a greater percentage of matches burn. Have students give their reasoning prior to burn.

   Light each of the matchstick forest pairs. Students should record the length of time of the burn, the maximum flame length and the number of matches burned. Each group will then report to the class.

   Follow up with a class discussion on how forest managers should deal with each of the conditions in a real forest as a conversation or in-class essay.

Students experiment with matchstick forests.

CREDIT:
Jennifer Payne

Assessment

1. Outdoor or in-lab live fire activity: Matchstick forest experimentation and demonstration worksheet — Students work in groups to formulate a hypothesis for the ignition results of their "experimental" matchstick forest. After ignition of both the "control" and "experimental" forests, students compare and explain the results. To demonstrate further understanding, students work individually to develop a hypothesis for a different variable and provide a written hypothesis for their prediction of the percentage of matchsticks burned. If there is time, students rejoin their groups to discuss their hypotheses.
2. Optional: In-class essay on managing forests for wildfire. Describe how each side of the fire triangle relates to the creation of fire, and how each side of the fire behavior triangle relates to how wildfire moves, grows or is stopped. Finally, identify the side of the triangle for each triangle that land managers and firefighters can most easily alter to reduce wildfire risk or fight fire. Explain your reasoning. Acknowledgment: The matchstick forest experimentation and demonstration activity and assessments were adapted from the Citizen Fire Academy curriculum, https://catalog.extension.oregonstate.edu/em9168.

B. Types of fire and fuel structure

Materials

- *Wildfire Types – Science Trek*, https://video.idahoptv.org/video/wildfire-types-oklwbu/
- Materials for outdoor or in-lab live fire activity: tinker tree competition: One aluminum cake pan per student group, several old newspapers, one vertical metal-rod support stand per student group, metal wire for "tree branches," lighter, spray bottle, fire extinguisher

Background information

Not all wildfires are the same. The fuels burning in a wildfire will greatly influence how it spreads and grows. There are three types of fuels:

- Material on the ground, like tree needles, downed branches and similar debris are known as *surface fuels*.
- Shrubs, small trees and lower tree limbs on larger trees all can serve as *ladder fuels*, which can allow a fire to climb off the ground.
- *Crown fuels* consist generally of tree crowns.

As seen in the matchstick forest demonstration, when there is *fuel continuity* in a landscape, wildfires are able to spread and grow as a surface fire, a ground fire or a crown fire. *Horizontal fuel continuity* is where fuels are near enough to each other that burning fuels will spread to unburned fuels. This is how a surface fire will spread along the floor of a landscape, how a ground fire will spread underground through roots, or how a crown fire will spread from tree top to tree top. *Vertical fuel continuity* is how one type of fire may grow into another type of fire. For example, *surface fires* will become *crown fires* when there is an availability of ladder fuels continuous to *surface* and *crown fuels*.

In this way, a surface fire will climb up the ladder fuels into the crown.

Crown fires are significantly more impactful to a landscape and are much more difficult to fight than a surface fire. Not all crown fire is the same. Most wildfires start as surface fires. From there, they may progress to a *passive crown fire*, which is where fire may climb up into the crowns of one or a few trees. The heat and fuels of the surface fire are not enough for the fire to spread to additional crowns.

When crown fire is able to spread, it is known as an *active crown fire*. Active crown fires still depend on an abundance of surface and ladder fuels to spread to other crowns.

Finally, when there is enough heat and fuels in the crown, a crown fire may develop into an *independent crown fire*, where fire is spread from crown to crown directly. Because independent crown fires can move quickly, they are dangerous to fight.

Wildfires can then create their own hazardous and self-perpetuating conditions. As fires reach into ladder and *crown fuels*, they give off embers that can travel by wind and cause *spotting*. Intense wildfires can also start to create their own weather by heating the air. Moisture in the air condenses as the air rises. This forms *pyroculumus clouds*, which may produce lightning and can start fires elsewhere as a result. Extreme fire behavior can result in extreme events like a *fire whirl*.

Key vocabulary

- Surface fuels
- Ladder fuels
- Crown fuels
- Fuel continuity
  - Vertical
  - Horizontal
- Passive crown fire
- Active crown fire
- Independent crown fire
- Spotting
- Pyroculumus clouds
- Fire whirl

Preparation

1. Prepare the *Wildfire Types – Science Trek* video for the in-class session.
2. Identify an appropriate guest speaker who can speak on the topics and key words identified in the background. Guest speakers from Oregon Department of Forestry, the U.S. Forest Service, the Bureau of Land Management, OSU Extension or another organization are ideal.
3. Outdoor or in-lab live fire activity: tinker tree competition. For each group of two to three students, acquire:
   a. Aluminum cake pans, several old newspapers, vertical metal-rod support stands, metal wire for “tree branches,” lighter, spray bottle, fire extinguisher.
   b. Four paper bags, each with about 20 strips of newspaper approximately 40 cm by 4 cm with holes punched in the middle. 10 half-sheets of newspaper (25 cm by 35 cm), and five quarter-sheets of newspaper.

Students manipulate their tinker trees before setting them alight. CREDIT: Jennifer Payne

Procedure

1. Introduce key terms to students.
2. *Wildfire Types — Science Trek*
3. Guest speaker: Types of fire and fuel structure
4. Outdoor or in-lab live fire activity: Tinker tree competition.

Break students into groups. Each group will get their own stand, metal pan, wire and bag of newspaper. Students will create their own tree out of the stand, wire branches and newspaper leaves (the 40 cm by 4 cm pieces).

The objective is to have the healthiest tree, as measured by length of the portion of a branch with unburnt leaves. Remind students about photosynthesis and the role of tree leaves in tree health. Students can have as many branches as they wish, and they may choose how many “leaves” to put on each branch.

After trees have been constructed, students will place two of the half sheets at the base of the tree (cut in the center to go around the tree trunk). This represents surface fuels.

Groups will next take the quarter-pages of newspaper and crumple them into loose balls. Replace

the surface fuel half-page newspaper sheets and put the quarter-sheet balls on top of the sheets. Explain to students that these are also ladder fuels. Ask students what these ladder fuels might represent (shrubs, small trees, logging slash, etc.)

Take each group's tree and have students or the instructor light each of the tinker trees at the base, on the lower right-hand corner of the metal pan at the corner of the half sheet of newspaper. Have groups collect their trees after to measure the length of the branch with unburned leaves. The group that has the most is the winner.

Discuss with students why certain groups' trees might have done better than other trees, and what a forest landowner might do to protect their trees in a fire. (Students could also discuss the topic in an in-class essay).

Assessment

1. Outdoor or in-lab LIVE FIRE activity: tinker tree competition worksheet — Use group participation grading rubric or require each student to complete the worksheet.
2. Students work individually to list and explain three changes that could be made to their group's tinker tree and ground fuels to improve the tree's chances of survival.

— *Tinker tree competition activity and assessments adapted from Fireworks curriculum, published by U.S. Forest Service, Rocky Mountain Research Station,* https://www.frames.gov/fireworks/home

C. Wildfire ecology: plant succession and species adaptations

Materials

Samples of plant fire adaptations (cones, bark, leaves, etc.)

Background information

As we learn in the "Forests in a wildfire-prone environment" module, different landscapes in Oregon have differing naturally occurring fire regimes. A *fire regime* is the general pattern in which wildfires naturally occur in a particular ecosystem. This includes general wildfire frequency, intensity, size, extent, season and severity. For example, in southern Oregon, historically fire has occurred frequently in any given forest (10–40 years in mixed conifer forests, as little as two to four years in ponderosa pine and oak forests). However, those fires were typically low in severity, with flames sticking close to the ground. On the other hand, coastal spruce and hemlock forests may go more than 100 years without fire. But when they burn, they burn intensely.

Animal and plant communities have evolved and adapted over thousands of years to best thrive in the conditions of the forest, including its fire regime. Wildfire is an ecological disturbance to the structure of the forest. It may result in generating *secondary succession* of the forest by eliminating competing vegetation, changing biotic and abiotic soil chemistry or altering sunlight.

As a result, some species possess adaptations to take advantage of secondary succession, even if this

increases the overall risk that an individual organism will not survive a wildfire. Species like lodgepole pine, which historically has experienced high severity, stand-replacing wildfire, have adapted by developing *serotinous cones*. These cones are coated in resin that melts in the heat of a wildfire, releasing mature seeds to ground with few or no living trees remaining. This gives lodgepole pine seedlings an advantage as a pioneer species, repopulating the landscape early, before other seeds can cover the ground. Similarly, some plants like Ceanothus (buckbrush) have fire-activated seeds, which require chemicals from the fire, smoke or bare ground nutrients to activate and start growing. These adaptations not only have allowed certain plant species to thrive in a fire regime, the plants have often become dependent on wildfire to reproduce.

Other plant communities respond by evolving ways for the individual organism to survive their wildfire regime. They may respond to frequent, low-intensity wildfire with *mitigation strategies* to help individuals of a species survive. An example of a mitigation strategy might be like that of ponderosa pine. In older ponderosa pine trees, thick bark protects the cambium, the growing part of the tree, during medium- to low-severity fire events. This allows the ponderosa pine tree to survive when other trees might be killed by the radiative heat of a fire. Self-pruning branches to remove ladder fuels and sprouting to regrow after a fire are other examples of mitigation strategies.

Plants are not the only organisms to take advantage of wildfire. Several wildlife species depend on the effects of fire to propagate and thrive. For example, when a wildfire kills a larger-sized tree that remains standing, it produces a snag. Snags become home to wood-boring insects, which in turn draw in woodpeckers looking for a meal. Wildfire may also remove decadent brush, such as manzanita or trees such as oaks, creating opportunities for fresh growth. Whether those trees and brush re-sprout or sprout by seed, the new growth is often sought out by *herbivorous* species like deer and elk. Similarly, certain insects may depend on understory vegetation that cannot grow prior to a fire due to competition or duff, but thrive after a wildfire. After a wildfire consumes the pine needles, leaves and woody debris, the bare ground created allows *herbaceous* plants to grow again in the understory, providing food and habitat for those species.

Key vocabulary

Ecological disturbance

Secondary succession

Wildfire adaptation strategies

Stand-replacing wildfire

Serotinous cones

Wildfire mitigation strategies

Herbivore

Herbaceous

Preparation

1. Identify an appropriate guest speaker who can speak on the topics and key words identified in the background. It may be useful to identify one speaker to present plant succession and plant adaptation and mitigation, with another speaker presenting animal adaptations. Speakers should be well-versed in local ecology and botany. Guest speakers from the U.S. Forest Service, the Bureau of Land Management, OSU Extension or a nonprofit environmental organization like The Nature Conservancy or a local watershed organization are ideal.
2. Collect examples of fire adaptation from a local forest. These might include serotinous cones from a lodgepole pine, the thick bark of an old-growth cedar, a manzanita seed, or a branch of a ponderosa pine in the process of losing its interior needles. Selected speakers may have samples or be able to help you find appropriate samples. If samples are not available, consider photos.
3. Prepare a list of possible plant and animal species for students to select from. Consider ponderosa pine, lodgepole pine, madrone, cottonwood trees, any oak species, manzanita, native grasses, silver lupine, deerbrush, any woodpecker species, elk, any species of raptor, amphibian or reptile. Consider using local or native species where possible.

   Prepare the list of questions that students should answer in a one- to two-page report on their selected species:

   a. Where in the state or in what forest type does this species live?

   b. What are the fire regimes in that area? What is the fire return interval in that area? What are the normal fire severities in that area?

   c. Does this species have a strategy or strategies for wildfire adaptation? (Does it use wildfire to its advantage at an individual or species level?) Describe those strategies.

   d. Does this species have a strategy or strategies for wildfire mitigation? (Does it avoid or reduce the negative impacts of wildfire on an individual or species level?) Describe those strategies.

Procedure

1. Introduce students to key terms.
2. Guest speaker: plant succession and plant species adaptations
3. Have students examine the collected samples of fire adaptation and mitigation.
4. Guest speaker: animal species adaptations
5. Have students complete the wildfire adaptation and mitigation short report in class or as a homework assignment.

Assessment

Wildfire adaptation and mitigation species report

D. Options for wildfire management

Key vocabulary

Preventive mechanical treatment

Fireline

Wildfire suppression

Managed wildfire

Prescribed broadcast burns

Background information

As we've seen in the prior lessons, wildfire is an indispensable part of the local ecology. Parts of Oregon are not only primed to burn, many plants and animals depend on burning as an ecological process to survive and thrive. At the same time, wildfires can threaten people, homes and communities with destruction or unhealthy smoke events. Consequently, land managers and firefighters may opt to treat each wildfire differently to accomplish different goals.

- *Preventive mechanical treatment.* Most land managers are engaged in some activity designed to reduce the risk of wildfire occurring or reduce the severity of wildfire should it occur. Recalling both the fire triangle and the fire behavior triangle, the one common denominator to both wildfires starting and wildfires spreading is fuel. Fuel reduction plays a big role in preparing for wildfire. Land managers can reduce horizontal fuel continuity and increase the space between trees and other fuels. Having larger distances between trees can help to alleviate drought stress or competition for sunlight, which will allow them to grow larger and more fire-resistant. Land managers can also reduce vertical fuel continuity by focusing on removing ladder fuels, removing lower branches, small trees and shrubs. Biomass may then be sold as timber, used as firewood, burned in piles, hauled off site, chipped, or occasionally, lopped and scattered to decompose. A part of this process may even include reforestation when land managers remove trees no longer suited to the area and add more fire-resistant trees to the composition of the forest.

- *Wildfire suppression.* Once a wildfire begins, land managers must work to reduce negative impacts to communities and habitats. Often, this means a wildfire will be suppressed. In wildfire suppression, firefighters work to contain and extinguish fires. Flames may be directly extinguished with water or fire retardant. More often, wildfire suppression takes a form similar to preventive treatments: Firefighters remove fuel to prevent wildfire spread. Containment of a wildfire refers to a continuous line free of fuels surrounding the fire, called a fireline. A wildfire may continue to burn for days, weeks and even months later, but usually it will not spread any farther than a well-dug fireline, as it lacks fuels to burn. Creating a line may consist of practices such as digging line by hand, mechanical efforts such as chipping or bulldozing, using natural and man-made fuel-free areas already in place, like a river or a road, or back-burning.

- *Managed wildfire.* When wildfire is not directly threatening communities, is difficult to approach safely with firefighters, or is providing an ecological benefit, it may become a managed wildfire. This is where an already occurring wildfire is allowed to continue to burn naturally. Managed wildfire is more often done by large public landowners, due to the risk of spread to neighboring property. Firefighters still manage wildfires. Land managers and firefighters will determine when a managed fire needs to become a suppressed wildfire. They will often take steps such as creating a fuel-free line to make sure the fire stays clear of communities or ecologically sensitive areas.

- *Prescribed broadcast burns.* Sometimes, a fire in the forest doesn't start by accident. It is ignited on purpose. A prescribed broadcast burn is when firefighters put fire on the ground in a controlled way. These prescribed burns will typically occur in spring or late fall, when temperatures are lower and humidity is higher. This helps keep the fire at a low intensity and makes it easier to control. Prescribed broadcast burns including back-burning aim to reduce fuels. These low-intensity burns can also restore some of the ecological functions a normal wildfire would have on a forest by clearing out decadent plants, producing snags and clearing groundcover to allow for new growth. Native Americans have been intentionally setting fire to forests for millennia, but modern land managers have only recently begun employing this strategy.

Preparation

1. Identify three to four speakers involved in wildfire decision-making for an in-class panel discussion. They should be able to speak on the topics and key words identified in the background. Consider one panelist for each approach to wildfire (prevention, suppression, managed and prescribed broadcast burns). Since different land managers have different objectives regarding fire, this may work best as a panel discussion, with each speaker able to speak to one or more of the types of wildfire management discussed below. Ideal guest speakers include representatives of the U.S. Forest Service, the Bureau of Land Management (preventative, suppression, prescribed broadcast burns or managed), the Oregon Department of Forestry (preventative or suppression), a local Native Tribal forest land manager or The Nature Conservancy (preventative or prescribed broadcast burns).
2. Introduce key terms to students prior to panel date.

Procedure

1. Introduce panelists.
2. In-class panel discussion on land and wildfire management decisions. Each panelist should cover the following questions:
    - **a.** What are the conditions in the forest that would make your management ideal?
    - **b.** What are the benefits and challenges to your management strategy?
        - i. From a community perspective?
        - ii. From an ecological perspective?
        - iii. From a financial perspective?
    - **c.** For what types of land ownership (public/private) is your management strategy feasible? Where is it ideal?
    - **d.** Who are the people carrying out your management strategy?
    - **e.** Other: Students may wish to create their own questions
3. Optional: Have students ask the panelists each question.
4. Each student selects one management option, records the answers from the respective panelist and writes a brief report on those answers.

Assessment

Student report — Students organize their reports as an essay with an introduction, three main points and a conclusion. Students address how the following may impact wildfire management policies for their selected agency or representative: agency funding sources, public issues with wildfire-generated smoke, and location of managed lands (near residential areas, near high public use areas, etc.).

E. A long history of putting fire on the ground: Indigenous burning

Materials

- *Revitalizing Our Relationship With Fire*, https://youtube/SF3MNpuqzSg
- Cultural plants and their relationship to fire worksheet
- Native plant station cards
- *Fire as Medicine: Fire-dependent Cultures and Re-empowering American Indian Tribes*, Fire Adapted Network, https://fireadaptednetwork.org/fire-as-medicine-fire-dependent-cultures/

Background information

In Oregon and in many places around the world, *Indigenous* cultures have skillfully used fire to tend their home landscapes for many thousands of years. This practice has many benefits, including recycling nutrients for cultivated or wild crops, creating habitat for wild plants and animals, maintaining travel routes and visibility, and protecting communities from uncontrolled fires. Regrowth after fires brings out vigorous, straight shoots which are used to make tools and baskets and serve as forage for herbivores such as deer. Berry, acorn, pine nut and hazelnut gathering areas are rejuvenated through repeated fires at specific intervals. Insect pests that eat acorns and other wild crops can be controlled through the use of fire, as can unwanted invasive plants. Scientists measure increases in biodiversity when there are many burned patches of different ages. Some people also feel the land is cleaner and healthier when looked after in this way.

Indigenous burning has many ecological benefits. Burning to create a *mosaic* of small patches prevents severe fires. The proximity of unburned, recently burned and older burned patches creates habitat for many species. Burning can lower water temperature in summer when smoke clouds the sky, which benefits cold-water fish like salmon. It increases water availability to plants and runoff into streams. Burning also leads to more snow accumulation in open forests, leading to water being released later into the spring. This is because without fire, dense trees intercept snowfall, which increases *evapotranspiration*. Counterintuitively, frequent burning even protects fire-sensitive species, because wildfires get bigger and are more intense if frequent fires are removed. Today, Indigenous burning is being employed for conservation goals, such as promoting rare species and controlling *invasive* weeds.

Across Oregon's diverse ecoregions, Indigenous burning takes on many forms. Wherever you are, it is likely that the landscape around you has been shaped by Indigenous ways, in subtle or more dramatic forms. Here is a brief overview:

- In the Willamette, Umpqua and Rogue valleys, annual burning has kept the grasslands and oak savannas from being overtaken by shrubs and conifers. This has favored large herds of elk and deer and patches of edible plants such as camas. Coastal meadows were once much more extensive and were maintained in a similar way. Cultural plants in these habitats include many medicinal plants, plants with edible seeds (tarweed, wild sunflowers), roots (lilies, onions and wild carrots), and leaves or stems (cow parsnip, miner's lettuce).
- In mountainous areas like the Coast Range, Cascades, and Blue and Wallowa Mountains, burning along ridges and riverways made long-distance travel easier, and networks of meadows were kept open by frequent burning. Mountain huckleberries were (and sometimes still are) burned regularly to maintain their habitat. Where forests are drier, as in southern Oregon and the eastern Cascades, fire use was more widespread and frequent, and lightning-ignited fire was also common.
- In the High Desert, fire was also used in sagebrush habitats to create mosaics of patches of different ages. Edible plants favored by fire include several species of grass, biscuitroots and pinyon pines. Wetland vegetation such as tule and cattails was also frequently burned.

In many places, traditional burning practices were criminalized and people struggled to continue using their ancestral knowledge. Many people, including some government officials, initially misunderstood the motives of Indigenous fire practitioners, fearing that fire would harm resources and threaten the economy. Yet, in some cases, non-native people have also adopted burning practices: Ranchers use fire to keep their pastures healthy; foresters have burned forests in the eastern Cascades for decades; wildlife managers burn wetlands in eastern Oregon and grasslands in the Willamette Valley (often with the help of tribal firefighters).

Despite the struggles Indigenous people have faced to carry out their traditional practices, many today are working to bring back the use of fire to keep the land healthy. Some tribes burn forestlands and meadows on their reservations. Others have advanced wildland firefighting departments that send firefighters all over the state and beyond when needed, or help agencies burn wildlife areas when possible. Other tribes have practitioners who burn small areas of basketry plants with their families. Because policies aimed at putting out all fires have had unintended consequences to ecological health and catastrophic wildfire risk, a societal shift is taking place towards preventive approaches, including frequent burning to reduce the impact of wildfires. Now, tribes are often partners in fire management in many regions, and collaborations are helping heal both the land and people.

Table 1. Reasons for Indigenous burning

Hunting	To drive game towards hunters as part of communal hunts.
Game habitat	To create feeding areas for deer, elk and other game animals, and pasture for horses.
Crop management	To improve seed harvest, increase berry production, clear ground for planting, etc.

Fireproofing areas	To protect certain medicinal plants, clear areas around villages, and reduce shrub and tree encroachment by removing fuels that could convey fire to these areas.
Insect gathering	"Fire surrounds" to collect and roast crickets and grasshoppers.
Pest management	To reduce flies, ticks, rodents, etc.; to kill insects that eat acorns or damage basketry plants.
Warfare and signaling	To deprive enemy of hiding places; for offensive reasons or to escape enemies. Large fires were used for signaling.
Clearing areas for travel	To clear trails and improve visibility in overgrown areas.
Ceremonies	As part of ceremonies and to fulfill a stewardship obligation.
Aesthetics and culture	To maintain open, parklike forests; to maintain sense of place, belonging and heritage.

— *Adapted from* Williams, G.W. 2000. Introduction to aboriginal fire use in North America. *Fire Management Today*, v. 60, no. 3

Key vocabulary

Indigenous

Mosaic

Evapotranspiration

Invasive

Preparation

1. Prepare the *Revitalizing Our Relationship with Fire* video for the in-class session.
2. Use the map to determine Indigenous tribes local to your area. Optional: Consider reaching out to your local tribes to invite them to your class to discuss historic and current uses of fire on the land.
3. Using the background, prepare to discuss the key concepts regarding how and why Indigenous tribes utilized fire on the land in their cultural practices. Prepare to discuss some of the most commonly important species:
    a. **Camas** (*Camassia* spp.)

        Camas is a type of lily that grows in wet meadows. It is an important food plant for many tribes, from northern California to British Columbia. For some, like the Kalapuya of the Willamette Valley, it was once a main staple. The bulbs are dug in the summer, usually after the plant has flowered. The bulbs are then cooked in a pit oven. When the pit is dug, it is lined with stones, and a fire is built in it. Once the

rocks are hot, the ashes are removed, and the bulbs are placed in the pit, layered with other plants like ferns. Earth is placed on top, and the bulbs are left to cook for at least one full day. If the bulbs are not cooked long enough, the starches in them are not digestible, but when they are cooked, they become quite sweet. Today, people often use Dutch ovens or slow cookers to achieve this effect. Burning camas meadows prevented trees (Douglas-fir, ash, maple) from taking over the meadow and shading out the camas. It also cleared thatch, creating bare ground for camas seeds to germinate and grow. People also remove rocks and weeds and use other methods to tend their camas patches.

b. Huckleberries (*Vaccinium* spp.)

Huckleberries remain a very important food for many tribes in Oregon. There are several species of huckleberries. On the coast, the evergreen huckleberry (*V. ovatum*) is common, and some tribes in southwest Oregon and northwest California burn it periodically. The mountain huckleberry (*V. membranaceum*) grows mostly in the Cascades, but also in the Blue, Wallowa and Siskiyou Mountains. Tribal gatherers make annual trips to collect these berries, which can be stored by drying or in jam. Burning keeps gaps in the forest open so these huckleberries can thrive. Old huckleberry bushes are less productive, so burning also rejuvenates the patch; bushes grow back from the roots. Today, it is hard for gatherers to get public land agencies to burn, and they sometimes need to cut young trees to prevent the huckleberry patch from disappearing. This is hard work! Tribal gatherers must also contend with commercial pickers who will take everything and sometimes damage the bushes. In a few areas, huckleberries can only be picked by Native American gatherers.

c. Ponderosa pine (*Pinus ponderosa*) or alternative, **sugar pine** (*Pinus lambertiana*)

Ponderosa pine is a versatile plant: Its pitch, needles and buds are used medicinally for a variety of purposes, and its nuts and inner bark can be eaten. Pitch is also used for waterproofing baskets and boats. The roots are sometimes used to make baskets. The wood is used for heating and building. Trees that have signs of bark harvest from before colonization still exist, and are called “culturally modified trees.” Ponderosa pine is adapted to frequent, low-intensity fire. Its bark is thick to protect it from the heat. Its lower branches fall off so that fire can’t climb up into the high branches. The needles crowd around and protect the fragile growing bud from flames. Ponderosa pines occur in parts of the state where tribes used fire commonly, though it’s difficult to say if people used fire to tend these trees in particular. More likely, fire was used for the overall health of the forest and the many resources it provided.

d. Yarrow (*Achillea millefolium*)

Yarrow is an example of a grassland plant that has medicinal uses. It is found everywhere in Oregon, maybe even in your backyard! Yarrow, like many wildflowers, needs a lot of light and can’t grow in dense forests. Indigenous people’s use of fire to maintain valley-bottom grasslands and mountain meadows has helped keep these

special habitats healthy for species like yarrow. Yarrow is powerfully antimicrobial and its medicinal uses include stopping bleeding and fighting colds.

e. Grassland plant alternatives

If yarrow is not available, you could use many other grassland plants instead, such as heal-all (*Prunella vulgaris*), another medicinal plant found in grasslands and backyards; goldenrod (*Solidago* spp.), used to brew a medicinal tea; stinging nettle (*Urtica dioica*), used as food and to make cordage (watch out when picking!); yampah (*Perideridia* spp., a sort of wild carrot); and milkweed (*Asclepias* spp.) and dogbane (*Apocynum cannabinum*), both used for cordage. This is only a short list of the many useful and cultural plants found in meadows and grasslands, which need fire to be healthy.

4. Consult with your local tribal contacts, your local OSU regional fire specialist or native plant societies to identify and obtain native, fire-adapted plants culturally or medicinally important in the area. Samples could be of the live plant, a pressed sample, or a photo if neither are available.
5. Prepare the cultural plants and their relationship to fire activity
    a. In this activity, arrange five to seven stations around the classroom, each presenting a locally important cultural plant. Gather one or more samples of each of the plants featured on the double-sided native plant station cards at each station. The top side of each card has text explaining how the plant is used, and why fire is important in tending the plant. The bottom side provides students with one to two questions to complete on the "Cultural plants and their relationship to fire" worksheet.
    b. If you have difficulty locating plant samples, contact your local OSU Extension office for assistance.

Procedure

1. Introduce students to key terms.
2. Revitalizing our relationship with fire
3. Optional: Speaker from a local tribe on Indigenous burning practices
4. Teacher discussion on concepts outlined in the background and important fire-adapted species
5. Cultural plants and their relationship to fire worksheet and native plant stations

Assessment

Cultural plants and their relationship to fire worksheet

Field content

Optional: Half-day field trip: Replanting in a burn

Preparation

1. Reach out to the USFS, BLM or ODF to identify a local burn scar and an appropriate agency employee in charge of replanting at the site who can speak to land management and wildfire at that location.
2. Have students review basics of tree planting prior to trip, particularly pages 4–9 of *The Care and Planting of Tree Seedlings on Your Woodland*, EC 1504, https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/ec1504.pdf
3. Work with an agency to secure tools and saplings for student replanting work.

Procedure

1. Arrive on-site. The land manager will talk about fire severity on the fire scar, typical frequency of fire in the area, how the fire was fought and native species to the site, in addition to a review of planting techniques.
2. Have students follow agency instruction to replant the site.

Full-day field trip: Applying fire to the landscape, fuel reduction and prescribed fire

Preparation

1. Reach out to the USFS, BLM, ODF or a local land conservancy to identify a forest property that would benefit from fuel reduction work. Identify an appropriate agency employee or organization liaison who can join and guide desired work.
2. Tools for fuel reduction work may likely be borrowed from the landowning agency or organization. If not, reach out to your local Oregon Department of Forestry or OSU Extension office to inquire about tools such as loppers, handsaws, pole saws, work gloves, hardhats, two-way radios if possible, etc.
3. Solicit parent or teacher chaperones. Aim for at least one adult per group of seven to 10 students.

Procedure

1. Arrive at the site and the land manager will discuss landowner objectives for the forest. Land managers will use maps to show students where they will be working and why those areas are important from a wildfire perspective.
2. Divide students into groups according to the number of adults available to lead each group.
3. Each group will be sent to a different area of the landscape to perform fuels reduction. Based on the desires of the land managers, students may be asked to gather fuels in specific ways for chipping, pile burning or disposal. Be sure to work with the land manager to clarify procedures in advance.

4. Throughout the workday, ask students how forest and fuel structure inform their decisions on what to remove.
5. Arrange for students to meet at lunch halfway through the field day.

A student performs fuel reduction. CREDIT: Jennifer Payne

Assessment

At the end of the field lab, students respond to the following:

1. What types of fuel reduction work did you perform today and why?
2. Describe any signs of fire suppression that you observed.
3. Prior to the final field Lab, students study maps of the areas to be visited and provide a one-paragraph description or an illustration of strategies that can be used to reduce fuels. (They can use Google maps to zoom in and view land conditions.) If students will be visiting areas that were both treated and untreated, students identify which areas were treated versus untreated. At the end of the field trip, students add additional knowledge gained from their field experience by making notations on their map copies.

Module assessment, evaluation and feedback

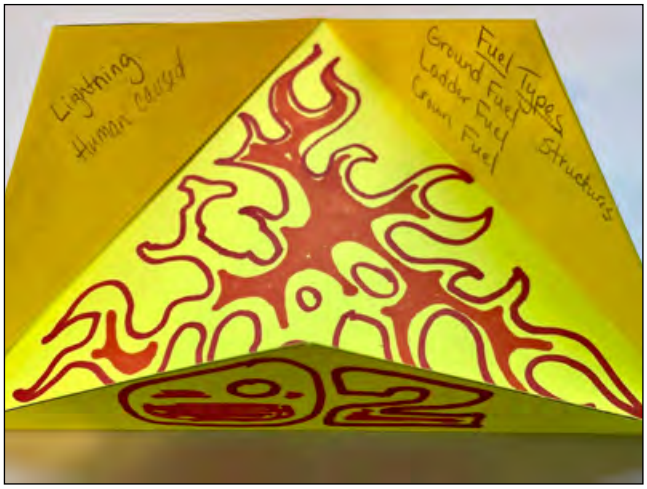
Students respond to the following questions:

1. Which activities in this module best helped you to understand and apply what you learned during this field experience?
2. What else would you like to learn about wildfire and wildfire management?

The fire triangle

To sustain a fire, three elements are needed: heat or an ignition source, oxygen, and fuel. Together, these elements are known as the fire triangle. Take one of these things away, and the fire will go out or won't start.

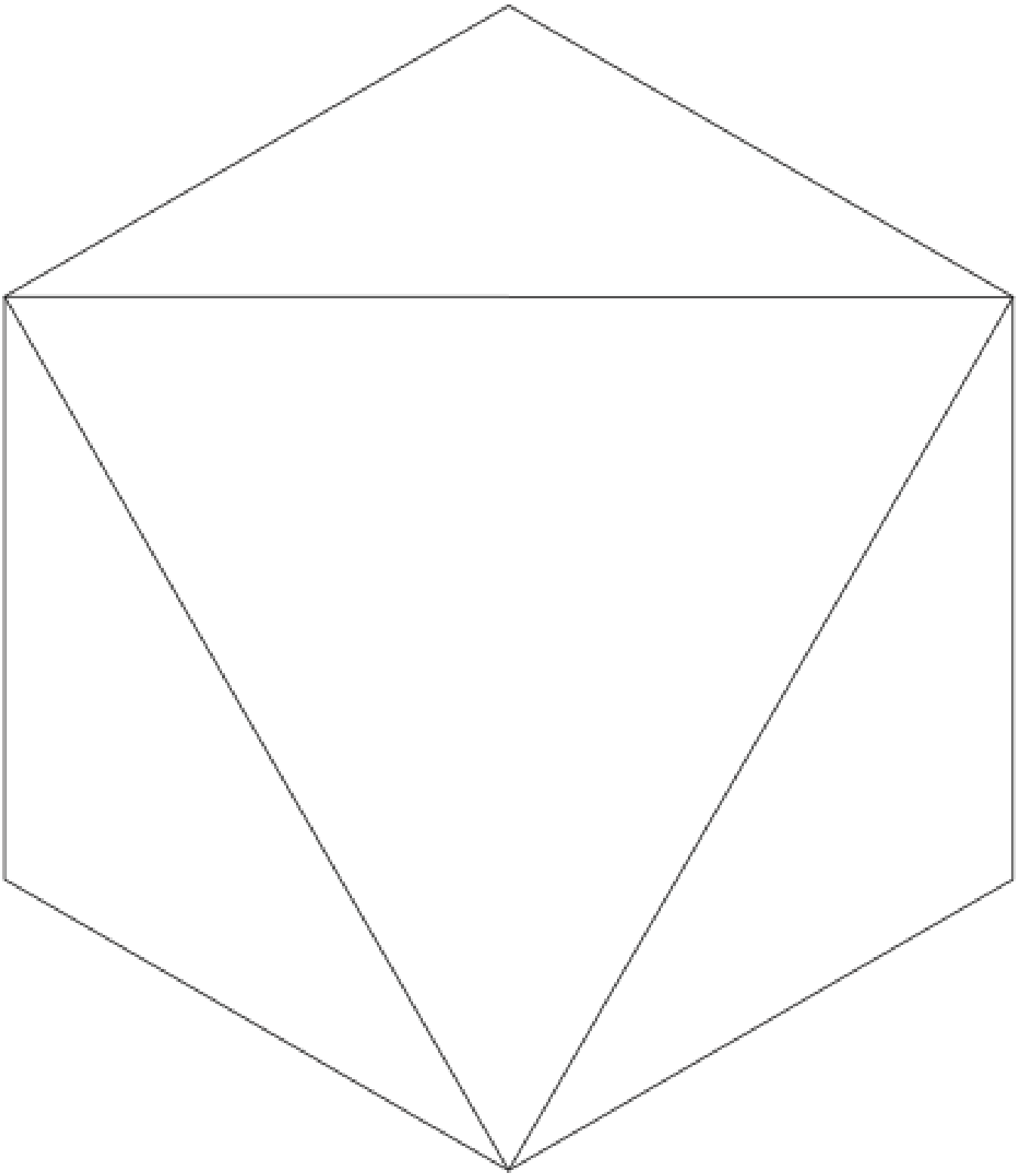
Make your own foldable fire triangle to demonstrate knowledge of the three elements of fire. Cut, fold, label and illustrate the fire triangle. Use the inside flaps to take notes and draw additional illustrations for each of the three elements. Use the template and examples provided.



The fire behavior triangle

Once a fire ignites in forestland or rangeland, the manner in which a fire reacts to local conditions is known as its behavior. The fire behavior triangle includes three elements: the amount and arrangement of fuel, the topography, and the weather conditions. A change in any one factor during the fire alters its behavior and type (whether it's a ground fire, surface fire or crown fire).

PHOTOS: Jennifer Payne



Matchstick forest experiment worksheet

Instructions: Build two matchstick forests, one control and one experimental. Decide what fire behavior question you'd like to explore. Select the parameters for the control forest. Then build the experimental forest the exact same way except for the parameter that will influence your chosen question.

Develop and discuss a hypothesis with your group on the results of ignition for both of your forests. Will the control burn faster? Will the experimental have a higher flame length?

The goal is not to severely burn both of your forests, but to use parameters that allow you to observe the differences in the one single altered parameter. So, for example, if you are testing the differences in number of matches, do not add several cups of ground fuels as well. If you are unsure, talk to your instructor.

Select an experimental question:

- How will the fire burn if more ground fuel (cedar shavings) is added?
- How will the fire burn if additional trees (matches) are added?
- How will the fire burn if I change the arrangement of trees (matches) to add or remove gaps in tree uniformity?
- How will the fire burn with wind (fan)?
- How will the fire burn with additional moisture (spray bottle application)?
- How will the fire burn if I change where ignition starts (where the lighter is applied)?
- How will the fire burn if I increase the slope?
- Come up with your own question — be sure to check with your instructor!

Matchstick forest parameters

Select parameters for the control forest. Note which parameter is altered for the experimental forest.

Parameter	Control	Experimental
Number of matches		
Quantity of cedar shavings (in ⅓-cup units)		
General arrangement of fuels (evenly spaced, clumped with gaps, or other). Describe.		
Direction of wind from fan (going upslope, going downslope, going sideslope or N/A)		
Number of times forest sprayed with water		
Location of initial ignition. (Draw spot in the space provided.)		
Slope of forest (inches pan is raised on one side)		

Hypothesis:

Matchstick forest results

Select parameters for the control forest. Note which parameter is altered for the experimental forest.

Parameter	Control	Experimental
Percentage of matches burned		
Highest flame length		
Length of time from initial ignition to last flame		

Tinker tree competition worksheet

Adapted from *FireWorks for the Sierra Nevada – Ladder Fuels and Fire Spread: The Tinker Tree Derby*

Instructions: A tinker tree is a two-dimensional model of a tree. Its trunk is a lab support stand. Its branches are rods stuck through holes in the trunk. Its leaves are strips of newspaper. Your goal is to design and build a tinker tree with a crown that does not burn when a fire burns the surface fuels beneath it. Your job could be easy — just put together a tree with no leaves. But your tree must also have foliage (leaves) to effectively photosynthesize, so the more, the better. You have to figure out how much foliage to use and how to arrange it on the tree so the tree can survive a surface fire while also being a strong, robust tree outside of fire season. Each group will build their own tree and try to have the best surviving tree.

Materials (for each group)

- A sheet pan or metal cookie tray for each group
- A support stand (metal)
- Wires cut into desired lengths
- Two sheets of newspaper or telephone book paper, enough for each sheet to cover the tray (approximately half a newspaper sheet)
- Two quarters of a newspaper sheet or telephone book paper
- As many 40 x 4 cm “leaves” as the group wishes to use. Fold in half.

Build your tree

- Place a support stand in the center of the metal tray.
- Layer the two half-pages of newspaper. Make sure that some air can get between the layers. You may lightly crumple these pages to get that effect.
- Cut or tear a line from one edge of the newspaper pieces to the middle. Then place the layers on the metal tray with the support stand sticking out from the tear.
- Crumple the quarter-page newspapers into two balls. These are shrubs. Students may select where to place the shrubs on the tray.
- Wrap wire branches on the post. You may use as many or as few branches as you want.
- Use the long, narrow strips of newspaper for foliage. Slide a foliage strip onto each tinker tree branch. For short branches, you may shorten the newspaper strip. Use the branch to poke a small hole at the outer end of the foliage strip rather than using a punched hole, so the newspaper won’t fly off the branch once you start burning.
- Use as much foliage as you like, but count the total number before burning and record it below.

- Teams will ignite their tinker trees one at the same time, especially if running the competition outdoors. This will ensure that teams will light under the same weather conditions (wind, moisture, etc.). Start the fire by igniting two corners along one long edge of the metal tray.

Rules

- Do not use any moisture on your tinker tree or experimental setup before it is burned. If you do, your tree will be disqualified.
- Allow the burn to complete before measuring results. Do not spray water on the tinker tree until after all smoke has stopped.
- Do not hang foliage so it dangles into the branches below.

Optional rules*

In addition to recording the amount of unburned foliage, record the amount of total foliage beforehand and take a percentage of total burned foliage. Any tinker trees with greater than 50% crown scorch (unburned foliage) are ineligible to win, even if the total length of unburned branches is greater. Their tree will have not survived.

Determining the winner

Count the number of unburned leaves. Unburned foliage is defined as any of the 40 x 4cm "leaves" that are still attached to the wire and are generally unburnt. Slight burns at the edges of the "leaves" are acceptable. Fill out the chart below:

Team name	Starting foliage	Ending foliage	*Percent foliage unburned

The team with the greatest amount of ending foliage is the winner!

STATION 1: Camas *Camassia* spp.

Camas is a type of lily that grows in wet meadows. It is an important food plant for many tribes from northern California to British Columbia. For some, like the Kalapuya of the Willamette Valley, it was once a main staple. People dig the bulbs in the summer, usually after the plant has flowered. The bulbs are then cooked in a pit oven. After the pit is dug, people line it with stones and build a fire in it. Once the rocks are hot, the ashes are removed. The bulbs are placed in the pit and layered with other plants like ferns. Soil is placed on top, and the bulbs are left to cook for at least one full day.

If the bulbs are not cooked long enough, the starches in them are not digestible. But when they are thoroughly cooked, they become quite sweet. Today, people often use Dutch ovens or slow cookers to achieve the desired flavor. Burning camas meadows prevented trees (Douglas-fir, ash, maple) from taking over the meadow and shading out the camas. It also cleared thatch, creating bare ground for camas seeds to germinate and grow. People also remove rocks and weeds, and use other methods to tend their camas patches.

PHOTO: Jennifer Payne

STATION 2: Huckleberries *Vaccinium* spp.

Huckleberries remain a very important food for many tribes in Oregon. There are several species of huckleberries. On the coast, the evergreen huckleberry (*V. ovatum*) is common, and some tribes in southwest Oregon and northwest California burn it periodically. The mountain huckleberry (*V. membranaceum*) grows mostly in the Cascades, but also in the Blue, Wallowa and Siskiyou Mountains.

Tribal gatherers make annual trips to collect these berries, which can be stored by drying or preserved in jam. Burning keeps gaps in the forest open so these huckleberries can thrive. Old huckleberry bushes are less productive, so burning also rejuvenates the patch. Bushes grow back from the roots.

Today, it is hard for gatherers to get public land agencies to burn, and they sometimes need to cut young trees to prevent the huckleberry patch from disappearing. This is hard work! Tribal gatherers must also contend with commercial pickers, who will take everything and sometimes damage the bushes. In a few areas, huckleberries can only be picked by Native American gatherers.

PHOTO: Jennifer Payne

STATION 3: Ponderosa pine *Pinus ponderosa*

PHOTO: Jennifer Payne

Ponderosa pine is a versatile plant: Its pitch, needles and buds are used medicinally for a variety of purposes, and its nuts and inner bark can be eaten. Pitch is also used for water-proofing baskets and boats. The roots are sometimes used to make baskets. The wood is used for heating and building.

Trees that have signs of bark harvest from before colonization still exist, and are called "culturally modified trees."

Ponderosa pine is adapted to frequent, low-intensity fire. Its thick bark protects it from the heat. Its lower branches fall off so that fire can't climb up into the high branches. The needles crowd around and protect the fragile growing bud from flames.

Ponderosa pines occur in parts of the state where tribes commonly used fire, though it's difficult to say if people used fire to tend these trees in particular. More likely, fire was used for the overall health of the forest and the many resources it provided.

STATION 4: Yarrow *Achillea millefolium*

PHOTO: Jennifer Payne

Yarrow is an example of a grassland plant that has medicinal uses. It is found everywhere in Oregon, maybe even in your backyard! Yarrow, like many wildflowers, needs a lot of light and can't grow in dense forests. Indigenous peoples' use of fire to maintain valley-bottom grasslands and mountain meadows has helped keep these special habitats healthy for species like yarrow. Yarrow is powerfully antimicrobial and its medic-inal uses include stopping bleeding and fighting colds.

Grasslands are full of diverse plants that have all sorts of uses:

- Heal-all (*Prunella vulgaris*), another medicinal plant found in grasslands and backyards.
- Goldenrod (*Solidago* spp.), used to brew a medicinal tea.
- Stinging nettle (*Urtica dioica*), used as food and to make cordage. (Watch out for the stinging hairs when picking!)
- Yampah (*Perideridia* spp.), milkweed (*Asclepias* spp.) and dogbane (*Apocynum cannabinum*), all used for cordage.

Fire is an integral part of ensuring these species remain healthy.

STATION 5: Tule *Schoenoplectus acutus*

Tule is a wetland plant. It produces stalks up to 10 feet tall in thick stands. These stalks are harvested by Native American gatherers to make cordage, mats, baskets, duck decoys and even boats! The roots are edible. Stalks die every year, and they grow into a thick mat if left alone. Burning this dead material helps recycle the nutrients and creates habitat for waterfowl, which prefer open water. Wildlife refuges continue the practice of burning tule for this reason.

Cattail *Typha latifolia*

Cattail is another useful wetland plant, and fire is used in a similar way to improve its habitat. Cattails produce the easily recognizable sausage-like spikes at the end of the flowering stalks. Cattails have many uses. Like tule, they are used to make mats, clothing and baskets. The fluff was used to stuff pillows, dress wounds and even for diapers! The roots and the spikes (actually many many seed-producing flowers) are edible.

PHOTOS: Jennifer Payne

STATION 6: Hazelnut *Corylus cornuta*

Hazelnut is used for basketry by many tribes in western Oregon, much in the same way as willow. If you are in eastern Oregon, a good alternative would be willow (see below). Burning hazel patches regularly creates a supply of stalks for basketry. If hazel isn't burned, the branches become crooked and full of knots; they can't be used to make baskets. But after a fire, the new shoots that come up from the roots are straight and supple and can be woven into a basket. Hazel bushes also produce nuts that were once widely used by tribes. Fire is also important for the nuts to stay productive. Older bushes start producing fewer hazelnuts after about 10 years.

Willow *Salix* spp.

Willow is an important basketry plant for many tribes. There are many species of willow, and some are better than others for making baskets. Basket weavers use the young, long, straight growth from a willow that has been previously burned. The bark can be used to make ropes.

PHOTOS: Jennifer Payne

STATION 7: Oregon white oak *Quercus garryana*

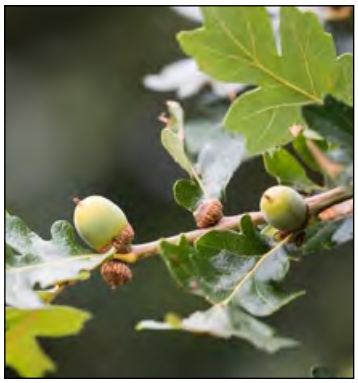


PHOTO: Jennifer Payne

Oregon white oak, also called Garry oak, is common in interior western Oregon and the Columbia Gorge, particularly the Willamette Valley.

Acorns are an important food to many tribes.

Fire is used to maintain oak groves for many reasons:

- Burning under oak trees cleans up sticks and shrubs that make it hard to harvest acorns.
- It prevents other trees, especially conifers, from growing up and shading out oak trees.
- It kills the insects that would infest the acorns and fungi and bacteria that make the trees sick.
- It spurs the growth of new sprouts, which can be used to create a variety of items.

Healthy oaks are important to many wildlife species. Many birds need oaks (including acorn woodpeckers and white-breasted nuthatch). Elk, deer and bear eat the acorns.

Many species of plants are unique to oak habitats. When using fire to keep these landscapes healthy, Native American cultural practitioners also think about these other animals and plants. In southwest Oregon, black oak (*Quercus kelloggii*) and canyon live oak (*Quercus chrysolepis*) are also common. Black oak is used by some tribes. Canyon live oak is used less often.

Name _____

Cultural plants and their relationship to fire worksheet

Instructions: Visit each of the native plant stations set up in your class individually or in groups. Each station has a card explaining the importance of the plant and how fire was used to manage it. Flip the card for the questions relevant to each plant. Record your answers on this worksheet.

1. **Fire helps keep camas meadows healthy by:**
   - ☐ Removing dead plants that prevent new seeds from germinating.
   - ☐ Fertilizing the soil with ash.
   - ☐ Killing trees that would otherwise take over the meadow.
   - ☐ All of the above.

2. **The edible part of a camas plant is:**
   - ☐ The bulb
   - ☐ The leaves
   - ☐ The seeds
   - ☐ The flowers

3. **Where do huckleberries grow best?**
   - ☐ In the desert.
   - ☐ In the mountains.
   - ☐ In wetlands.
   - ☐ Along rivers.

4. **In a few sentences, explain why you think tribes have a hard time persuading public land agencies like the U.S. Forest Service to let them burn huckleberry fields?**

5. Use these words to fill in the blanks:

often infrequent needles bark pitch low high

Ponderosa pines are adapted to _____ intensity fires. These fires burn _____, which prevents dead plant matter ("fuels") from accumulating. When fires become _____, fuels accumulate, potentially causing _____ intensity fires that could be harmful to the forest and nearby communities.

The sticky _____ of ponderosa pines is used to waterproof baskets, its sweet inner_____ is eaten, and a tea can be made from the _____ .

6. How many different uses can you think of for plants of grasslands and meadows? Consider: medicine, food, dye, basketry, cordage.

7. Before they used engines and other firefighting equipment, what do you think are some methods Native Americans might have used to prevent fires from spreading where they didn't want them?

8. True (T) or false (F)?

___ Tule grows in dry, rocky places.
___ Burning tule harms the animals that live in it.
___ Tule stalks make a great spring salad.
___ Even though it's basically a type of grass, some tribes make boats out of tule.

9. **Even though you may not get to use baskets very often, they are important items in all Native cultures in Oregon. Imagine living in a world without plastic or pottery. How many uses can you think of for baskets?**

10. **Match the parts of an oak tree to the uses by Native people. Find two uses for each part of the tree. (Some uses will apply to more than one part.)**

Acorns	Firewood
	Musical instruments
Branches	Medicine
	Dye
Bark	Weapons
	Food
Galls	Games
	Hide tanning
Sprouts	Tattoo ink
	Arrows

Cultural plants and their relationship to fire worksheet

Instructions: Visit each of the native plant stations set up in your class individually or in groups. Each station has a card explaining the importance of the plant and how fire was used to manage it. Flip the card for the questions relevant to each plant. Record your answers on this worksheet.

1. **Fire helps keep camas meadows healthy by:**
   - ☐ Removing dead plants that prevent new seeds from germinating.
   - ☐ Fertilizing the soil with ash.
   - ☐ Killing trees that would otherwise take over the meadow.
   - ☐ **All of the above.**

2. **The edible part on a camas plant is:**
   - ☐ **The bulb**
   - ☐ The leaves
   - ☐ The seeds
   - ☐ The flowers

3. **Where do huckleberries grow best?**
   - ☐ In the desert.
   - ☐ **In the mountains.**
   - ☐ In wetlands.
   - ☐ Along rivers.

4. **In a few sentences, explain why you think tribes have a hard time persuading public land agencies like the U.S. Forest Service to let them burn huckleberry fields?**

   Agencies are concerned about fires escaping and damaging timber; they prioritize other resources rather than those that are of interest to Native American gatherers; they don't utilize Indigenous knowledge; they are concerned about public opinion or political backlash.

5. Use these words to fill in the blanks:

often infrequent needles bark pitch low high

Ponderosa pines are adapted to **low-**intensity fires. These fires burn **often**, which prevents dead plant matter ("fuels") from accumulating. When fires become **infrequent**, fuels accumulate, potentially causing **high-**intensity fires that could be harmful to the forest and nearby communities.

The sticky **pitch** of ponderosa pines is used to waterproof baskets, its sweet inner **bark** is eaten, and a tea can be made from the **needles.**

6. How many different uses can you think of for plants of grasslands and meadows? Consider: medicine, food, dye, basketry, cordage.

Possible answers should explain one of the hints above.

7. Before they used engines and other firefighting equipment, what do you think are some methods Native Americans might have used to prevent fires from spreading where they didn't want them?

Possible answers: using rivers, lakes, and rocky areas to stop fires; using previously burned areas to stop a new fire; burning dry areas surrounded by moist areas (for example, grass in sunny meadows is often dry when the shady forest is too moist to burn, or fall leaves dry out under oaks when the grass is green and won't burn).

8. True (T) or false (F)?

F Tule grows in dry, rocky places.

F Burning tule harms the animals that live in it.

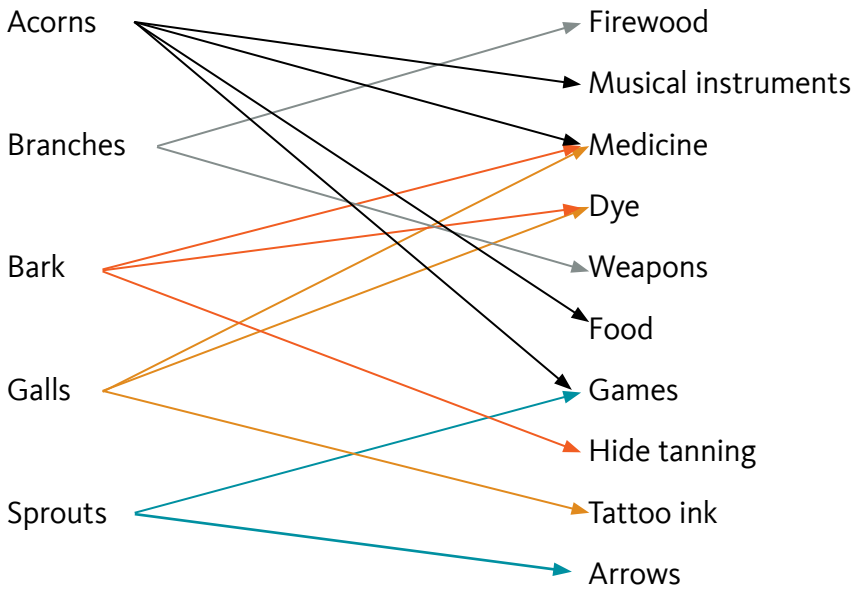
F Tule stalks make a great spring salad.

T Even though it's basically a type of grass, some tribes make boats out of tule.

9. Even though you may not get to use baskets very often, they are important items in all Native cultures in Oregon. Imagine living in a world without plastic or pottery. How many uses can you think of for baskets?

Possible answers: to store food such as acorns and seeds; to carry heavy items such as wood for fires; to cook (fire-heated rocks can be placed in water or soup to bring it to a boil); for serving food; for carrying water.

10. Match the parts of an oak tree to the uses by Native people. Find two uses for each part of the tree. (Some uses will apply to more than one part.)



4. WILDLAND FIREFIGHTING AND NATURAL RESOURCE CAREER PATHWAYS

This module will expose students to the skills needed for a career in fighting wildfire and pathways to the career. Students will also be exposed to job opportunities and career pathways in natural resources.

Time considerations

Preparation

2+ hours, including travel time

Procedure

Seven 50-minute in-class sessions:

- **A.** Wildfire fighting: Roles and tools (two class sessions)
- **B.** Parts of a fire and situational awareness (one class session)
- **C.** The Incident Command System (one class session)
- **D.** Career paths for firefighters and wildfire-related natural resource management (two class sessions)

1 full-day field trip

Learning objectives

Students will be able to:

1. Understand wildland firefighting safety and situational awareness.
2. Identify the tools of firefighting.
3. Understand the Incident Command System.

4. Understand physical and mental requirements of wildland firefighting positions.
5. Connect with employment opportunities.

Behavioral objectives

Students have completed:

1. Exploration of careers that help to protect the community.
2. Increased awareness of community vulnerability.

Standards connections

Oregon Science Standards

Performance Expectations

- HS.ESS3.3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations and biodiversity. [Activities A, B, C, D and field trip]

Disciplinary Core Ideas

- ESS3.C: Human Impacts on Earth Systems. The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. [Activities A, B, C, D and field trip]
- ETS1.B: Developing Possible Solutions. When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. [Activities B, C and field trip]

Science and Engineering Practices

- 3. Planning and Carrying Out Investigations. Select appropriate tools to collect, record, analyze and evaluate data. [Activities A, B, C and field trip]
- 6. Constructing Explanations and Designing Solutions. Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [Activities A, B, C and field trip]

Oregon English Language Arts Standards

- 9-10.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activities A, B, C, D and field trip]
- 11-12.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 11–12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activities A, B, C, D and field trip]
- 9-10.W.4. Produce clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience. [Activity D]
- 11-12.W.4. Produce clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience. [Activity D]

Oregon CTE Knowledge and Skills Statements

- KSS.C: Supervise the protection of natural resource environments and woodlands. [Activities A, B, C and field trip]
- KSS.H: Describe ecological concepts and principles; investigate and explain the relationships between these principles and natural resource environment development. [Activities B, D and field trip]

- KSS.L: Acquire the specific academic knowledge and skills necessary to pursue a full range of career and post-secondary opportunities within natural resources management. [Activities A, B, C, D and field trip]
- KSS.M: Use oral and written communication skills in creating, expressing and interpreting natural resource management information and ideas including technical terminology. [Activities A, B, C and field trip]
- KSS.O: Know and understand the importance of employability skills for careers in natural resources. [Activity D and field trip]

Classroom activities

A. Wildfire fighting: Roles and tools

Materials

- How do firefighters combat and control wildfires? https://thekidshouldseethis.com/post/how-do-firefighters-combat-wildfires
- Relative humidity and dew point table, https://www.frames.gov/documents/nwcg/fbfrg/us_2012_temp-rh-dewpoint-lookup-tables_fbfc.pdf
- Fire effects monitoring worksheet
- Ask to borrow the following tools from your guest instructor or your local OSU Extension or ODF office: a pulaski, a McLoed, a shovel, a combination tool, an empty drip torch, a fusee, a typical firefighter's pack that includes the emergency shelter; two–three belt weather kits, a compass, a Kestrel Meter or other portable anemometer, a copy of the Incident Response Pocket Guide or the relative humidity and dew point table.

Background information

Wildland firefighters do not fight fires in the same way your local fire department might try to extinguish structural fire. Wildland fire often takes place miles from communities,.The description of a wildland firefighter's job is more accurately described as the attempt to control how and where a fire burns, rather than the extinguishing of fires on what could be thousands of acres.

Whether in wilderness areas or right next door to homes, wildland firefighting requires many boots on the ground and a high level of coordination to keep everyone safe while using resources effectively. The *Incident Command System* is the mechanism through which this coordination happens.

The backbone of any wildfire fighting operation is the foundational job position, *Fire Fighter Type 2*, or FFT2. This position also marks the start of any wildfire-fighting career. FFT2s make up hand crews, engine crews and *Helitak* crews. FFT2s do most of the physical work required in wildfire suppression. This might include using *pulaskis*, shovels, and *Mcleods* to dig vegetation-free lines around the perimeter of a fire, reducing the chance that the fire will spread beyond the line. FFT2s may also use chain saws to remove vegetation in these fire-free lines. They use drip torches and *fusees* to *backburn*, burning off fuels in a controlled way to remove possible fuels for wildfire. In limited situations, they will use portable pumps and hoses on engines to create wet-line, further reducing the chance the fire will spread beyond the line.

Fallers, also known informally as sawyers, are specialist firefighters with significant training in the use of chain saws to fell large or burning trees. Trees may be felled to remove fuels that might enable a fire to spread, or to take down a burning tree before fire can spread. More likely, fallers are called in to take down hazard trees, including trees near an area of attack, like a fire line, that pose a risk to the firefighters if it were to fall. Fallers go through extensive training to ensure their safety and the safety of others.

Crew bosses determine fire-line tactics that firefighters on the ground will use. It is their responsibility to ensure all crews have adequate equipment and supplies. They verify crew qualifications and supervise slopovers, *spot fires* and *mop-up*. Crew bosses have a high level of responsibility.

Crew bosses need on-the-ground information to avoid putting firefighters who are active in operations into dangerous situations, and to help decision-makers in logistics roles determine the best strategies. *Fire Effects Monitors* (known as FEMO) fulfill this role and take real-time, on-the-ground data on wind speed and direction, humidity levels, cloud cover, weather, and other relevant information to the wildfire site. Humidity is measured using a comparison between a dry-bulb temperature and a wet-bulb temperature. Winds are determined using a Beaufort scale, and weather is assessed with scales such as a drought index and a lightning activity level.

All the different roles on a wildfire — FFT2, fallers, crew bosses and FEMOs — are also found on controlled burns, also called prescribed fires. Many firefighters take part in controlled burns when they are actively fighting fires. As mentioned in the *How Do Firefighters Combat and Control Wildfires?* video, fire is an important part of keeping many ecosystems healthy and reducing the intensity of future wildfires. During prescribed fire, firefighters use all the same tools and many of the same tactics, such as clearing fuels to create fire breaks and using drip torches to methodically burn an area, using knowledge of how slope and wind affect fire to keep the burn under control.

Key vocabulary

Incident Command System	fuse	spot fires
Fire Fighter Type 2	backburn	mop-up
Helitak crew	faller	Fire Effects Monitor
Pulaski	crew boss	
McLeod	Slop over	

Preparation

1. Prepare the *How Do Firefighters Combat and Control Wildfires?* video for the in-class session.
2. Identify an appropriate guest speaker who can speak on the topics and key words identified in the Background section. Seek a Speaker who has fought wildfires from either a local fire district, the Oregon Department of Forestry, the U.S. Forest Service or the Bureau of Land Management.

3. Work with the speaker to secure one of each of the firefighting tools such as a pulaski, a McLeod, a shovel, a combination tool, an empty drip torch, a fusee and a typical firefighter's pack that includes the emergency shelter.
4. Work with the speaker to ensure that each group of two to three students has a secure enough Belt Weather Kit, a compass, a Kestrel Meter or another portable anemometer, a copy of the Incident Response Pocket Guide or the relative humidity and dew point table, and a fire effects monitoring worksheet.
5. If there are not enough belt weather Kits, prepare or have students prepare do-it-yourself dry-bulb/wet-bulb thermometers.
    a. You will need: Two alcohol-based thermometers, two small pieces of cotton cloth, a small rubber band, clear packing tape, a piece of sturdy cardboard approximately 6 inches long by 3 inches wide and a length of sturdy string approximately 6 inches long.

       First, punch a hole near the short side of the cardboard and thread the string through it, tying it into a loop. Be careful not to put the hole so close to the edge of the cardboard that it tears.

       Arranging the cardboard so that the string and hole are on top, use the packing tape and affix one of the thermometers down the length of the cardboard on the left side so that the bulb (the exclusively red portion of the thermometer) is clear of the cardboard. Most of the thermometer should be affixed to the cardboard to ensure the thermometer does not fly off during use.

       Next, layer the two pieces of cloth and put them on the bulb of the second thermometer so that the red bulb of the thermometer is completely hidden. It is OK for the cloth to cover more than the bulb, so long as an accurate measurement can still be read. Use the rubber band to hold the cloth in place. This will be the wick of your Wet bulb. Using the packing tape, affix the Wet bulb to the right side of the cardboard so that the cloth is not touching the cardboard or the other thermometer.

       With this DIY wry bulb/wet bulb set of thermometers, you can proceed with the activity using the same steps as with a belt weather kit. If there are not enough belt weather kits, prepare or have students prepare do-it-yourself dry bulb/wet bulb thermometers.
6. Select areas on school grounds or at a nearby location where students can take weather measurements utilizing the fire effects monitoring worksheet. Ideally, the teacher will select several proximate locations with different factors such as an area in the sun, an area in the shade, an area on a north slope or an area on the south slope, or an area near a water body or water course.

Procedure

1. Discuss key terms.
2. How do firefighters combat and control wildfires?
3. Guest speaker: Wildfire fighting roles and tools

4. In-class activity: First look at wildland firefighting tools. Guest speaker will instruct students on the role of each tool and piece of equipment. Students will be able to touch the tools, feel how heavy they are and ask questions about tool function. Speaker can also address how these tools are used in the context of controlled burns.
5. Outdoor activity: Fire effects monitoring
    a. Take the class out to the preselected fire effects monitoring locations. With guidance and instruction from the guest speaker, have them collect fire effects monitoring data. Use the fire effects monitoring worksheet to have students record data on 1) aspect, 2) elevation, 3) time of recording, 4) exposure (shade or sun) 5) dry bulb temperature, 6) wet bulb temperature, 7) relative humidity, 8) wind speed and 9) wind direction.

       Students will use the compass to determine the aspect of the slope they are on. Elevation will need to be provided by a GPS or teacher source.

       To determine the dry bulb and wet bulb temperatures, have the students submerge the wet bulb thermometer in distilled water to ensure the wick is saturated but not dripping. Be sure students do not touch the wick or the dry bulb. Facing into the wind, have students record the dry bulb thermometer temperature after holding it away from the body for approximately two minutes. Then, swing the thermometers like a plane propeller, checking the wet bulb temperature every 30 to 60 seconds. Have students record the wet bulb thermometer temperature when it reaches its lowest point. This will usually take two to three minutes but could take more. Be careful to not let the wick dry out or the data will have to be retaken. Relative humidity can be determined by selecting the correct relative humidity and dew point chart based on elevation and contrasting the dry and wet bulb temperatures.

       Use the compass to determine wind direction. Have students use the Kestrel Meter to get the wind speed by facing into the wind and keeping the propeller perpendicular to the oncoming wind. If you do not have a Kestrel Meter, use a portable anemometer, which is included in a belt weather kit.

       After all the data has been recorded, regroup and ask students to report their findings. Students can complete the essay portion of the fire effects monitoring worksheet or alternatively a discussion on how fire behavior might be different at each of the monitoring locations.

Assessment

1. Firefighting tools assessment — After asking questions about the function of each tool, students create a rough sketch of each tool, label it and describe its function in one sentence.
2. Fire effects monitoring worksheet. Students discuss how different conditions affect fire behavior and relate their answers to the fire behavior triangle that they learned about in module 3. Consider discussing wind speed and humidity's impact on fire spread and severity.

B. Parts of a fire and situational awareness

Materials

- *Wildland Fire Safety Training Annual Refresher: Situational Awareness*, https://www.youtube.com/watch?v=Z0xJUEH5CmU
- 10 Standard Firefighting Orders, https://www.nwcg.gov/publications/pms110
- National Interagency Fire Center photos, https://www.flickr.com/photos/nifc/

Background information

The most important part of wildland firefighting is firefighter safety, and the foundation of safety is *situational awareness*. Situational awareness is the cycle of updating your awareness of the situation and surroundings through direct observation (sight, sound, smell, etc.), communicating those observations effectively (orally or in writing) and then being able to make predictions based on observations (make decisions, take action). During a wildfire fighting operation, it helps to update your perception of on-the-ground conditions and assess probability of risk in the near future. As understanding of the situation and surroundings changes through new information, a wildland firefighter can change their perception of the danger, which helps to inform them of a plan of attack.

Situational awareness is not about simply paying attention. It's about knowing what to pay attention to and being able to make predictions based on observations. Through experience, wildland firefighters become better at filtering out distractions and unimportant information and knowing what to focus on.

There are many *barriers to achieving situational awareness*. A *low level of experience* with local conditions often occurs when the wildland firefighter is new to the profession or landscape. *Distraction* from primary task is a common problem when focus is drawn away from relevant conditions and observations to other focuses, such as interpersonal conflicts, mitigating errors or incidents within incidents, such as injuries that require medical attention at the site of a wildfire. *Fatigue* impacts the ability to make observations, communicate findings and make decisions through conditions like over-tiredness, dehydration, heat stress and other factors. *Stress reactions* can include rushed decision-making, worsening communication skills and ignoring important observations outside of the immediate task. Finally, *hazardous attitudes*, such as a sense of invulnerability, complacency or resignation, can negatively impact situational awareness, which puts crew members in danger. It is important to regularly update observations and communicate them when appropriate to avoid these pitfalls.

Understanding the parts of a wildfire and where firefighters are engaged with the fire are essential pieces of information for both those on the ground and those making decisions within Incident Command, from the *ignition point* and beyond. Firefighting tactics may differ at the *head*, *flank* or at the *back of the fire*. Situational awareness is essential for avoiding becoming trapped in a dangerous *pocket* of the fire or a quick running *finger*. And a firefighter always wants to be aware of where the already-burned-over *black* is located, as a potential refuge if conditions in the still flammable *green* become dire. This will help a firefighter to identify *safety zones* and *escape routes*.

Situational awareness is also important during controlled burns, for all the same reasons it is important on wildfires. Firefighters need to be aware of changes in fire behavior and weather, while identifying and calling out hazards such as falling trees or loose rocks. Even though these burns are controlled and intentional, it takes constant attention and good communication to address any potential risks and keep the burn safe.

Key vocabulary

- Situational awareness
- Barriers to situational awareness
  - Low level of experience
  - Distraction
  - Fatigue
  - Stress reactions
  - Hazardous attitudes
- Ignition point
- Head of a fire
- Flank of a fire
- Back of a fire
- Finger (wildfire)
- Pocket (wildfire)
- Black (wildfire)
- Green (wildfire)
- Safety zone
- Escape route

Preparation

1. Prepare the *Wildland Fire Safety Training Annual Refresher: Situational Awareness* video for the in-class session.
2. Identify an appropriate guest who can speak on the topics and key words identified in the background. Ideal candidates include speakers who have fought wildfires, from either a local fire district, the Oregon Department of Forestry, the U.S. Forest Service or the Bureau of Land Management.
3. Download or print out *10 Standard Firefighting Orders*.
4. Work with the guest speaker to select and download or print out a number of photos showing a variety of wildland firefighting scenes with varying scenarios. Some examples might be a crew building a fire line, a wildfire running uphill, a wildfire producing windblown smoke, a wildland fire running into dense fuels or a wildfire in an area of hazardous conditions such as powerlines. Photos are available at National Interagency Fire Center photos, or the guest speaker may have photos to use.

Procedure

1. Discuss key terms.
2. Guest speaker: parts of a fire and situational awareness.
3. *Wildland Fire Safety Training Annual Refresher: Situational Awareness*

4. Review and discuss how the *10 Standard Firefighting Orders* improve situational awareness.
5. Situational awareness: Wildland fire photos. Split students into teams and ask them to write down their observations for each photo (5–10 minutes per photo). Review each group's observations with the guest speaker. Some factors they should consider:
    a. **Weather and flame direction:** Is the fire burning intensely, and can students make out any indication of wind? Where do students think it is likely the fire will spread? What time of year does it appear to be? Are the fuels likely to be more available (dry, heated) or less available (wet)?
    b. **Landscape and terrain:** What is the topography of the area? Are there slopes a fire is likely to make a run up on? Are there natural hazards, like dead trees that can fall and thickets of dense brush, or man-made hazards like telephone poles and slash piles? Have you identified safety zones and escape routes?
    c. **Personnel:** Are the firefighters in the picture practicing safe distance? Are they holding their tools properly so as to use them easily while protecting co-workers? Are they wearing proper protective personal equipment?

Assessment

Situational awareness: After working in groups, students shift to working individually. Give students photo slides of wildland firefighting scenes and a list of key terms that they can use in their responses to describe fire parts and situational awareness factors. Students explain the clues they used to reach conclusions (such as fuel availability and flame direction).

C. The Incident Command System

Materials

Wildland firefighting scenarios

Background information

The Incident Command System is a system flexible enough to manage any size wildfire while providing clear roles, responsibilities and pathways for communication up and down the *chain of command*. It is a method of organization drawing from the military, and it is used for many emergency response incidents like wildfires and tornadoes.

There are five parts to the Incident Command System: *Command*, *operations*, *planning*, *logistics* and *finance and administration*.

Command is responsible for the overall management of the incident. These are the people who set objectives and strategy for the suppression or management of the fire. When a wildfire is large enough to encompass multiple jurisdictions or public lands, the people within command organize and coordinate between the various agencies tasked with firefighting.

Operations is the part of the Incident Command System that is on the ground, or sometimes in the air, getting the work done. This includes Firefighter Type 2, fallers and crew bosses, all the way up to the *operations section chief*.

Planning provides the essential functions of monitoring the status of resources, both human and equipment, tracking the situation on the ground, documenting incidents and developing a demobilization plan at the end of suppression activities.

Logistics plays a major support role. They allocate resources as required on an incident and are responsible for equipment maintenance and refueling, and food and water for personnel. Logistics is responsible for medical aid. In the event of an *incident within an incident* they are responsible for providing medical aid and implementing emergency procedures. During a large wildfire where it is necessary to bring in and house hundreds or thousands of people for the suppression effort, logistics is responsible for organizing and coordinating the camp where people stay.

Finance and administration are especially important during a large-scale wildfire. They are responsible for ensuring personnel time is recorded and compensated. They handle contracts with outside vendors and resources and claims for injuries and property damage. They ensure all the bills are paid.

Key vocabulary

Chain of command	Resources
Command	Logistics
Operations	Incident within an incident
Operations section chief	Finance and administration
Planning	

Preparation

1. Identify an appropriate guest who can speak on the topics and key words identified in the background. Ideal speakers are those from a local fire district or the Oregon Department of Forestry with experience as an Incident Commander Type 3/ICT3 (preferred) or at least an Incident Commander Type 4/ICT4 (minimum). A federal firefighter from the U.S. Forest Service or Bureau of Land Management with equivalent qualifications may work for your area. However, keep in mind that they may have different position descriptions. The guest speaker should have managed wildfire-fighting crews as a crew boss or other type of single resource boss, as well as been involved in wildfire attack decision-making.
2. Review the wildland firefighting scenarios and select one or all to be used in class. Each scenario presents a number of decision points where students can choose between two or more possible solutions to a given problem. Each possible solution is linked to a slide that reveals the impact of that decision. Familiarize yourself with how to use the slide decks by clicking on a possible solution on the slide, rather than advancing the slides normally.

   Work with the guest speaker to familiarize them with the scenarios and plan for who will implement the exercise. The guest speaker should be prepared to answer questions and further explain scenario results.

Procedure

1. Discuss key terms.
2. Guest speaker: The Incident Command System
3. Wildland firefighting scenarios: Run scenarios in small groups or with the full class. Begin each scenario on slide one and advance to the first decision, explaining the scenario. Give students two to five minutes, depending on the decision, to discuss it among themselves. Next, take a vote among students to determine the choice of possible solutions.

   If the students are correct, advance the slide to the next decision and repeat. If the students are unsuccessful, return to the prior decision slide. If there are multiple remaining options, have them vote again. If not, select the correct solution and discuss with students why that solution was correct. These scenarios are designed to get students thinking about decisions to be made in the field and to emphasize the need for situational awareness. They are not a test of knowledge.

   When introducing this scenario exercise to the students, and throughout, remind students that it is OK to make mistakes. That is how we learn and grow. Reinforce that there is no judgment in getting it "wrong" in class, and remind students not to judge each other either or themselves. If you plan to cover all wildland firefighting scenarios, consider conducting this exercise in a separate class period from the guest speaker presentation on the Incident Command System. Due to the content of this activity, it could be difficult or uncomfortable for some students. Refer to Module 1 and Module 5 to implement appropriate trauma-informed tools and strategies to support students' mental and emotional health.

Assessment

- Students work in groups to create their own wildland firefighting scenario, using either paper, cardstock or computers. Each group presents to the class, and the other class members participate in the scenario.
- Students work individually to describe the Incident Command System in two to four sentences.

D. Career paths for firefighters and physical requirements

Materials

- *Wildland Fire Safety Training Annual Refresher : Situational Awareness*, https://www.youtube.com/watch?v=Z0xJUEH5CmU
- *10 Standard Firefighting Orders*, https://www.nwcg.gov/publications/pms110
- National Interagency Fire Center photos, https://www.flickr.com/photos/nifc/

Background information

As we have seen, there are a lot of options for wildland firefighting and related forestry careers, as well as a variety of companies, agencies and organizations where students could find themselves working in the future. This panel discussion will expose students to careers in wildland firefighting, fuel reduction, forestry, emergency response and others.

Preparation

1. Identify four to five wildfire and forestry professionals. Consider including a representative from the Oregon Department of Forestry and a representative from each public land management agency engaged in wildfire suppression in the area. This may include the U.S. Forest Service and the Bureau of Land Management. Additional panelists may come from a local fire district, a local wildland firefighting contracting firm or a timber company with wildland firefighting personnel, depending on your area. Panelists will be given 10 minutes to talk about their career path and career paths available at their organization. Panelists should be willing to look over student-generated resumés and provide comments.
2. Have students prepare questions in advance for panelists.
3. Optional: Provide instruction on resumé writing. Share examples of wildland firefighting and natural resource professionals' resumés. Assign students to write their resumé or give them class time to do so.

Procedure

1. In-class panel on career options. Each panelist should cover: An introduction of the mission or purpose of the agency, organization or company the panelist represents; the duties associated with various positions; the educational and physical qualifications of a potential hire; the potential for career advancement in the future; and any currently open entry-level or internship opportunities. Finally, panelists should discuss how an interested student might apply for a position. Encourage students to ask questions.
2. Break students into groups and have them pose their questions for each panelist, as the panelists rotate through the groups. Students take notes and record panelists' responses.
3. Optional activity: Resumé writing.
    a. Students will select a panelist to review their resumé. Encourage students to select the panelist representing the position that most appeals to them, although it is not required for a student to be actively interested in a career in wildfire or forestry.
    b. The panelist will spend five to 10 minutes discussing the resume with the student. Panelists will present recommendations on how to write a strong resumé, including recommendations on appropriate educational and professional experiences that will help make the student competitive in the field. If any summer positions or internships exist in the panelist's organization, they will discuss those with the student and help them to craft their resumé for that position.
    c. After consultation, students will spend the next class updating their resumés. Consider having students send their revised resumés to the panelists they had worked with in the prior class.

Assessment

Resumes: Students first draft mock resumes, including an objective, education and work background, and a list of transferable skills they possess that are relevant to their career objective. In the education section, students include the current course and any other training they have researched

that is critical for their job position of choice. They should include volunteer work ideas in the work experience section. Use a technical writing grading rubric to assess formatting, content, spelling and grammar.

Field content

Full-day field trip: wildland firefighting

Preparation

1. Connect with your local fire district or the Oregon Department of Forestry for the morning site visit tour. The morning session should be at a station where wildland firefighters are dispatched, and the site host should be willing to let students tour the facilities and explain the function of equipment and employees during a wildfire scenario.
2. Connect with your local fire district or the Oregon Department of Forestry for the afternoon training session. Site requirements for the afternoon session include a space where firefighting training is normally conducted, such as a field or lot. The second half of the training may take place at the same site as the morning session.
3. Confirm with the training site host the availability of training equipment such as practice emergency shelters, pack-test vests, Pulaskis, shovels, McLeods, combination tools and hose. If the site does not have the necessary equipment, connect with other fire districts or ODF field stations to inquire. Your local OSU Extension office may also have some tools on hand.
4. Confirm at least one guest instructor at the training site, depending on the facilities and personnel available. The trainer should be a crew boss or someone higher in the hierarchy who is familiar with training protocols for new recruits, and who can instruct students on basics of wildland firefighting and safety protocols for the second half of the day. Confirm at least one adult chaperone for each group of five to seven students for the training portion of the day.

Procedure

1. For the morning session, students will visit the site's dispatch and speak with wildland firefighters and responders on their process when an incident is reported. The site host should speak to students about local jurisdiction. The site host should have maps on hand to demonstrate protection areas. The site host should also talk about their experiences in a recent wildfire and use a map to discuss the attack.
2. The site host should discuss some of the entry-level positions and the long-term career options that exist at the site. Students will also have the opportunity to see some of the heavier equipment used in wildland firefighting such as engines, dozers and anything else the station has available. The site host should be able to speak to the experience required to operate such equipment. Be sure to provide time for students to ask questions.
3. The site visit portion should take about 2+ hours including travel. Make arrangements for students to have lunch after the site visit, before the training.

4. Students will start the afternoon training session with a review of class material, in particular, situational awareness and Firefighter Type 2 duties. Students will learn the requirements to pass the pack test. Students will not complete the 45-minute pack-test, but they may be asked to try the pack on and walk with it for a brief period.
5. Next, students will learn the process of deploying and using an emergency shelter, using practice emergency shelters. Students will be tested on their ability to deploy the shelter in a short enough time to qualify to be a wildland firefighter.
6. Finally, students will get a chance to use the tools of an FFT2. This includes digging line to stop the progression of fire. The trainer should include explanations on how to hold the tool when not in use, spacing between firefighters and communication between firefighters while working. Students will also learn how to lay out hose from an engine and the communication needed for that process. The trainer can also explain how these tools and tactics are used on controlled burns. They might even be able to show the students an area nearby that has received a controlled burn.

Students practice with hose. CREDIT: Jennifer Payne

Wildland firefighting training includes practice with hose. CREDIT: Jennifer Payne

Assessment

Prior to the field trip, students formulate three to five questions to pose to either fire district dispatcher or trainer presenters. Questions address dispatch procedures, equipment use, strategies for success in wildland fighting situations, career path options, etc. If there is time during the field trip, provide students with an opportunity to record the answers to the questions asked by themselves and others. If there is not time, students complete their question/answer sheet upon returning to the classroom.

Module assessment, evaluation and feedback:

Students respond to the following:

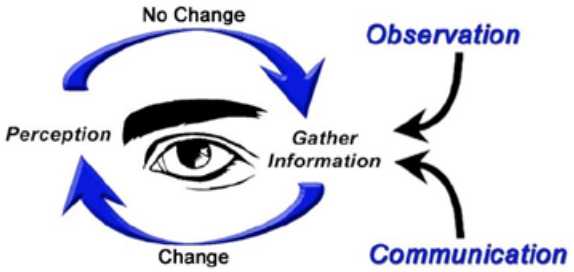
1. What part of this module did you find most interesting or helpful?
2. What else would you like to learn about wildland firefighting or natural resource management careers?
3. Are you considering a career in wildland firefighting and/or natural resource management? if yes, which aspects of the work most interest you?

Situational awareness

Essential as a wildland firefighter

What is situational awareness?

https://www.youtube.com/watch?v=ubNF9QNEQLA



Considerations important to situational awareness

- What are the current conditions of the wildfire that impact wildfire behavior?
- What are natural and human-made hazards that could change wildfire behavior?
- Do I have a good escape route if the situation becomes unsafe?
- What are my fellow firefighters doing?
- What resources are on hand at this site?
- Am I able to communicate with my crew and crew boss?
- What is the plan if I am no longer able to communicate with my crew and crew boss?

Barriers to situational awareness

1. **Tunneled senses:** Narrowing attention to one geographic area of an incident scene.
2. **Task fixation:** Narrowing attention to one task being performed at an incident scene.
3. **Command location:** The person in charge being hands-on or physically too close to the action to see the big picture.
4. **Inexperience:** Personnel lacking the training or experience to understand clues to an impending flashover or unforeseen circumstance?

Barriers to situational awareness

5. **Complacency:** Lowering of vigilance on the assumption the situation is routine and predictable.
6. **Bravado**: Blatantly ignoring the signs of danger and commencing with high-risk activities in spite of the presence of information indicating the situation has escalated beyond control.
7. **Unrealistic expectations**: Believing personnel are able to accomplish tasks faster and more efficiently than is realistic. Failing to give consideration to quantity and quality of the crews involved in the emergency. Not all crews are created equal!

What can we spot in this photo?
(Use situational awareness)

Even intentional burns require situational awareness

Temperature, relative humidity and dew point tables

Elevations between 0 and 500 feet (In Alaska, between 0 and 300 feet)

Dry Bulb Temperatures 41 to 60 F (Read Across)

Wet Bulb Temperatures 28 to 59 F (Read Down)

Wet Bulb Temperatures 23 to 40 F

DP / RH

Dry Bulb Temperatures	28	29	30	31	32	33	34	35	36	37	38	39	40	Dry Bulb Temperatures
41	-36 3	-12 10	-1 17	7 24	13 32	18 39	22 44	25 53	29 61	31 68	34 74	37 84	39 92	41
42	-23 5	-7 12	3 19	10 26	15 33	20 40	23 47	27 54	30 62	33 69	35 77	38 84	40 92	42
43	-49 1	-15 8	-2 14	4 21	12 28	17 35	21 41	25 48	28 55	31 62	34 70	36 77	39 85	41 92	43
44	-29 4	-9 10	2 17	9 23	14 29	19 36	23 43	26 49	29 54	32 63	35 70	37 78	40 85	42 92	44
45	-18 6	-4 12	5 19	11 25	16 31	21 37	24 44	28 51	31 57	34 64	36 71	39 78	41 85	43 93	45
46	-33 2	-11 8	0 14	7 20	13 26	18 32	22 39	26 45	29 52	32 58	35 65	37 72	40 79	42 86	44 91	46
47	-22 5	-6 10	3 16	10 22	16 28	20 34	24 40	27 46	31 53	33 59	36 64	38 72	41 79	43 86	45 93	47
48	-45 1	-14 7	-2 12	6 18	13 24	18 29	22 35	26 41	29 47	32 54	35 60	37 64	40 71	42 79	44 84	46 93	48
49	-27 3	-8 9	2 14	9 20	15 25	20 31	24 37	27 42	30 48	33 54	36 61	39 67	41 73	43 80	45 86	47 93	49
50	-17 5	-3 10	5 14	12 21	17 27	21 32	25 38	29 44	32 49	35 55	37 61	40 68	42 74	44 80	46 87	48 93	50
51	-33 2	-11 7	1 12	8 17	14 23	19 28	23 34	27 39	30 45	33 52	34 56	39 62	41 68	43 74	45 81	47 87	49 93	51
52	-21 4	-5 9	4 14	11 19	17 24	21 29	25 35	29 40	32 44	35 51	37 57	40 63	42 69	44 75	46 81	48 87	50 94	52
53	-42 1	-13 6	-1 11	8 16	14 21	19 26	23 31	27 34	30 41	33 47	36 51	39 58	41 64	43 69	45 75	47 81	49 87	51 94	53
54	-25 3	-7 8	3 12	11 17	16 22	21 27	25 32	28 37	32 42	35 48	37 53	40 59	42 64	44 70	47 76	49 82	50 88	52 94	54
55	-15 5	-2 9	7 14	13 19	18 24	23 28	27 34	30 38	33 41	36 49	39 54	41 59	43 65	46 70	48 76	50 82	51 88	53 94	55
56	-29 2	-8 7	3 11	10 16	16 20	21 25	26 30	29 35	32 39	35 44	37 50	40 55	42 60	45 65	47 71	49 77	51 82	53 89	54 94	56
57	-17 4	-3 8	6 13	13 17	18 22	23 27	27 31	30 36	33 41	36 45	39 50	41 56	44 61	46 66	48 71	50 77	52 83	54 88	55 94	57
58	-33 2	-10 6	2 10	10 14	14 19	21 23	25 28	28 32	32 37	35 42	38 46	40 51	43 56	45 61	47 67	49 72	51 77	53 83	55 88	56 94	58
59	-19 3	-4 7	6 12	13 16	18 21	23 24	27 29	30 33	33 38	36 43	39 47	41 52	44 57	46 62	48 67	50 72	52 78	54 83	56 89	57 94	59
60	-38 1	-11 5	1 9	9 13	15 17	20 21	25 26	29 30	32 34	35 39	38 44	40 48	43 53	45 58	47 63	49 68	51 73	53 78	55 85	57 89	58 94

Dry Bulb Temperatures	23	24	25	26	27	28	29	30	Dry Bulb Temperatures
31	-8 18	1 27	8 37	13 47	18 57	22 68	25 78	28 89	31
32	-16 11	-4 20	4 30	10 39	15 49	19 59	23 69	26 79	29 89	32
33	-31 5	-12 14	-1 23	4 32	12 41	17 51	21 60	24 70	28 80	30 90	33
34	-22 8	-7 16	2 25	9 34	14 43	18 52	22 62	26 71	29 81	32 90	34
35	-47 2	-16 10	-4 19	5 27	11 36	16 45	20 54	24 63	27 72	30 81	33 91	35
36	-30 5	-11 13	0 21	7 29	13 38	18 47	22 55	25 64	28 73	31 82	34 91	36
37	-21 7	-4 15	3 23	9 31	15 40	19 48	23 57	26 65	29 74	32 82	35 91	37
38	-42 2	-14 10	-2 18	4 25	12 33	17 42	21 50	25 58	28 66	31 74	33 83	36 91	38
39	-27 5	-9 12	1 20	8 28	14 35	19 43	22 51	26 59	29 67	32 75	34 83	37 92	39
40	-18 7	-4 15	4 22	11 30	16 37	20 45	24 52	27 60	30 68	33 76	35 84	38 92	40

Temperature, relative humidity and dew point tables

Elevations between 0 and 500 feet (In Alaska, between 0 and 300 ft)

Wet Bulb Temperatures
40 to 79 F
(Read Down)

Dry Bulb Temperatures
61 to 80 F
(Read Across)

DP / RH

Dry Bulb	40	41	42	43	44	45	46	46	48	49	50	51	52	53	54	55	56	57	58	59	60	Dry Bulb
61	-21	-4	5	12	18	23	27	30	34	36	39	42	44	46	48	50	52	54	56	58	59	61
	3	7	11	15	19	23	27	31	36	40	44	49	54	58	63	68	73	78	84	89	94	
62	-44	-12	1	9	15	20	25	29	32	35	38	41	43	45	48	50	52	54	55	57	59	60	62
	1	6	8	12	16	20	24	28	32	37	41	45	50	54	59	64	69	74	79	84	89	95	
63	-23	-7	3	12	18		23	27	31	34	37	39	42	44	47	49	51	53	55	56	58	60	61	63
	2	6	10	14	17		21	25	29	33	38	42	46	51	55	60	64	69	74	79	84	89	95	
64	-50	-11	0	9	18		21	25	29	32	35	38	41	43	46	48	50	52	54	56	57	59	61	62	64
	1	4	8	11	15		19	23	26	30	34	39	43	47	51	56	60	65	70	74	79	84	89	95	
65	-23	-5	5	12			18	23	27	31	34	37	40	42	45	47	49	51	53	55	57	59	60	62	63	65
	2	6	9	11			16	20	24	28	31	35	39	44	48	52	56	61	65	70	75	80	85	90	95	
66	-57	-13	0	9			15	21	25	29	33	36	39	41	44	46	48	50	52	54	56	58	60	61	63	64	66
		4	7	10			14	18	21	25	29	32	36	40	44	49	53	57	62	66	71	75	80	85	90	95	
67	-26	-6	5				12	18	23	27	31	34	37	40	43	45	47	50	52	54	55	57	59	61	62	64	65	67
	2	5	8				12	15	19	22	26	30	34	37	41	45	49	54	58	62	66	71	76	80	85	90	95	
68	-14	0					9	16	21	25	29	33	36	39	42	44	47	49	51	53	55	57	58	60	62	63	65	67	68
	3	7					10	13	17	20	24	27	31	34	38	42	46	50	54	58	63	67	71	76	81	85	91	95	
69	-26	-6					5	13	19	23	28	31	35	38	41	43	44	48	50	52	54	56	58	60	61	63	64	66	68	69
	2	5					8	11	14	18	21	23	28	32	35	39	43	47	51	55	59	63	67	72	76	81	85	90	95	
70	-14						0	9	16	21	26	30	33	36	39	42	45	47	49	51	53	55	57	59	61	62	64	66	67	69	70
	3						6	9	12	16	19	22	26	29	33	36	40	44	48	51	55	60	64	68	72	77	81	86	90	95	
71	-26	-5	5	13	19	24	28	32	35	38	41	44	46	48	51	53	55	56	58	60	62	63	65	67	68	70	71		
	2	5	8	11	14	17	20	23	27	30	34	37	41	45	48	52	54	60	64	68	73	77	81	86	90	95			
72	-13	1	10	16	22	26	30	34	37	40	43	45	47	50	52	54	56	58	59	61	63	64	66	68	69	71	72		
	3	6	9	12	15	18	21	24	29	31	35	38	42	45	49	53	57	61	65	69	73	77	82	85	91	95			
73	-26	-5	6	13	19	24	29	32	36	39	41	44	47	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73	
	2	4	7	10	13	16	19	22	25	29	32	35	39	42	44	50	53	57	61	65	69	73	77	82	84	91	95		
74	-13	1	10	17	22	27	31	34	37	40	43	46	48	50	52	54	56	58	60	62	63	65	67	68	70	71	73	74	
	1	6	8	11	14	17	20	23	24	30	33	34	40	43	47	50	54	58	62	66	70	74	78	82	84	91	95		
75	-25	-4	6	14	20	25	29	33	34	39	42	45	47	49	52	54	56	58	59	61	63	65	66	68	69	71	72	74	75
	2	4	7	10	12	15	18	21	24	27	31	34	37	40	44	47	51	55	58	62	66	70	74	78	82	87	91	95	
76	-57	-12	2	11	17	23	27	31	35	38	41	44	46	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73	75	76
		3	5	8	11	14	16	19	22	25	28	31	35	38	41	45	48	52	55	59	63	64	70	74	78	82	87	91	95	
77	-23	-3	7	15	21	25	30	33	37	40	43	45	48	50	52	54	56	58	60	62	63	65	67	68	70	71	73	74	76	77
	2	4	7	9	12	15	18	20	23	24	29	32	35	39	42	45	49	52	54	59	63	67	71	75	79	83	87	91	94	
78	-49	-11	3	12	18	23	28	32	35	39	41	44	47	49	51	53	56	57	59	61	63	65	66	68	69	71	72	74	75	77	78
		3	5	8	10	13	16	19	21	24	27	30	33	36	39	43	46	49	53	56	60	63	67	71	75	79	83	87	91	94	
79	-21	-2	8	15	21	26	30	34	37	40	43	44	48	51	53	55	57	59	61	62	64	66	67	69	70	72	73	75	76	78	79
	2	4	6	9	12	14	17	20	22	25	28	31	34	37	40	43	47	50	53	57	60	64	68	71	75	79	83	87	91	94	
80	-43	-9	4	12	19	24	29	33	36	39	42	45	47	50	52	54	56	58	60	62	64	65	67	68	70	72	73	74	76	77	79
		3	5	8	10	13	15	18	21	23	26	29	32	35	38	41	44	47	50	54	57	61	64	68	72	75	79	83	87	91	94

Temperature, relative humidity and dew point tables

Elevations between 0 and 500 feet (In Alaska, between 0 and 300 feet)

Wet Bulb Temperatures
50 to 90 F
(Read Down)

Dry Bulb Temperatures
81 to 100 F
(Read Across)

DP DP
RH RH

Dry Bulb	Wet Bulb 50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	Dry Bulb
81	-19	-1	9	16	22	27	31	35	38	41	44	46	49	51	53	55	57	59	61	63	65	66	68	70	71	73	74	76	77	78	80	81
	2	4	6	9	11	14	16	19	21	24	27	30	33	35	38	42	45	48	51	54	58	61	65	68	72	76	80	83	87	92	96	
82	-37	-7	5	13	20	25	29	33	37	40	43	45	48	50	53	55	57	59	61	62	64	66	68	69	71	72	74	75	77	78	79	81
	1	3	5	7	10	12	15	17	20	22	25	28	31	33	36	39	42	45	48	52	55	58	62	65	69	72	76	80	84	88	95	94
83	-16	0	10	17	23	28	32	35	39	42	44	47	50	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	78	79	80	82
	2	4	6	9	11	13	16	18	21	23	26	29	31	34	37	40	43	46	49	52	55	59	62	65	69	73	76	80	84	88	92	96
84	-31	-6	6	14	21	26	30	34	37	41	43	46	49	51	53	55	57	59	61	63	65	67	68	70	71	73	74	76	77	79	80	81
	1	3	5	7	10	12	14	17	19	22	24	27	29	32	35	38	41	43	46	50	53	56	59	62	66	69	73	76	80	84	88	92
85	-14	2	11	18	24	28	33	36	39	42	45	48	50	53	55	57	59	61	63	64	66	68	69	71	72	74	75	77	78	80	81	82
	2	4	6	8	11	13	15	18	20	22	25	28	30	33	34	38	41	44	47	50	53	56	60	63	66	70	73	77	80	84	88	92
86	-26	-4	8	15	22	27	31	35	38	41	44	47	49	52	54	56	58	60	62	64	66	67	69	70	72	74	75	77	78	79	81	82
	1	3	5	7	9	12	14	16	18	21	23	26	28	31	34	36	39	42	45	48	51	54	57	60	63	67	70	73	77	81	84	88
87	-11	3	12	19	25	29	33	37	40	43	44	49	51	53	55	58	59	61	63	65	67	68	70	72	73	75	76	78	79	80	82	83
	2	4	6	8	10	13	15	17	19	22	24	27	29	32	34	37	40	42	45	48	51	54	57	60	64	67	70	74	77	81	84	88
88	-22	-2	9	17	23	28	32	36	39	42	45	48	50	53	55	57	59	61	63	64	66	68	70	71	73	74	76	77	79	80	81	83
	1	3	5	7	9	11	13	16	18	20	22	25	27	30	32	35	38	40	43	46	49	52	55	58	61	64	67	71	74	77	81	85
89	-45	-8	5	14	20	26	30	34	38	41	44	47	49	52	54	56	58	60	62	64	66	67	69	71	72	74	75	77	78	80	81	82
		2	4	6	8	10	12	14	17	19	21	23	26	28	30	33	36	38	41	44	46	49	52	55	58	61	64	68	71	74	78	81
90	-17	0	11	18	24	29	33	37	40	43	44	48	51	53	55	58	60	62	63	65	67	69	70	72	73	75	76	78	79	81	82	84
	1	3	5	7	9	11	13	15	17	20	22	24	26	29	31	34	36	39	41	44	47	50	53	55	58	62	65	68	71	74	78	81
91	-34	-5	7	15	22	27	31	35	39	42	45	48	50	53	55	57	59	61	63	65	66	68	70	71	73	75	76	78	79	80	82	83
	1	2	4	6	8	10	12	14	16	18	20	23	25	27	29	32	34	37	39	42	45	47	50	53	56	59	62	65	68	71	75	78
92	-13	3	12	19	25	30	34	37	41	44	47	49	52	54	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	82	83	84
	2	3	5	7	9	11	13	15	17	19	21	23	26	28	30	33	35	37	40	43	45	48	51	53	56	59	62	65	68	72	75	78
93	-26	-3	9	17	23	28	32	36	40	43	46	48	51	53	56	58	60	62	64	65	67	69	71	72	74	75	77	78	80	81	83	84
	1	3	4	6	8	10	12	14	16	18	20	22	24	26	28	31	33	36	38	41	43	46	48	51	54	57	60	63	66	69	72	75
94	-10	5	14	21	26	31	35	38	42	45	48	50	53	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79	81	82	84	85
	2	3	5	7	9	11	13	14	16	18	21	23	25	27	29	31	34	36	39	41	44	46	49	52	54	57	60	63	66	69	72	75
95	-20	0	11	18	24	29	33	37	41	44	47	49	52	54	56	59	61	63	64	66	68	70	71	73	75	76	78	79	81	82	83	85
	1	3	4	6	8	10	11	13	15	17	19	21	23	25	28	30	32	34	37	39	42	44	47	49	52	55	57	60	63	66	69	72
96	-39	-6	7	15	22	27	32	36	39	43	46	48	51	53	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	82	83	84
		2	4	5	7	9	10	12	14	16	18	20	22	24	26	28	30	33	35	37	40	42	45	47	50	52	55	58	61	64	67	70
97	-14	2	12	20	25	30	35	38	42	45	48	50	53	55	57	59	61	63	65	67	69	71	72	74	75	77	78	80	81	83	84	85
	1	3	4	6	8	10	11	13	15	17	19	21	23	25	27	29	31	33	36	38	40	43	45	48	50	53	55	58	61	64	67	70
98	-28	-3	9	17	23	29	33	37	40	44	47	49	52	54	57	59	61	63	65	67	68	70	72	73	75	77	78	80	81	82	84	85
	1	2	4	5	7	9	10	12	14	16	18	19	21	23	25	27	30	32	34	36	38	41	43	46	48	51	53	56	59	61	64	67
99	-10	5	14	21	27	32	36	39	43	46	48	51	54	56	58	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84	85	86
	1	3	5	6	8	9	11	13	15	16	18	20	22	24	26	28	30	32	34	37	39	41	44	46	48	51	54	56	59	62	65	67
100	-20	0	11	19	25	30	34	38	42	45	48	50	53	55	57	60	62	64	66	67	69	71	73	74	76	77	79	80	82	83	85	86
	1	2	4	5	7	9	10	12	14	15	17	19	21	23	25	27	29	31	33	35	37	39	42	44	46	49	51	54	57	59	62	65

Temperature, relative humidity and dew point tables

Elevations between 0 and 500 feet (In Alaska, between 0 and 300 feet)

Wet Bulb Temperatures, 58 to 95 F

(Read Down)

Dry Bulb	DP / RH	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
101	DP	-40	-6	8	16	23	28	33	37	40	44	47	49	52	54	57	59	61	63	65	67	69	70	72	74	75	77	79	80	81	83	84	86	87	88	90	91	92	94
	RH		2	3	5	6	8	9	11	13	14	16	18	20	21	23	25	27	29	31	33	36	38	40	42	45	47	49	52	54	57	60	62	65	68	71	74	77	80
102	DP	-14	3	3	13	21	26	31	36	39	43	46	49	51	54	56	58	61	63	65	66	68	70	72	73	75	77	78	80	81	83	84	86	87	88	90	91	92	93
	RH		1	3	4	5	7	9	10	12	13	15	17	18	20	22	24	26	28	30	32	34	36	38	40	43	45	47	50	52	55	57	60	63	65	68	71	74	77
103	DP	-26	-2	10	18	24	30	34	38	42	45	48	50	53	55	58	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84	85	87	88	89	91	92	93
	RH		1	2	3	5	6	8	9	11	12	14	16	17	19	21	23	25	26	28	30	32	34	37	39	41	43	45	48	50	53	55	58	60	63	66	68	71	74
104	DP	-8	6	15	22	26	33	37	40	44	47	50	52	55	57	59	61	63	65	67	69	71	73	74	76	77	79	80	82	83	85	86	88	89	90	92	93
	RH		1	3	4	6	7	9	10	12	13	15	16	18	20	22	23	25	27	29	31	33	35	37	39	41	44	46	48	51	53	55	58	61	63	66	69	72
105	DP	-18	2	12	20	26	31	35	39	43	46	49	51	55	56	59	61	63	65	67	69	70	72	74	75	77	79	80	82	83	85	86	87	89	90	91	93
	RH		1	2	4	5	6	8	9	11	12	14	15	17	19	20	22	24	26	28	30	31	33	35	38	40	42	44	46	49	51	53	56	58	61	63	66	69
106	DP	-34	-4	9	18	24	29	34	38	42	45	48	51	53	56	58	60	62	64	66	68	70	72	73	75	77	78	80	81	83	84	86	87	88	90	91	92
	RH		2	3	4	6	7	8	10	11	13	14	16	18	19	21	23	25	26	28	30	32	34	36	38	40	42	44	47	49	51	54	56	59	61	64	66
107	DP	-11	5	15	22	28	33	37	41	44	47	50	53	55	57	60	62	64	66	68	70	71	73	75	76	78	79	81	83	84	85	87	88	90	91	92
	RH		1	2	4	5	6	8	9	11	12	14	15	17	18	20	22	23	25	27	29	31	32	34	36	38	41	43	45	47	49	52	54	56	59	61	64
108	DP	-22	0	12	20	26	31	35	39	43	46	49	52	54	57	59	61	63	65	67	69	71	73	74	76	78	79	81	82	84	85	87	88	89	91	92
	RH		1	2	3	4	6	7	8	10	11	13	14	16	17	19	21	22	24	26	27	29	31	33	35	37	39	41	43	45	47	50	52	54	57	59	62
109	DP	-46	-6	8	17	24	29	34	38	42	45	48	51	54	56	58	61	63	65	67	69	70	72	74	76	77	79	80	82	83	85	86	88	89	90	92
	RH		1	3	4	5	6	8	9	11	12	13	15	16	18	20	21	23	24	26	28	30	32	33	35	37	39	41	43	46	48	50	52	55	57	60
110	DP	-14	4	14	22	28	33	37	41	44	47	50	53	55	58	60	62	64	66	68	70	72	74	75	77	78	80	82	83	85	86	87	89	90	91
	RH		1	2	3	5	6	7	8	10	11	13	14	15	17	19	20	22	23	25	27	28	30	32	34	36	38	40	42	44	46	48	50	53	55	57
111	DP	-26	-1	11	19	26	31	36	39	43	46	49	52	55	57	59	62	64	66	68	70	71	73	75	76	78	80	81	83	84	86	87	89	90	91
	RH		2	3	4	5	6	8	9	10	12	13	15	16	18	19	21	22	24	26	27	29	31	33	34	36	38	40	42	44	46	49	51	53	55
112	DP	-7	8	17	24	29	34	38	42	45	48	51	54	56	59	61	63	65	67	69	71	73	74	76	78	79	81	82	84	85	87	88	90	91
	RH		1	2	3	5	6	7	8	10	11	12	14	15	17	18	20	21	23	24	26	28	29	31	33	35	37	39	41	43	45	47	49	51	53
113	DP	-16	3	14	22	28	33	37	41	44	48	50	53	56	58	60	63	65	67	69	70	72	74	76	77	79	81	82	84	85	87	88	89	91
	RH		1	2	3	4	5	7	8	9	10	12	13	14	16	17	19	20	22	23	25	27	28	30	32	33	35	37	39	41	43	45	47	49	51
114	DP	-31	-2	11	19	26	31	36	40	43	47	50	52	55	57	60	62	64	66	68	70	72	74	75	77	79	80	82	83	85	86	88	89	91
	RH		1	3	4	5	6	7	8	10	11	12	14	15	16	18	19	21	22	24	25	27	29	30	32	34	36	38	39	41	43	45	47	50
115	DP	-9	7	17	24	29	34	39	42	46	49	52	54	57	59	61	64	66	68	70	71	73	75	77	78	80	81	83	85	86	87	89	90
	RH		1	2	3	4	5	7	8	9	10	12	13	14	16	17	18	20	21	23	24	26	28	29	31	33	34	36	38	40	42	44	46	48
116	DP	-18	3	14	22	28	33	37	41	45	48	51	54	56	59	61	63	65	67	69	71	73	75	76	78	80	81	83	84	86	87	89	90
	RH		1	2	3	4	5	6	7	8	10	11	12	13	15	16	17	19	20	22	23	25	26	28	30	31	33	35	37	38	40	42	44	46
117	DP	-35	-3	11	19	26	31	36	40	44	47	50	53	55	58	60	63	65	67	69	71	72	74	76	78	79	81	82	84	85	87	88	90
	RH		1	2	3	4	6	7	8	9	10	11	13	14	15	17	18	19	21	22	24	25	27	28	30	32	33	35	37	39	41	43	44
118	DP	-9	7	17	24	30	35	39	43	46	49	52	55	57	60	62	64	66	68	70	72	74	76	77	79	80	82	84	85	87	88	89
	RH		1	2	3	4	5	6	7	8	10	11	12	13	15	16	17	19	20	21	23	24	26	27	29	31	32	34	36	37	39	41	43
119	DP	-19	2	14	22	28	33	38	42	45	48	51	54	57	59	61	64	66	68	70	72	73	75	77	79	80	82	83	85	86	88	89

Dry Bulb Temperatures

101 to 119 F

(Read Across)

Temperature, relative humidity and dew point tables

Elevations between 501 and 1,900 feet (In Alaska, between 301 and 1,700 feet)

Dry Bulb Temperatures 41 to 60 F (Read Across)

Wet Bulb Temperatures 28 to 59 F (Read Down)

DP	DP
RH	RH

Each cell: DP / RH

Dry Bulb	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
41	-26 / 5	-9 / 11	1 / 18	8 / 24	14 / 33	18 / 40	22 / 47	26 / 54	29 / 61	32 / 69	34 / 77	37 / 84	39 / 92			
42		-18 / 7	-4 / 14	5 / 21	11 / 28	16 / 34	20 / 41	24 / 48	27 / 55	30 / 62	33 / 70	35 / 77	38 / 85	40 / 92		
43		-33 / 3	-11 / 9	0 / 16	8 / 23	13 / 29	18 / 36	22 / 42	25 / 49	28 / 54	31 / 63	34 / 70	36 / 78	39 / 85	41 / 92	
44			-21 / 5	-6 / 12	3 / 18	10 / 24	13 / 31	20 / 37	23 / 44	27 / 50	30 / 57	33 / 64	35 / 71	38 / 78	40 / 85	42 / 93
45			-42 / 2	-13 / 8	-1 / 14	6 / 20	12 / 26	17 / 32	21 / 39	25 / 45	28 / 51	31 / 58	34 / 65	36 / 72	39 / 78	41 / 86
46				-25 / 4	-7 / 10	2 / 16	9 / 22	14 / 28	19 / 34	23 / 40	26 / 46	30 / 52	32 / 59	35 / 65	38 / 72	40 / 79
47				-36 / 1	-16 / 6	-3 / 12	5 / 18	11 / 23	17 / 29	21 / 35	25 / 41	28 / 47	31 / 53	34 / 60	36 / 66	39 / 73
48					-29 / 3	-10 / 8	1 / 14	8 / 19	14 / 25	19 / 31	23 / 36	26 / 42	29 / 48	32 / 54	35 / 60	38 / 67
49						-19 / 5	-5 / 10	4 / 16	11 / 21	16 / 26	20 / 32	24 / 38	28 / 43	31 / 49	34 / 55	36 / 61
50						-37 / 2	-12 / 7	-1 / 12	7 / 17	13 / 22	18 / 28	22 / 33	26 / 39	29 / 44	32 / 50	35 / 56
51							-23 / 4	-6 / 9	3 / 14	10 / 19	15 / 24	20 / 29	24 / 35	28 / 40	31 / 46	34 / 51
52							-47 / 1	-14 / 6	-2 / 11	6 / 15	13 / 20	18 / 25	22 / 31	26 / 36	29 / 41	32 / 47
53								-27 / 3	-8 / 7	2 / 12	9 / 17	15 / 22	20 / 27	24 / 32	27 / 37	31 / 42
54									-17 / 5	-3 / 9	6 / 14	12 / 19	17 / 23	22 / 20	26 / 33	29 / 30
55									-32 / 2	-10 / 6	1 / 11	9 / 15	15 / 20	20 / 25	24 / 30	27 / 34
56										-19 / 4	-4 / 0	5 / 13	12 / 17	17 / 21	22 / 26	26 / 31
57										-37 / 1	-11 / 4	1 / 10	8 / 14	14 / 18	19 / 23	24 / 27
58											-21 / 3	-5 / 7	5 / 11	11 / 10	17 / 20	22 / 24
59											-43 / 1	12 / 5	0 / 9	8 / 13	14 / 17	19 / 21
60												-24 / 3	-6 / 7	4 / 10	11 / 14	17 / 18

Dry Bulb	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
45	43 / 93															
46	42 / 86	44 / 93														
47	41 / 79	43 / 86	45 / 93													
48	40 / 73	42 / 80	44 / 86	46 / 93												
49	39 / 67	41 / 74	43 / 80	45 / 87	47 / 93											
50	38 / 62	40 / 68	42 / 74	44 / 80	46 / 87	48 / 93										
51	36 / 57	39 / 63	41 / 69	43 / 75	45 / 81	47 / 87	49 / 93									
52	35 / 52	38 / 58	40 / 63	42 / 69	44 / 75	46 / 81	48 / 87	50 / 94								
53	34 / 48	36 / 53	39 / 58	41 / 64	43 / 70	46 / 76	48 / 82	49 / 88	51 / 96							
54	32 / 43	35 / 49	38 / 54	40 / 59	42 / 65	45 / 70	47 / 76	49 / 02	50 / 00	52 / 94						
55	31 / 39	34 / 44	36 / 49	39 / 55	41 / 60	44 / 65	46 / 71	48 / 76	50 / 82	52 / 88	53 / 94					
56	29 / 36	32 / 40	35 / 45	38 / 50	40 / 55	43 / 61	45 / 66	47 / 71	49 / 77	51 / 02	53 / 88	54 / 94				
57	27 / 32	31 / 37	34 / 41	37 / 46	39 / 51	42 / 56	44 / 61	46 / 67	48 / 72	50 / 77	52 / 83	54 / 88	55 / 94			
58	26 / 29	29 / 33	32 / 38	35 / 42	38 / 47	40 / 52	43 / 57	45 / 02	47 / 67	49 / 72	51 / 70	53 / 03	55 / 09	56 / 94		
59	24 / 25	28 / 30	31 / 34	34 / 39	37 / 43	39 / 48	42 / 53	44 / 58	46 / 63	48 / 68	50 / 73	52 / 78	54 / 83	56 / 89	57 / 94	
60	22 / 22	26 / 27	29 / 31	33 / 35	36 / 40	38 / 44	41 / 49	43 / 54	45 / 58	47 / 63	49 / 60	51 / 73	53 / 70	55 / 03	57 / 00	58 / 94

Wet Bulb Temperatures

Dry Bulb Temperatures

Dry Bulb	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
31	-37 / 1	-19 / 10	-8 / 20	2 / 29	9 / 38	14 / 48	18 / 58	22 / 68	25 / 78	28 / 89									
32		-34 / 4	-13 / 13	-3 / 22	5 / 31	11 / 40	15 / 50	20 / 60	23 / 69	26 / 79	29 / 90								
33			-25 / 7	-9 / 15	0 / 24	7 / 33	13 / 42	17 / 52	21 / 61	25 / 71	28 / 80	30 / 90							
34			-36 / 1	-18 / 9	-5 / 10	3 / 26	9 / 35	14 / 44	19 / 53	23 / 62	26 / 72	29 / 01	32 / 91						
35				-34 / 4	-13 / 12	-2 / 20	4 / 29	11 / 37	16 / 46	20 / 55	24 / 64	27 / 73	30 / 82	33 / 91					
36					-14 / 6	-8 / 14	1 / 22	8 / 31	14 / 39	18 / 40	22 / 54	25 / 65	28 / 74	31 / 02	34 / 91				
37					-50 / 1	-17 / 9	-4 / 17	4 / 25	10 / 33	15 / 41	20 / 49	24 / 58	27 / 66	30 / 74	32 / 83	35 / 91			
38						-31 / 4	-11 / 11	0 / 19	7 / 27	13 / 35	17 / 43	21 / 51	25 / 59	28 / 67	31 / 75	33 / 83	34 / 91		
39							-21 / 7	-6 / 14	3 / 21	9 / 29	15 / 37	19 / 44	23 / 52	26 / 60	29 / 67	32 / 75	34 / 83	37 / 92	
40							-42 / 2	-14 / 9	-2 / 16	6 / 23	12 / 31	17 / 38	21 / 46	24 / 53	28 / 61	30 / 68	33 / 76	36 / 84	38 / 92

Temperature, relative humidity and dew point tables

Elevations between 501 and 1,900 feet (In Alaska, between 301 and 1,700 feet)

Wet Bulb Temperatures
39 to 80 F
(Read Down)

Dry Bulb Temperatures
61 to 80 F
(Read Across)

DP = Dew Point (F)
RH = Relative Humidity (%)

Dry Bulb	Wet Bulb 39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	DP -50	-14	-1	8	14	19	24	28	31	34	37	40	42	44	47	49	51	53	54	56	58	59
	RH 1	4	8	12	16	20	24	28	32	34	41	45	50	54	59	64	69	74	79	84	89	95
62	DP -25	-6	4	11	17	22		26	30	33	34	38	41	43	44	48	50	52	54	55	57	59
	RH 2	6	10	13	17	21		25	29	33	37	42	44	50	55	60	64	69	74	79	84	89
63	DP -54	-14	-1	8	14	20		24	28	31	34	37	40	42	45	47	49	51	53	55	57	58
	RH	4	7	11	15	19		22	24	30	34	38	43	47	51	56	60	65	70	74	79	84
64	DP -27	-7	4	11	17			22	26	30	33	34	39	41	44	46	48	50	52	54	56	58
	RH 2	5	9	12	14			20	24	27	31	35	39	43	48	52	54	61	65	70	75	80
65	DP -15	-1	8	14				20	24	28	32	35	38	40	43	45	47	49	51	53	55	57
	RH 3	7	10	14				17	21	25	29	32	34	40	44	48	53	57	61	64	70	75
66	DP -28	-7	4	11				17	22	24	30	33	36	39	42	44	46	49	51	53	54	56
	RH 2	5	8	12				15	19	22	26	30	33	37	41	45	49	53	58	62	64	71
67	DP -15	-1	8					15	20	24	28	32	35	38	41	43	44	48	50	52	54	56
	RH 3	6	10					13	16	20	23	27	31	34	38	42	46	50	54	58	63	67
68	DP -29	-7	4					12	18	22	27	30	34	37	40	42	45	47	49	51	53	55
	RH 2	5	8					11	14	18	21	24	28	32	35	39	43	47	51	55	59	63
69	DP -15	-1						8	15	20	25	29	32	35	38	41	44	46	48	50	52	54
	RH 3	4						9	12	16	19	22	24	29	33	34	40	44	47	51	55	59
70	DP -29	-7						4	12	18	23	27	31	34	37	40	43	45	47	50	52	54
	RH 1	4						7	10	14	17	20	23	27	30	34	37	41	44	48	52	56
71	DP -15							0	9	15	21	25	29	33	34	39	42	44	46	49	51	53
	RH 3							6	9	12	15	18	21	24	28	31	34	38	42	45	49	53
72	DP -28							-6	5	12	18	23	28	31	35	38	40	43	44	48	50	52
	RH 1							4	7	10	13	16	19	22	25	29	32	35	39	42	44	50
73	DP -14								0	9	16	21	26	30	33	34	39	42	45	47	49	51
	RH 3								5	8	11	14	17	20	23	26	30	33	36	40	43	47
74	DP -27								-4	5	13	19	24	28	32	35	38	41	44	46	48	51
	RH 1								4	7	10	12	15	18	21	24	27	30	34	37	40	44
75	DP -13									1	10	16	22	26	30	34	37	40	43	45	48	50
	RH 3									5	8	11	13	16	19	22	25	28	31	35	38	41
76	DP -25									-5	4	14	20	24	29	32	34	39	42	44	47	49
	RH 1									4	7	9	12	15	17	20	23	26	29	32	35	39
77	DP -57									-12	2	10	17	22	27	31	34	38	41	43	46	48
	RH									3	5	8	10	13	16	18	21	24	27	30	33	36
78	DP -23										-4	7	14	20	25	29	33	36	39	42	45	47
	RH 1										4	6	9	11	14	17	19	22	25	28	31	34
79	DP -48										-11	3	11	18	23	28	32	35	38	41	44	46
	RH										3	5	8	10	13	15	18	20	23	26	29	32
80	DP -21											-2	8	15	21	26	30	34	37	40	43	45
	RH 2											4	6	9	11	14	16	19	21	24	27	30

Dry Bulb	Wet Bulb 61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
61	DP 61																			
	RH 95																			
62	DP 60	62																		
	RH 95																			
63	DP 60	61	63																	
	RH 89	95																		
64	DP 59	61	62	64																
	RH 85	90	95																	
65	DP 59	60	62	63	65															
	RH 80	85	90	95																
66	DP 58	60	61	63	64	66														
	RH 74	80	85	90	95															
67	DP 57	59	61	62	64	66	67													
	RH 71	76	80	85	90	95														
68	DP 57	59	60	62	63	65	67	68												
	RH 67	72	76	81	85	90	95													
69	DP 56	58	60	61	63	65	66	68	69											
	RH 64	68	72	77	81	84	90	95												
70	DP 55	57	59	60	62	64	66	67	69	70										
	RH 60	64	68	72	77	81	86	90	95											
71	DP 55	57	58	60	62	63	65	67	68	70	71									
	RH 57	60	65	69	73	77	82	86	91	95										
72	DP 54	56	58	60	61	63	65	66	68	69	71	72								
	RH 53	57	61	65	69	73	77	82	86	91	95									
73	DP 53	55	57	59	61	62	64	66	67	69	70	72	73							
	RH 50	55	58	62	65	69	74	78	82	84	91	95								
74	DP 53	55	57	58	60	62	64	65	67	68	70	71	73	74						
	RH 47	51	54	58	62	64	70	74	78	82	87	91	95							
75	DP 52	54	56	58	60	61	63	65	66	68	69	71	72	74	75					
	RH 44	48	51	55	59	62	66	70	74	78	82	87	91	95						
76	DP 51	53	55	57	59	61	62	64	66	67	69	70	72	73	75	76				
	RH 42	45	49	52	56	59	63	67	71	75	79	83	87	91	96					
77	DP 50	53	55	57	58	60	62	64	65	67	68	70	71	73	74	76	77			
	RH 39	43	46	49	53	56	60	63	67	71	75	79	83	87	91	96				
78	DP 48	50	52	54	56	58	60	61	63	65	66	68	69	71	72	74	75	77	78	
	RH 37	40	43	46	50	53	57	60	64	67	71	75	79	83	87	91	96			
79	DP 49	51	53	55	57	59	61	63	64	66	67	69	71	72	73	75	76	78	79	
	RH 35	38	41	44	47	50	54	57	61	64	68	72	75	79	83	87	91	96		
80	DP 48	50	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	77	79	80
	RH 32	35	38	41	45	48	51	54	58	61	65	68	72	76	79	83	87	92	96	

Temperature, relative humidity and dew point tables

Elevations between 501 and 1,900 feet (In Alaska, between 301 and 1,700 feet)

Wet Bulb Temperatures
49 to 91 F
(Read Down)

Dry Bulb Temperatures
81 to 100 F
(Read Across)

DP DP
RH RH

	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	-40	-9	4	12	19	24	28	32	34	39	42	45	47	49	52	54	56	58	60	61	63	65	67	68	70	71	73	74	76	77	78	80
	1	3	5	7	10	12	15	17	20	22	25	28	30	33	36	39	42	45	48	51	55	58	62	65	69	72	76	80	84	88	92	96
82	-18	-1	9	16	22	27	31	34	38	41	44	46	49	51	53	55	57	59	61	63	64	66	68	69	71	72	74	75	77	78	79	81
	2	4	6	8	10	13	16	18	21	23	26	28	31	34	37	40	43	46	49	52	55	59	62	65	69	73	76	80	84	88	92	96
83	-34	-7	5	13	20	25	29	33	34	40	43	45	48	50	52	54	56	58	60	62	64	66	67	69	70	72	73	75	76	78	79	80
	1	3	5	7	9	12	14	17	19	21	24	27	29	32	35	38	40	43	46	49	53	56	59	62	66	69	73	76	80	84	88	92
84	-15	1	10	17	23	27	32	35	38	41	44	47	49	52	54	56	58	60	62	63	65	67	68	70	71	73	74	76	77	79	80	81
	2	4	6	8	10	13	15	17	20	22	25	27	30	33	35	38	41	44	47	50	53	56	59	63	66	70	73	77	80	84	88	92
85	-29	-5	7	14	21	26	30	34	37	40	43	46	48	51	53	55	57	59	61	63	65	66	68	69	71	73	74	76	77	78	80	81
	1	3	5	7	9	11	14	16	18	21	23	26	28	31	33	36	39	42	45	47	50	54	57	60	63	66	70	73	77	81	84	88
86	12	2	11	18	24	28	32	36	39	42	45	48	50	52	54	57	59	60	62	64	66	67	69	71	72	74	75	77	78	79	81	82
	2	4	6	8	10	12	15	17	19	22	24	26	29	32	34	37	40	42	45	48	51	54	57	60	64	67	70	74	77	81	84	88
87	-24	-3	6	16	22	27	31	35	38	41	44	47	49	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	78	79	80	82
	1	3	5	7	9	11	13	16	18	20	22	25	27	30	32	35	37	40	43	46	49	51	54	58	61	64	67	70	74	77	81	85
88	-50	-10	4	13	16	25	29	33	37	40	43	46	48	51	53	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80	81
		2	4	6	8	10	12	14	16	19	21	23	26	28	30	33	35	38	41	43	46	49	52	55	58	61	64	67	71	74	78	81
89	-19	-1	10	17	23	28	32	36	39	42	45	48	50	52	55	57	59	61	62	64	66	68	69	71	72	74	76	77	78	80	81	83
	1	3	5	7	9	11	13	15	17	19	22	24	26	29	31	34	36	39	41	44	47	50	52	55	58	61	65	68	71	74	78	81
90	-37	-7	6	14	21	26	30	34	38	41	44	47	49	52	54	56	58	60	62	64	66	67	69	71	72	74	75	77	78	79	81	82
		2	4	6	8	10	12	14	16	18	20	22	25	27	29	32	34	37	39	42	45	47	50	53	56	59	62	65	68	71	75	78
91	-15	1	11	18	24	29	33	37	40	43	46	48	51	53	55	57	59	61	63	65	67	68	70	72	73	76	78	79	81	82	83	85
	1	3	5	7	9	11	13	15	17	19	21	23	25	28	30	32	35	37	40	42	45	48	51	53	56	59	62	65	68	72	75	78
92	-28	-4	8	16	22	27	31	35	39	42	45	47	50	52	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80	82	83
	1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	31	33	35	38	40	43	46	48	51	54	57	60	63	66	69	72	75
93	-11	4	13	20	25	30	34	38	41	44	47	49	52	54	56	58	60	62	64	66	68	69	71	72	74	76	77	78	80	81	82	84
	2	3	5	7	9	11	12	14	16	18	20	23	25	27	29	31	34	36	38	41	43	46	49	51	54	57	60	63	66	69	72	75
94	-21	-1	10	17	23	28	32	36	40	43	46	48	51	53	55	58	60	62	63	65	67	69	70	72	74	75	77	78	80	81	82	84
	1	3	4	6	8	10	11	13	15	17	19	21	23	25	28	30	32	34	37	39	41	44	47	49	52	55	57	60	63	66	69	72
95	-43	-7	6	14	21	26	31	35	39	42	45	47	50	52	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79	81	82	83
		2	4	5	7	9	10	12	14	16	18	20	22	24	26	28	30	33	35	37	40	42	45	47	50	52	55	58	61	64	66	70
96	-16	1	11	19	25	29	34	37	41	44	47	49	52	54	56	58	60	62	64	66	68	70	71	73	74	76	77	79	80	82	83	85
	1	3	4	6	8	9	11	13	15	17	19	21	23	25	27	29	31	33	35	38	40	43	45	48	50	53	55	58	61	64	67	70
97	-30	-4	8	16	23	28	32	36	40	43	46	48	51	53	56	58	60	62	64	66	67	69	71	72	74	76	77	79	80	81	83	84
	1	2	4	5	7	9	10	12	14	16	17	19	21	23	25	27	29	32	34	36	38	41	43	45	48	51	53	56	59	61	64	67
98	-11	4	13	20	26	31	35	38	42	45	48	50	53	55	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84	85
	1	3	5	6	8	9	11	13	15	16	18	20	22	24	26	28	30	32	34	37	39	41	44	46	48	51	54	56	59	62	64	67
99	-21	-1	10	18	24	29	33	37	41	44	47	49	52	54	57	59	61	63	65	66	68	70	72	73	75	76	78	79	81	82	84	85
	1	2	4	5	7	9	10	12	14	15	17	19	21	23	25	27	29	31	33	35	37	39	42	44	46	49	51	54	57	59	62	65
100	-43	-7	4	15	22	27	32	36	40	43	46	49	51	54	56	58	60	62	64	66	68	70	71	73	74	76	77	79	81	82	83	85
		2	3	5	6	8	9	11	13	14	16	18	20	21	23	25	27	29	31	33	35	38	40	42	44	47	49	52	54	57	60	62

	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
81	81														
82	81	82													
	96														
83	80	82	83												
	92	96													
84	80	81	83	84											
	88	92	96												
85	80	81	82	84	85										
	84	88	92	96											
86	79	81	82	83	85	86									
	81	84	88	92	96										
87	79	80	82	83	84	86	87								
	77	81	85	88	92	96									
88	79	80	81	83	84	85	87	88							
	74	78	81	85	88	92	96								
89	78	80	81	83	84	85	86	88	89						
	71	74	78	81	85	88	92	96							
90	78	79	81	82	84	85	86	87	89	90					
	68	71	75	78	82	85	89	92	96						
91	79	81	82	83	85	86	87	88	90	90	91				
	65	68	72	75	78	82	85	89	92	96					
92	77	79	80	82	83	84	86	87	88	90	91	92			
	63	66	69	72	75	78	82	85	89	92	96				
93	77	78	80	81	82	84	85	86	88	89	90	92	93		
	60	63	66	69	72	75	79	82	86	89	93	96			
94	77	78	80	81	82	84	85	86	88	89	90	92	93	94	
	57	60	63	66	69	72	76	79	82	86	89	93	96		
95	76	78	79	81	82	83	85	86	87	89	90	91	93	94	95
	55	58	61	64	66	70	73	76	79	82	86	89	93	96	
96	76	77	79	80	82	83	85	86	87	88	90	91	92	94	95
	53	55	58	61	64	67	70	73	76	79	82	86	89	93	96
97	76	77	79	80	81	83	84	86	87	88	90	91	92	93	95
	51	53	56	59	61	64	67	70	73	76	79	83	86	89	93
98	75	77	78	80	81	83	84	85	87	88	89	91	92	93	94
	48	51	54	56	59	62	64	67	70	73	76	80	83	86	89
99	75	76	78	79	81	82	84	85	86	88	89	90	92	93	94
	46	49	51	54	57	59	62	65	68	71	74	77	80	83	86
100	74	76	78	79	81	82	83	85	86	87	89	90	91	93	94
	44	47	49	52	54	57	60	62	65	68	71	74	77	80	83

Temperature, relative humidity and dew point tables

Elevations between 501 and 1,900 feet (In Alaska, between 301 and 1,700 feet)

Wet Bulb Temperatures, 58 to 95 F

(Read Down)

Dry Bulb Temperatures 101 to 119 F

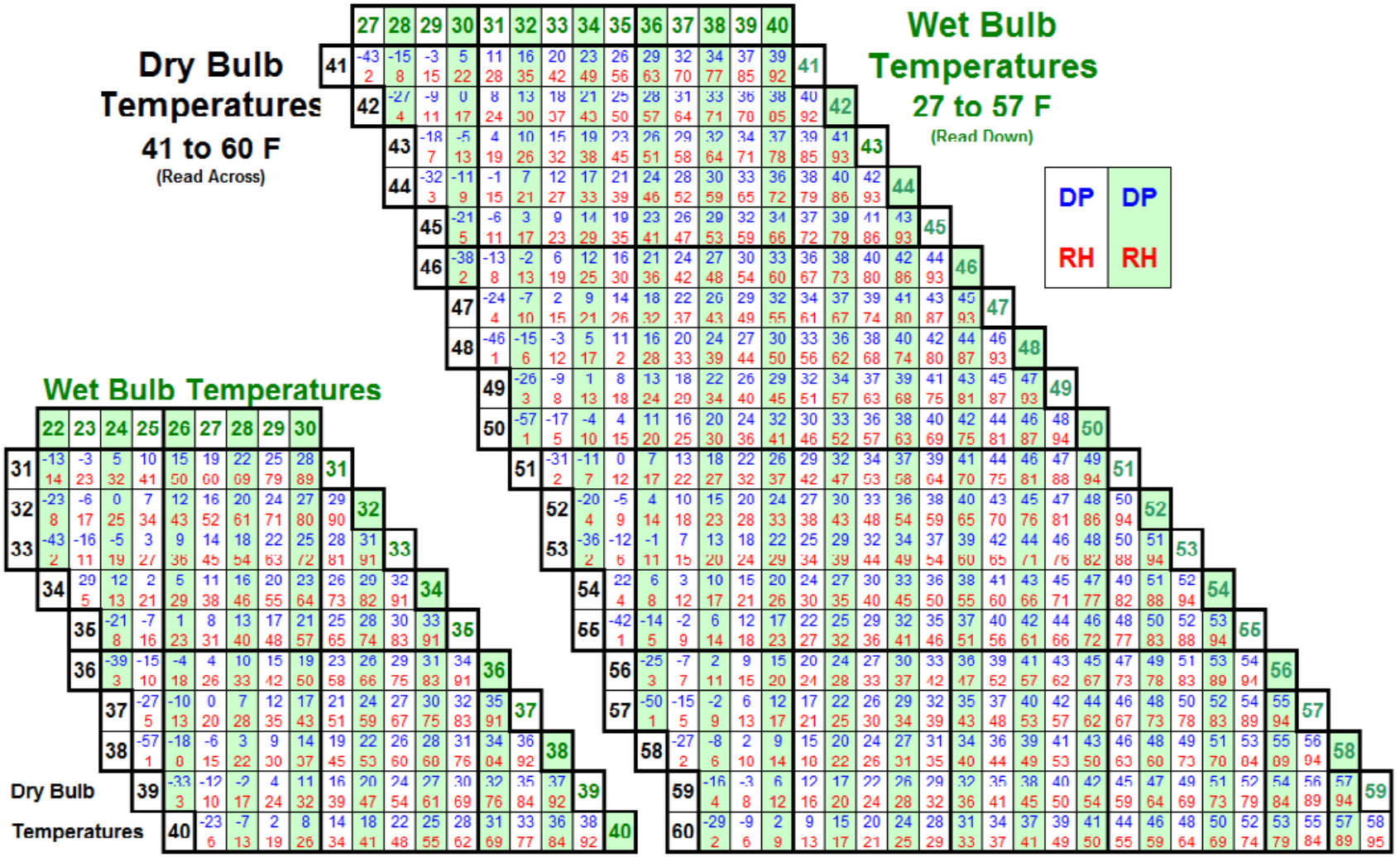
(Read Across)

DP / RH

Dry Bulb	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
101	-15	2	12	20	26	30	35	38	42	45	48	50	53	55	57	60	62	64	65	67	69	71	72	74	76	77	79	80	82	83	84	86	87	89	90	91	92	94
	1	3	4	5	7	8	10	12	13	15	17	18	20	22	24	26	28	30	32	34	36	38	40	43	45	47	50	52	55	57	60	63	65	68	71	74	77	80
102	-28	-3	9	17	24	29	33	37	41	44	47	50	52	55	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84	86	87	88	90	91	92	93
	1	2	3	5	6	8	9	11	12	14	16	17	19	21	23	25	26	28	30	32	34	36	39	41	43	45	48	50	53	55	58	60	63	66	68	71	74	77
103	-10	5		15	21	27	32	36	40	43	46	49	51	54	56	58	60	63	64	66	68	70	72	73	75	76	78	80	81	82	84	85	87	88	89	91	92	93
	1	3		4	6	7	8	10	12	13	15	16	18	20	21	23	25	27	29	31	33	35	37	39	41	43	46	48	50	53	55	58	60	63	66	69	71	74
104	-19	1	2	12	19	25	30	35	38	42	45	48	51	53	55	58	60	62	64	66	68	69	71	73	75	76	78	79	81	82	84	85	86	88	89	90	92	93
	1	2		3	5	6	8	9	11	12	14	15	17	19	20	22	24	26	28	29	31	33	35	37	40	42	44	46	48	51	53	56	58	61	63	66	69	72
105	-37	-5		8	17	23	29	33	37	41	44	47	50	52	55	57	59	61	63	65	67	69	71	72	74	76	77	79	80	82	83	85	86	87	89	90	91	93
		2		3	4	6	7	8	10	11	13	14	16	18	9	21	23	24	26	28	30	32	34	36	38	40	42	44	47	49	51	54	56	59	61	64	66	69
106	-12	4		14	21	27	32		36	40	43	46	49	52	54	56	59	61	63	65	67	69	70	72	74	75	77	79	80	82	83	84	86	87	89	90	91	93
	1	2		4	5	6	8		9	11	12	14	15	17	18	20	22	23	25	27	29	30	32	34	36	38	40	43	45	47	49	52	54	56	59	61	64	67
107	-23	-1		11	19	25	30		35	38	42	45	48	51	53	56	58	60	62	64	66	68	70	72	73	75	77	78	80	81	83	84	86	87	88	90	91	92
	1	2		3	4	6	7		8	10	11	13	14	16	17	19	20	22	24	26	27	29	31	33	35	37	39	41	43	45	47	50	52	54	57	59	62	64
108	-49	-7		7	16	23	29		33	37	41	44	47	50	53	55	57	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84	85	87	88	89	91	92
		1		3	4	5	6		8	9	10	12	13	15	16	18	19	21	23	24	26	28	30	31	33	35	37	39	41	43	46	48	50	52	55	57	59	62
109	-15	3		13	21	27			32	36	40	43	46	49	52	54	57	59	61	63	65	67	69	71	73	74	76	78	79	81	82	84	85	86	88	89	91	92
	1	2		3	5	6			7	8	10	11	13	14	15	17	18	20	22	23	25	27	28	30	32	34	36	38	40	42	44	46	48	50	53	55	57	60
110	-28	-2		10	19	25			30	35	39	42	45	48	51	54	56	58	61	63	65	67	69	70	72	74	76	77	79	80	82	83	85	86	88	89	90	92
		2		3	4	5			6	8	9	10	12	13	15	16	18	19	21	22	24	25	27	29	31	32	34	36	38	40	42	44	46	48	51	53	55	58
111	-8	7		16	23				29	33	37	41	44	48	50	53	56	58	60	62	64	66	68	70	72	73	75	77	78	80	81	83	84	86	87	89	90	91
	1	2		3	5				6	7	8	10	11	12	14	15	17	18	20	21	23	24	26	28	29	31	33	35	37	39	41	43	45	47	49	51	53	56
112	-17	2		13	21				27	32	36	40	43	47	50	52	55	57	60	62	64	66	68	70	71	73	75	76	78	80	81	83	84	86	87	88	90	91
	1	2		3	4				5	7	8	9	10	12	13	14	16	17	19	20	22	23	25	26	28	30	32	33	35	37	39	41	43	45	47	49	51	54
113	-32	-3		10	18				25	30	35	39	42	46	49	52	54	57	59	61	63	65	67	69	71	73	74	76	78	79	81	82	84	85	87	88	90	91
		1		2	4				5	6	7	8	10	11	12	14	15	16	18	19	21	22	24	25	27	29	30	32	34	36	37	39	41	43	45	47	50	52
114	-10	6		16					23	29	33	38	41	45	48	51	53	56	58	61	63	65	67	69	71	72	74	76	77	79	81	82	84	85	86	88	89	91
	1	2		3					4	5	7	8	9	10	11	13	14	15	17	18	20	21	23	24	26	27	29	31	32	34	36	38	40	42	44	46	48	50
115	-19	2		13					21	27	32	36	40	44	47	50	53	55	58	60	62	64	66	68	70	72	74	75	77	79	80	82	83	85	86	88	89	90
	1	2		3					4	5	6	7	8	10	11	12	13	15	16	17	19	20	22	23	25	26	28	30	31	33	35	36	38	40	42	44	46	48
116	-3	10							18	25	30	35	39	43	44	49	52	55	57	59	62	64	66	68	70	71	73	75	77	78	80	81	83	84	86	87	89	90
	1	2							3	4	6	7	8	9	10	11	13	14	15	17	18	19	21	22	24	25	27	28	30	32	33	35	37	39	41	42	44	46
117	-10	6							16	23	29	34	38	42	45	48	51	54	56	59	61	63	65	67	69	71	73	75	76	78	80	81	83	84	86	87	89	90
	1	2							3	4	5	6	7	8	10	11	12	13	14	16	17	18	20	21	23	24	26	27	29	30	32	34	36	37	39	41	43	45
118	-20	2							13	21	27	32	37	41	44	47	50	53	56	58	60	63	65	67	69	71	72	74	76	78	79	81	82	84	85	87	88	90
	1	1							2	3	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	23	25	26	28	29	31	33	34	36	38	39	41	43
119	-40	-4							10	19	25	31	35	40	43	47	50	52	55	58	60	62	64	66	68	70	72	74	76	77	79	80	82	84	85	87	88	
		1							2	3	4	5	6	7	8	9	11	12	13	14	15	17	18	19	21	22	24	25	27	28	30	31	33	35	36	38	40	

Temperature, relative humidity and dew point tables

Elevations between 1,901 and 3,900 feet (In Alaska, between 1,701 and 3,600 feet)



Temperature, relative humidity and dew point tables

Elevations between 1,901 and 3,900 feet (In Alaska, between 1,701 and 3,600 feet)

Wet Bulb Temperatures
39 to 79 F
(Read Down)

Dry Bulb Temperatures
61 to 80 F
(Read Across)

DP = Dew Point (F)
RH = Relative Humidity (%)

Dry Bulb	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	-17	-3	6	12	18	22	26	29	33	35	38	40	43	45	47	49	51	53	55	56	58	59
	4	7	11	14	18	22	26	30	34	38	42	47	51	56	60	65	69	74	79	84	89	95
62	-31	-9	2	9	15	20	24	28	31	34	37	39	42	44	46	48	50	52	54	56	57	59
	2	5	9	12	16	20	23	27	31	35	39	43	48	52	56	61	65	70	75	80	85	90
63	-18	-3	6	12	18	22	26	30	33	36	38	41	43	45	47	49	51	53	55	57	58	60
	3	7	10	14	17	21	25	28	32	36	40	44	48	53	57	61	66	70	75	80	85	90
64	-32	-9	2	9	15	20	24	28	31	34	37	40	42	45	47	49	51	53	54	56	58	59
	1	5	8	11	15	18	22	26	29	33	37	41	45	49	53	57	62	66	71	75	80	85
65	-18	-3	6	13	18	23	27	30	33	36	39	41	44	46	48	50	52	54	55	57	59	60
	3	6	9	13	16	20	23	27	30	34	38	42	46	50	54	58	62	67	71	76	80	85
66	-32	-9	2	10	16	21	25	29	32	35	38	40	43	45	47	49	51	53	55	57	58	60
	1	4	8	11	14	17	21	24	28	31	35	39	43	47	51	55	59	63	67	72	76	81
67	-18	-3	6	13	18	23	27	30	34	37	39	42	44	46	48	50	52	54	56	58	59	61
	3	6	9	12	15	19	22	25	29	32	36	40	43	47	51	55	59	63	68	72	76	81
68	-32	-9	2	10	16	21	25	29	32	35	38	41	43	45	48	50	52	54	55	57	59	60
	1	4	7	10	13	17	20	23	26	30	33	37	41	44	48	52	56	60	64	68	72	77
69	-17	-3	7	13	19	23	27	31	34	37	40	42	45	47	49	51	53	55	56	58	60	62
	3	6	9	12	15	18	21	24	27	31	34	38	41	45	49	53	56	60	64	69	73	77
70	-31	-9	3	10	16	21	26	29	33	36	39	41	44	46	48	50	52	54	56	58	59	61
	1	4	7	10	13	16	19	22	25	28	32	35	39	42	46	49	53	57	61	65	69	73
71	-17	-2	7	14	19	24	28	31	35	38	40	43	45	47	49	51	53	55	57	59	60	62
	3	5	8	11	14	17	20	23	26	29	33	36	39	43	46	50	54	58	61	65	69	73
72	-30	-8	3	11	17	22	26	30	33	36	39	42	44	46	49	51	53	55	56	58	60	62
	1	4	7	9	12	15	18	21	24	27	30	34	37	40	44	47	51	54	58	62	66	70
73	-16	-1	8	15	20	24	28	32	35	38	41	43	46	48	50	52	54	56	58	59	61	63
	3	5	8	11	13	16	19	22	25	28	31	34	38	41	44	48	51	55	59	62	66	70
74	-28	-7	4	12	18	23	27	31	34	37	40	42	45	47	49	51	53	55	57	59	61	62
	1	4	6	9	12	14	17	20	23	26	29	32	35	38	42	45	48	52	55	59	63	67
75	-14	0	9	15	21	25	29	33	36	39	41	44	46	48	51	53	55	56	58	60	62	63
	3	5	8	10	13	16	18	21	24	27	30	33	36	39	42	46	49	52	56	60	63	67
76	-26	-6	5	13	18	23	27	31	35	38	40	43	45	48	50	52	54	56	58	59	61	63
	1	4	6	9	11	14	17	19	22	25	28	31	34	37	40	43	46	50	53	57	60	64
77	-54	-13	1	9	16	21	26	30	33	36	39	42	45	47	49	51	53	55	57	59*	61	62
		3	5	7	10	12	15	18	20	23	26	29	32	34	37	41	44	47	50	54	57	61
78	-23	-4	6	13	19	24	28	32	35	38	41	44	46	48	51	53	55	56	58	60	62	63
	1	4	6	9	11	13	16	19	21	24	27	29	32	35	38	41	44	48	51	54	57	61
79	-45	-11	2	10	17	22	27	30	34	37	40	43	45	48	50	52	54	56	58	60	61	63
		3	5	7	10	12	14	17	20	22	25	27	30	33	36	39	42	45	46	51	55	58
80	-20	-3	7	14	20	25	29	33	36	39	42	44	47	49	51	53	55	57	59	61	62	64
	2	4	6	8	11	13	15	18	20	23	26	28	31	34	37	40	43	46	49	52	55	58

Dry Bulb	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
61	61																			
	95																			
62	60	62																		
	95																			
63	61	63	63																	
	95																			
64	61	63	64	64																
	90	95																		
65	60	62	64	65	65															
	85	90	95																	
66	60	61	63	65	66	66														
	81	85	90	95																
67	59	61	63	64	66	67	67													
	76	81	86	90	95															
68	59	60	62	64	65	67	68	68												
	72	77	81	86	90	95														
69	58	60	62	63	65	66	68	69	69											
	69	73	77	81	86	91	95													
70	58	59	61	63	64	66	67	69	70	70										
	65	69	73	77	82	86	91	95												
71	55	57	59	60	62	64	65	67	68	70	71									
	58	61	65	69	73	78	82	86	91	95										
72	55	56	58	60	62	63	65	66	68	69	71	72								
	54	58	62	66	70	74	78	82	86	91	95									
73	54	56	58	59	61	63	64	66	67	69	70	72	73							
	51	55	59	62	66	70	74	78	82	87	91	95								
74	53	55	57	59	61	62	64	65	67	68	70	71	73	74						
	48	52	55	59	63	67	70	74	78	83	87	91	95							
75	53	55	56	58	60	62	63	65	66	68	69	71	72	74	75					
	46	49	52	56	60	63	67	71	75	79	83	87	91	96						
76	52	54	56	58	59	61	63	64	66	68	69	70	72	73	75	76				
	43	46	50	53	57	60	64	67	71	75	79	83	87	91	96					
77	51	53	55	57	59*	61	62	64	66	67	69	70	71	73	74	76	77			
	41	44	47	50	54	57	61	64	68	71	75	79	83	87	91	96				
78	51	53	55	56	58	60	62	63	65	67	68	70	71	73	74	75	77	78		
	38	41	44	48	51	54	57	61	64	68	72	76	79	83	87	91	96			
79	50	52	54	56	58	60	61	63	65	66	68	69	71	72	74	75	76	78	79	
	36	39	42	45	46	51	55	58	61	65	68	72	76	80	84	88	92	96		
80	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73	75	76	77	79	
	34	37	40	43	46	49	52	55	58	62	65	69	72	76	80	84	88	92	96	

Temperature, relative humidity and dew point tables

Elevations between 1,901 and 3,900 feet (In Alaska, between 1,701 and 3,600 feet)

Wet Bulb Temperatures
49 to 89 F
(Read Down)

Dry Bulb Temperatures
81 to 100 F
(Read Across)

Dry Bulb	Wet Bulb 49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	-9	3	12	18	23	27	31	35	38	41	43	46	48	50	53	55	57	58	60	62	64	65	67	68	70	71	73	74	76	77	78	80
	3	5	7	9	12	14	16	19	21	24	26	29	32	35	37	40	43	46	49	52	56	59	62	66	69	73	76	80	84	88	92	96
82	-17	-1	8	15	21	26	30	33	37	40	42	45	47	50	52	54	56	58	60	61	63	65	66	68	70	71	72	74	75	77	78	79
	2	4	6	8	10	13	15	17	20	22	25	27	30	33	35	38	41	44	47	50	53	56	59	63	66	69	73	77	80	84	88	92
83	-31	-7	5	13	19	24	28	32	35	39	41	44	47	49	51	53	55	57	59	61	63	64	66	68	69	71	72	74	75	76	78	79
	1	3	5	7	9	11	14	16	18	21	23	26	28	31	33	36	39	42	44	47	50	53	57	60	63	66	70	73	77	80	84	88
84	-14	1	10	17	22	27	31	34	37	40	43	46	48	50	53	55	57	59	60	62	64	66	67	69	70	72	73	75	76	77	79	80
	2	4	6	8	10	12	15	17	19	21	24	26	29	31	34	37	39	42	45	48	51	54	57	60	63	67	70	74	77	81	84	88
85	-26	-5	6	14	20	25	29	33	36	39	42	45	47	50	52	54	56	58	60	62	63	65	67	68	70	71	73	74	76	77	78	80
	1	3	5	7	9	11	13	15	18	20	22	25	27	30	32	35	37	40	43	46	48	51	54	57	61	64	67	70	74	77	81	85
86	-11	2	11	18	23	28	32	35	38	41	44	47	49	51	53	55	57	59	61	63	65	66	68	69	71	72	74	75	77	78	80	81
	2	4	6	8	10	12	14	16	19	21	23	25	28	30	33	35	38	41	43	46	49	52	55	58	61	64	67	71	74	78	81	85
87	-21	-2	8	15	21	26	30	34	37	40	43	46	48	50	53	55	57	59	61	62	64	66	67	69	71	72	74	75	76	78	79	81
	1	3	5	7	9	11	13	15	17	19	22	24	26	29	31	33	36	39	41	44	47	49	52	55	58	61	64	68	71	74	78	81
88	-39	-8	4	13	19	24	29	33	36	39	42	45	47	50	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	78	79	80
		2	4	6	8	10	12	14	16	18	20	22	25	27	29	32	34	37	39	42	44	47	50	53	56	59	62	65	68	71	75	78
89	-17	0	9	17	22	27	31	35	38	41	44	47	49	51	53	56	58	59	61	63	65	67	68	70	71	73	74	76	77	79	80	81
	1	3	5	7	9	11	13	15	17	19	21	23	25	28	30	32	35	37	40	42	45	48	50	53	56	59	62	65	68	71	75	78
90	-30	-6	6	14	20	25	30	34	37	40	43	46	48	51	53	55	57	59	61	63	64	66	68	69	71	72	74	75	77	78	80	81
	1	2	4	6	8	10	12	13	15	17	20	22	24	26	28	31	33	35	38	40	43	45	48	51	54	56	59	62	65	69	72	75
91	-13	2	11	18	23	28	32	36	39	42	45	47	50	52	54	56	58	60	62	64	66	67	69	71	72	74	75	77	78	79	81	82
	2	3	5	7	9	11	12	14	16	18	20	22	25	27	29	31	34	36	38	41	43	46	49	51	54	57	60	63	66	69	72	75
92	-23	-3	8	16	22	27	31	35	38	41	44	47	49	51	54	56	58	60	62	63	65	67	69	70	72	73	75	76	78	79	80	82
	1	3	4	6	8	10	11	13	15	17	19	21	23	25	27	30	32	34	36	39	41	44	46	49	52	54	57	60	63	66	69	72
93	-45	-9	4	13	19	25	29	33	37	40	43	46	48	51	53	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80	81
		2	3	5	7	9	10	12	14	16	18	20	22	24	26	28	30	32	35	37	39	42	44	47	50	52	55	58	60	63	66	69
94	-17	0	10	17	23	28	32	36	39	42	45	47	50	52	54	57	59	61	62	64	66	68	69	71	72	74	76	77	78	80	81	83
	1	3	4	6	8	9	11	13	15	17	19	20	22	24	27	29	31	33	35	38	40	42	45	47	50	53	55	58	61	64	67	70
95	-31	-5	6	15	21	26	30	34	38	41	44	47	59	52	54	56	58	60	62	64	66	67	69	71	72	74	75	77	78	80	81	82
	1	2	4	5	7	9	10	12	14	16	17	19	21	23	25	27	29	31	34	36	38	40	43	45	48	50	53	56	58	61	64	67
96	-12	3	12	19	24	29	33	37	40	43	46	48	51	53	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79	81	82	83
	1	3	4	6	8	9	11	13	14	16	18	20	22	24	26	28	30	32	34	36	39	41	43	46	48	51	53	56	59	61	64	67
97	-23	-2	9	16	22	27	32	36	39	42	45	48	50	52	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80	82	83
	1	2	4	5	7	8	10	12	13	15	17	19	21	23	24	26	28	30	33	35	37	39	41	44	46	49	51	54	56	59	62	65
98	-44	-8	5	14	20	26	30	34	38	41	44	47	49	52	54	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	81	83
		2	3	5	6	8	9	11	13	14	16	18	19	21	23	25	27	29	31	33	35	37	40	42	44	47	49	52	54	57	59	62
99	-16	1	11	18	24	29	33	37	40	43	46	49	51	53	56	58	60	62	64	65	67	69	71	72	74	75	77	78	80	81	83	84
	1	2	4	5	7	8	10	12	13	15	17	18	20	22	24	26	28	30	32	34	36	38	40	42	45	47	50	52	55	57	60	62
100	-29	-4	8	16	22	27	32	35	39	42	45	48	50	53	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79	81	82	84
	1	2	3	5	6	8	9	11	12	14	16	17	19	21	23	24	26	28	30	32	34	36	38	41	43	45	48	50	52	55	57	60

Dry Bulb	Wet Bulb 81	82	83	84	85	86	87	88	89	90
81	81	82	83	84	85	86	87	88	89	90
	96	96	96	96	96	96	96	96	96	96
82	81	82	83	84	85	86	87	88	89	90
	96	96	96	96	96	96	96	96	96	96
83	80	82	83	84	85	86	87	88	89	90
	92	96	96	96	96	96	96	96	96	96
84	80	81	83	84	85	86	87	88	89	90
	88	92	96	96	96	96	96	96	96	96
85	80	81	82	84	85	86	87	88	89	90
	85	88	92	96	96	96	96	96	96	96
86	80	81	82	83	85	86	87	88	89	90
	81	85	88	92	96	96	96	96	96	96
87	79	81	82	83	84	86	87	88	89	90
	78	81	85	88	92	96	96	96	96	96
88	79	80	82	83	84	85	87	88	89	90
	75	78	81	85	89	92	96	96	96	96
89	79	80	81	83	84	85	87	88	89	90
	71	75	78	82	85	89	92	96	96	96
90	78	80	81	82	84	85	86	88	89	90
	69	72	75	78	82	85	89	92	96	96
91	78	79	81	82	83	85	86	87	89	90
	66	69	72	75	79	82	85	89	93	96
92	78	79	80	82	83	84	86	87	88	90
	63	66	69	72	75	79	82	86	89	93
93	77	79	80	81	83	84	85	87	88	89
	60	63	66	69	73	76	79	82	86	89
94	77	78	80	81	83	84	85	87	88	89
	58	61	64	67	70	73	76	79	82	86
95	77	78	80	81	82	84	85	86	88	89
	56	58	61	64	67	70	73	76	79	83
96	76	78	79	81	82	83	85	86	87	89
	53	56	59	61	64	67	70	73	76	79
97	76	77	79	80	82	83	84	86	87	88
	51	54	56	59	62	65	67	70	73	76
98	76	77	79	80	81	83	84	85	87	88
	49	52	54	57	59	62	65	68	71	74
99	75	77	78	80	81	83	84	85	87	88
	47	50	52	55	57	60	62	65	68	71
100	75	76	78	79	81	82	84	85	86	88
	45	48	50	52	55	57	60	63	65	68

Temperature, relative humidity and dew point tables

Elevations between 1,901 and 3,900 feet (In Alaska, between 1,701 and 3,600 feet)

Wet Bulb Temperatures, 57 to 90 F

(Read Down)

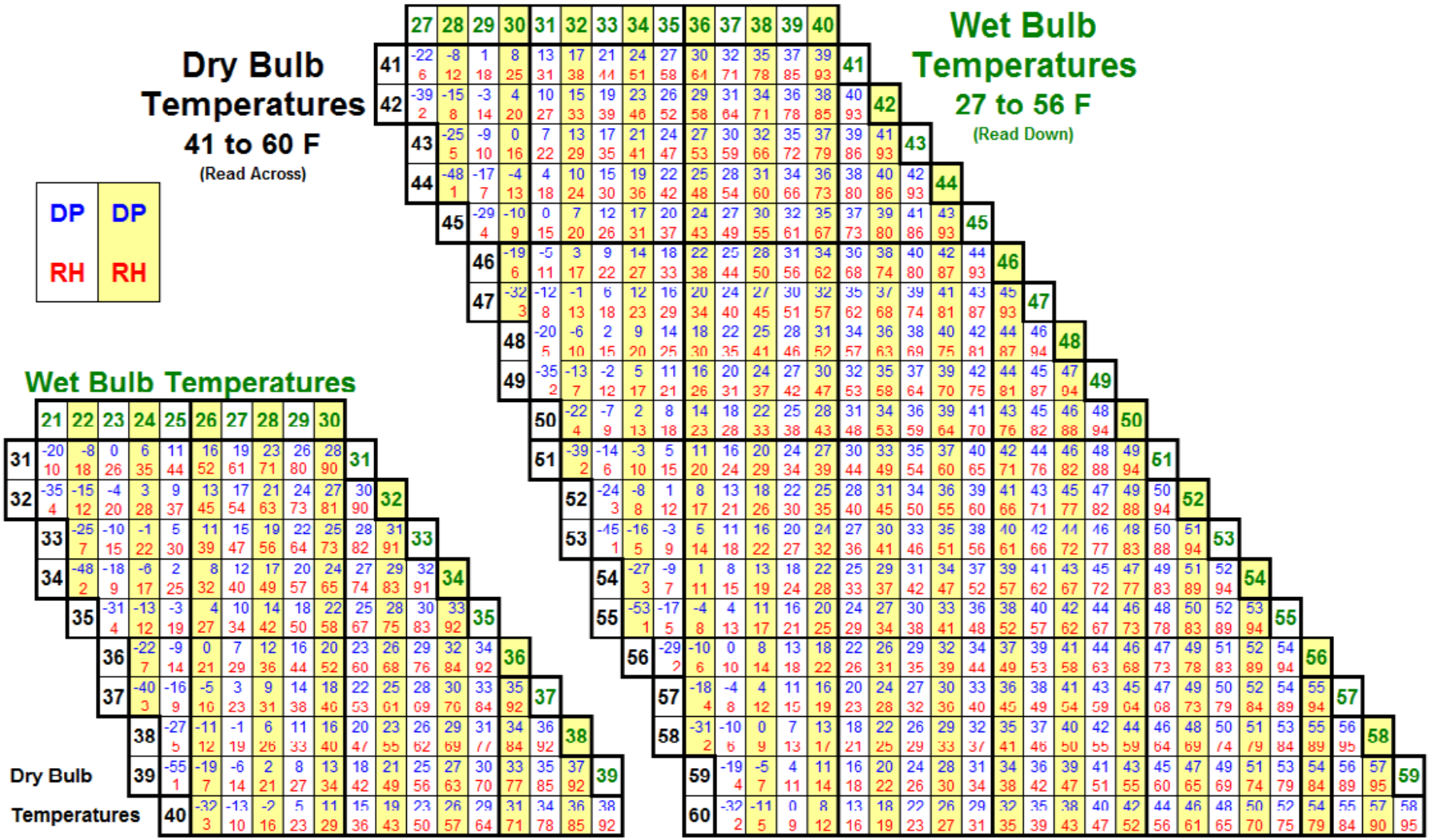
DP DP
RH RH

Dry Bulb Temperatures
101 to 119 F
(Read Across)

Dry Bulb	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
101	-11	4	13	20	25	30	34	38	41	44	47	50	52	54	57	59	61	63	65	66	68	70	71	73	75	76	78	79	81	82	83	85	86	87
	1	3	4	5	7	8	10	11	13	15	16	18	20	21	23	25	27	29	31	33	35	37	39	41	43	46	48	50	53	55	50	60	63	66
102	-20	-1	10	18	24	29	33	37	40	43	46	49	51	54	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	82	83	84	86	87
	1	2	3	5	6	8	9	11	12	14	15	17	19	20	22	24	26	27	29	31	33	35	37	39	42	44	46	48	51	53	56	58	61	63
103	-37	-6	7	15	22	27	32	36	39	42	45	48	51	53	55	58	60	62	64	65	67	69	71	72	74	75	77	78	80	81	83	84	86	87
		2	3	4	6	7	8	10	11	13	14	16	18	19	21	23	24	26	28	30	32	34	36	38	40	42	44	48	49	51	53	56	58	61
104	-13	3	13	20	25	30	34	38	41	44	47	50	52	55	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84	85	87	
	1	2	4	5	6	8	9	11	12	13	15	17	18	20	21	23	25	27	28	30	32	34	36	38	40	42	45	47	49	51	54	56	59	
105	-24	-2	9	17	24	29	33	37	40	43	46	49	52	54	56	58	61	63	64	66	68	70	72	73	75	76	78	79	81	82	84	85	86	
	1	2	3	4	6	7	8	10	11	13	14	16	17	19	20	22	24	25	27	29	31	33	35	37	49	41	43	45	47	49	52	54	57	
106	-48	8	6	15	22	27	32	36	39	43	46	48	51	53	56	58	60	62	64	66	68	69	71	73	74	76	78	79	80	82	83	85	86	
		1	3	4	5	6	8	9	10	12	13	15	16	18	19	21	23	24	26	28	30	31	33	35	37	39	41	43	45	48	50	52	54	
107	-16	2	12	19	25	30	34	38	42	45	48	50	53	55	57	59	62	64	65	67	69	71	72	74	76	77	79	80	82	83	84	86		
	1	2	3	4	6	7	8	10	11	12	14	15	17	18	20	22	23	25	27	28	30	32	34	36	38	40	42	44	46	48	50	52		
108	-28	-3	9	17	23	29	33	37	41	44	47	49	52	54	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84	86		
		2	3	4	5	6	8	9	10	12	13	14	16	17	19	20	22	24	25	27	29	31	32	34	36	38	40	42	44	46	48	51		
109	-9	5	15	21	27	32	36	40	43	46	49	51	54	56	58	60	63	64	66	68	70	72	73	75	77	78	80	81	83	84	85			
	1	2	3	5	6	7	8	10	11	12	14	15	17	18	19	21	23	24	26	28	29	31	33	35	36	38	40	42	44	47	49			
110	-18	1	12	19	25	30	35	38	42	45	48	51	53	56	58	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84	85			
	1	2	3	4	5	6	8	9	10	12	13	14	16	17	19	20	22	23	25	26	28	30	31	33	35	37	39	41	43	45	47			
111	-32	-4	9	17	24	29	33	37	41	44	47	50	52	55	57	59	61	64	65	67	69	71	73	74	76	77	79	80	82	83	85			
		1	2	4	5	6	7	8	10	11	12	13	15	16	18	19	21	22	24	25	27	28	30	32	34	35	37	39	41	43	45			
112	-10	5	15	22	27	32	36	40	43	46	49	52	54	57	59	61	63	65	67	69	70	72	74	76	77	79	80	82	83	85				
	1	2	3	4	5	7	8	9	10	11	13	14	15	17	18	20	21	23	24	26	27	29	31	32	34	36	38	40	42	44				
113	-19	1	12	19	25	31	35	39	42	45	48	51	54	56	58	60	63	65	66	68	70	72	74	75	77	78	80	81	83	84				
	1	2	3	4	5	6	7	8	10	11	12	13	15	16	17	19	20	22	23	25	26	28	29	31	33	35	36	38	40	42				
114	-35	-4	9	17	24	29	34	38	41	44	47	50	53	55	58	60	62	64	66	68	70	71	73	75	76	78	80	81	83	84				
		1	2	3	4	5	6	7	8	9	11	13	14	15	16	18	19	21	22	24	25	27	28	30	32	33	35	37	39	40				
115	-11	5	15	22	27	32	36	40	44	47	50	52	55	57	59	61	64	66	67	69	71	73	74	76	78	79	81	82	84					
	1	2	3	4	5	6	7	8	9	11	12	13	14	16	17	18	20	21	23	24	26	27	29	30	32	34	35	37	39					
116	-20	1	12	20	26	31	35	39	43	46	49	51	54	56	59	61	63	65	67	69	71	72	74	76	77	79	81	82	84					
	1	2	2	4	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	23	25	26	28	29	31	32	34	36	38					
117	-38	-4	9	17	24	29	34	38	42	45	48	51	53	56	58	60	63	65	67	68	70	72	74	75	77	79	80	82	83					
		1	2	3	4	5	6	7	8	9	11	12	13	14	15	17	18	19	21	22	24	25	26	28	30	31	33	34	36					
118	-11	5	15	22	28	33	37	41	46	47	50	53	55	58	60	62	64	66	68	70	72	73	75	77	78	80	81	83						
	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	20	21	23	24	25	27	28	30	32	33	35						
119	-21	1	12	20	26	31	36	40	43	46	49	52	55	57	59	62	64	66	68	69	71	73	75	76	78	80	81	83						
		1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	18	19	20	22	23	24	26	27	29	30	32	34						

Temperature, relative humidity and dew point tables

Elevations between 3,901 and 6,100 feet (In Alaska, between 3,601 and 5,700 feet)



Temperature, relative humidity and dew point tables

Elevations between 3,901 and 6,100 feet (In Alaska, between 3,601 and 5,700 feet)

Wet Bulb Temperatures
38 to 79 F
(Read Down)

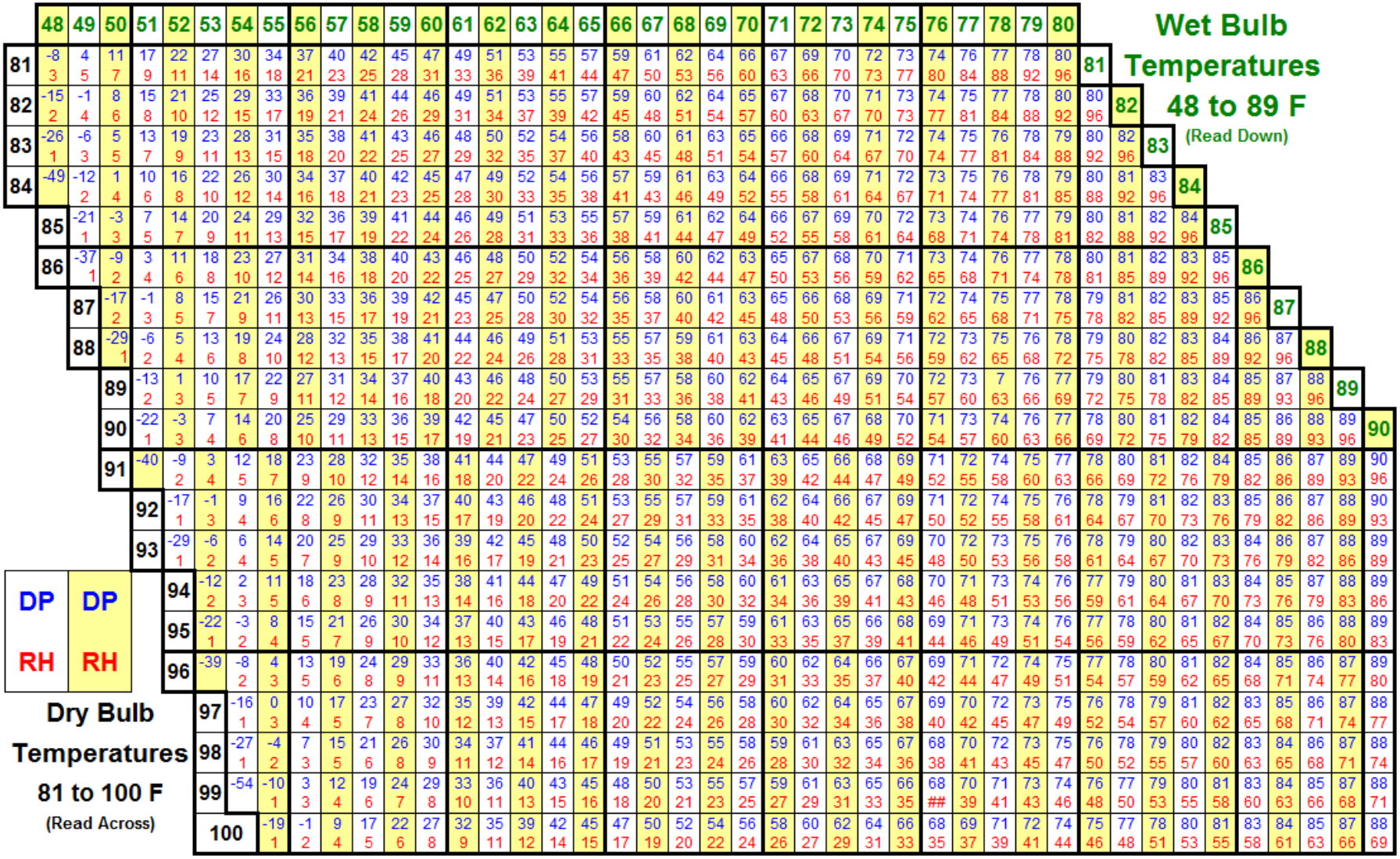
Dry Bulb Temperatures
61 to 80 F
(Read Across)

	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
61	-19 3	-5 7	4 10	11 14	16 17	21 21	24 24	28 28	31 32	34 36	37 40	39 44	41 48	43 52	46 57	48 61	49 66	51 70	53 75	55 80	56 85	58 90	59 95	61
62	-33 1	-11 5	0 8	8 11	14 15	19 18	23 22	26 26	30 29	33 33	35 37	38 41	40 45	43 49	45 53	47 57	49 62	51 66	52 71	54 75	56 80	57 85	59 90	61 95	62
63	-19 3	-5 6	4 9	11 13	16 16	21 20	25 23	28 27	31 30	34 34	37 38	39 42	42 46	44 50	46 54	48 58	50 62	52 67	54 71	55 76	57 80	58 85	60 90	62 95	63
64	-34 1	-11 4	0 8	8 11	14 14	19 17	23 21	27 24	30 28	33 31	36 35	38 39	41 43	43 46	45 50	47 54	49 59	51 63	53 67	55 72	56 76	58 81	60 85	61 90	63 95	64
65	-19 3	-4 6	5 9	11 12	17 15	21 19	25 22	29 25	32 29	35 32	37 36	40 40	42 43	44 47	47 51	49 55	50 59	52 63	54 68	56 72	57 76	59 81	61 86	62 90	64 95	65
66	-33 1	-10 4	1 7	8 10	14 13	19 16	23 20	27 23	31 26	34 30	36 33	39 37	41 40	44 44	46 48	48 52	50 56	52 60	53 64	55 68	57 72	58 77	60 81	62 86	63 90	65 95	65
67	-19 3	-4 6	5 8	12 11	17 15	22 18	26 21	29 24	32 27	35 31	38 34	40 38	43 41	45 45	47 49	49 52	51 56	53 60	55 64	56 68	58 73	60 77	61 81	63 86	64 90	66 95	67
68	-32 1	-10 4	1 7	9 10	15 13	20 16	24 19	28 22	31 25	34 28	37 32	39 35	42 39	44 42	46 46	48 49	50 53	52 57	54 61	56 65	57 69	59 73	61 77	62 82	64 86	65 91	67 95	68
69	-18 3	-3 5	6 8	12 11	18 14	22 17	26 20	30 23	33 26	36 29	38 33	41 36	43 39	45 43	48 46	50 50	52 54	53 57	55 61	57 65	59 69	60 73	62 78	63 82	65 86	66 91	68 95	69
70	-31 1	-9 4	2 7	10 9	15 12	20 15	25 18	28 21	32 24	35 27	37 30	40 33	42 37	45 40	47 44	49 47	51 51	53 54	55 58	56 62	58 66	60 70	61 74	63 78	64 82	66 86	67 91	69 95	70
71	-17 3	-3 5	6 8	13 11	18 13	23 16	27 19	30 22	33 25	36 28	39 31	41 34	44 38	46 41	48 44	50 48	52 51	54 55	56 58	57 62	59 66	61 70	62 74	64 78	65 82	67 87	68 91	70 95	71
72	-29 1	-8 4	3 6	10 9	16 12	21 14	25 17	29 20	32 23	35 26	38 29	41 32	43 35	45 38	47 42	49 45	51 48	53 52	55 55	57 59	59 63	60 66	62 70	63 74	65 78	66 83	68 87	69 91	71 95	72
73	-15 3	-2 5	7 8	14 10	19 13	23 16	27 18	31 21	34 24	37 27	40 30	42 33	44 36	47 39	49 42	51 46	53 49	55 52	56 56	58 59	60 63	61 67	63 71	64 75	66 79	67 83	69 87	70 91	72 96	73
74	-26 1	-7 4	4 6	11 9	17 11	22 14	26 17	30 19	33 22	36 25	39 28	41 31	44 34	46 37	48 40	50 43	52 46	54 50	56 53	58 56	59 60	61 64	62 67	64 71	66 75	67 79	68 83	70 87	71 91	73 96	74
75	-52	-14 3	0 5	8 7	15 10	20 12	24 15	28 18	32 20	35 23	38 26	40 29	43 31	45 34	47 37	49 41	51 44	53 47	55 50	57 53	59 57	60 60	62 64	64 68	65 71	67 75	68 79	70 83	71 87	72 91	74 96	75
76	-24 2	5 4	5 6	12 9	18 11	22 13	27 16	30 19	33 21	36 24	39 27	42 29	44 32	47 35	49 38	51 41	53 44	55 47	56 51	58 54	60 57	62 61	63 64	65 68	66 72	68 75	69 79	71 83	72 87	73 91	75 96	76
77	-43	-12 3	1 5	9 7	15 10	21 12	25 14	29 17	32 19	35 22	38 25	41 27	43 30	46 33	48 36	50 39	52 42	54 45	56 48	58 51	59 55	61 58	63 61	64 65	66 68	67 72	69 76	70 80	72 83	73 87	74 92	76 96	77
78	-21 2	-4 4	6 6	13 8	19 11	23 13	27 15	31 18	34 20	37 23	40 26	43 28	45 31	47 34	49 37	51 40	53 42	55 46	57 49	59 52	61 55	62 58	64 62	65 65	67 69	68 72	70 76	71 80	73 84	74 88	75 92	77 96	78
79	-36 1	-10 3	2 5	10 7	16 9	21 12	26 14	30 16	33 19	36 21	39 24	42 26	44 29	46 32	49 35	51 37	53 40	55 43	57 46	58 49	60 52	62 6	63 59	65 62	66 66	68 69	69 73	71 76	72 80	74 84	75 88	76 92	78 96	79
80	-18 2	-2 4	7 6	14 8	20 10	24 13	28 15	32 17	35 20	38 22	41 25	43 27	46 30	48 32	50 35	52 38	54 41	56 44	58 47	60 50	61 53	63 56	65 59	66 63	68 66	69 69	71 73	72 77	73 80	75 84	76 88	77 92	79 96	

DP	DP
RH	RH

Temperature, relative humidity and dew point tables

Elevations between 3,901 and 6,100 feet (In Alaska, between 3,601 and 5,700 feet)



Temperature, relative humidity and dew point tables

Elevations between 3,901 and 6,100 feet (In Alaska, between 3,601 and 5,700 feet)

Wet Bulb Temperatures, 55 to 90 F

(Read Down)

Dry Bulb Temperatures 101 to 119 F (Read Across)	DP / RH	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
101	DP	-33	-6	6	14	21	26	30	34	38	41	44	46	49	51	54	56	58	60	62	64	65	67	69	70	72	74	75	77	78	79	81	82	84	85	86	88
	RH		2	3	4	6	7	8	10	11	13	14	16	18	19	21	23	24	26	28	30	32	34	36	38	40	42	44	46	49	51	53	56	58	61	63	66
102	DP		-13	2	12	19	24	29	33	37	40	43	46	48	51	53	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79	81	82	83	85	86	87
	RH		1	2	4	5	6	8	9	11	12	13	15	17	18	20	21	23	25	27	28	30	32	34	36	38	40	42	44	47	49	51	54	56	59	61	64
103	DP		-22	-2	9	16	22	27	32	35	39	42	45	48	50	52	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80	82	83	84	86	87
	RH		1	2	3	4	6	7	8	10	11	13	14	16	17	19	20	22	24	25	27	29	31	33	35	37	39	41	43	45	47	49	52	54	56	59	61
104	DP		-39	-7	5	14	20	26	30	34	38	41	44	47	49	52	54	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	81	83	84	86	87
	RH			1	3	4	5	6	8	9	10	12	13	15	16	18	19	21	23	24	26	28	29	31	33	35	37	39	41	43	45	47	50	52	54	57	59
105	DP			-14	2	11	18	24	29	33	37	40	43	46	49	51	53	56	58	60	62	64	65	67	69	71	72	74	75	77	78	80	81	83	84	85	87
	RH			1	2	3	5	6	7	8	10	11	12	14	15	17	18	20	21	23	25	26	28	30	32	34	36	37	39	41	44	46	48	50	52	55	57
106	DP			-25	-3	8	16	22	27	32	36	39	42	45	48	50	53	55	57	59	61	63	65	67	69	70	72	73	75	77	78	80	81	82	84	85	86
	RH			1	2	3	4	5	6	8	9	10	12	13	14	16	17	19	20	22	24	25	27	29	30	32	34	36	38	40	42	44	46	48	50	53	55
107	DP			-47	-8	5	14	20	26	30	35	38	41	44	47	50	52	54	57	59	61	63	65	66	68	70	72	73	75	76	78	79	81	82	83	85	86
	RH				1	2	4	5	6	7	8	10	11	12	14	15	17	18	19	21	23	24	26	27	29	31	33	35	36	38	40	42	44	46	49	51	55
108	DP				-16	1	11	18	24	29	33	37	40	44	46	49	52	54	56	58	60	62	64	66	68	69	71	73	74	76	77	79	80	82	83	85	86
	RH				1	2	3	4	5	7	8	9	10	12	13	14	16	17	19	20	22	23	25	26	28	30	31	33	35	37	39	41	43	45	47	49	51
109	DP				-27	-3	8	16	23	28	32	36	39	43	46	48	51	53	56	58	60	62	64	66	67	69	71	72	74	76	77	79	80	82	83	84	86
	RH					2	3	4	5	6	7	8	10	11	12	13	15	16	18	19	21	22	24	25	27	28	30	32	34	35	37	39	41	43	45	47	49
110	DP				-58	-9	5	14	21	26	31	35	38	42	45	48	50	53	55	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84	85
	RH					1	2	3	4	5	7	8	9	10	11	13	14	15	17	18	20	21	23	24	26	27	29	31	32	34	36	38	40	41	43	45	47
111	DP					-17	1	11	19	24	29	34	37	41	44	47	49	52	54	57	59	61	63	65	67	68	70	72	73	75	77	78	80	81	82	84	85
	RH					1	2	3	4	5	6	7	8	10	11	12	13	15	16	17	19	20	22	23	25	26	28	29	31	33	34	36	38	40	42	44	46
112	DP					-29	-4	8	16	23	28	32	36	40	43	46	49	51	54	56	58	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84	85
	RH						1	2	3	4	6	7	8	9	10	11	13	14	15	16	18	19	21	22	24	25	27	28	30	31	33	35	37	38	39	42	44
113	DP						-10	5	14	21	26	31	35	39	42	45	48	51	53	55	58	60	62	64	66	68	69	71	73	74	76	77	79	80	82	83	85
	RH						1	2	3	4	5	6	7	8	10	11	12	13	14	16	17	18	20	21	23	24	26	27	29	30	32	34	35	37	39	41	43
114	DP						-18	1	11	19	25	30	34	38	41	44	47	50	53	55	57	59	61	63	65	67	69	71	72	74	76	77	79	80	82	83	85
	RH						1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	19	20	22	23	24	26	27	29	31	32	34	36	37	39	41
115	DP						-31	-4	8	17	23	28	33	37	40	44	47	49	52	54	57	59	61	63	65	67	69	70	72	74	75	77	78	80	81	83	84
	RH							1	2	3	4	5	6	7	8	9	11	12	13	14	15	17	18	19	21	22	23	25	26	28	29	31	33	34	36	38	40
116	DP							-10	5	14	21	27	32	36	39	43	46	49	51	54	56	58	60	62	64	66	68	70	72	73	75	77	78	80	81	83	84
	RH							1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	20	21	23	24	25	27	28	30	31	33	35	36	38
117	DP							-18	1	12	19	25	30	35	38	42	45	48	51	53	55	58	60	62	64	66	68	70	71	73	75	76	78	79	81	82	84
	RH							1	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	18	19	20	22	23	24	26	27	29	30	32	33	35	37
118	DP							-31	-3	9	17	24	29	33	37	41	44	47	50	52	55	57	59	62	64	65	67	69	71	73	74	76	78	79	81	82	84
	RH								1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	21	22	23	25	26	28	29	31	32	34	35
119	DP								-9	6	15	22	27	32	36	40	43	46	49	52	54	57	59	61	63	65	67	69	71	72	74	76	77	79	80	82	83
	RH								1	2	3	4	4	5	6	7	8	9	10	12	13	14	15	16	17	19	20	21	22	24	25	27	28	30	31	33	34

Temperature, relative humidity and dew point tables

Elevations between 6,101 and 8,500 feet (In Alaska, between 5,701 and 7,900 feet)

Wet Bulb Temperatures

20 to 50 F

(Read Down)

Dry Bulb Temperatures

31 to 50 F

(Read Across)

DP = Dew Point (°F)
RH = Relative Humidity (%)

Dry Bulb	Wet Bulb 20	21	22	23	24	25	26	27	28	29	30
31	DP -29	-13	-4	3	8	13	17	20	23	26	28
	RH 6	14	22	30	38	46	55	63	72	81	90
32	DP -57	-21	-9	-1	5	10	14	18	21	24	27
	RH 1	9	16	24	32	40	48	56	64	73	82
33	DP -36	-16	-5	2	7	12	16	20	23	36	28
	RH 4	11	18	26	34	41	49	57	66	74	83
34	DP -26	-11	-2	4	10	14	18	21	24	27	30
	RH 6	13	21	28	35	43	51	59	67	75	84
35	DP -44	-19	-7	1	7	12	16	19	23	26	28
	RH 2	9	16	23	30	37	45	52	60	68	76
36	DP -31	-13	-4	3	9	13	17	21	24	27	29
	RH 4	11	18	25	32	39	46	54	61	69	77
37	DP -22	-9	0	6	11	15	19	22	25	28	31
	RH 7	13	20	27	34	41	48	55	63	70	77
38	DP -37	-16	-5	3	8	13	17	21	24	27	29
	RH 3	9	16	22	29	35	42	49	57	64	71
39	DP -25	-10	-1	4	11	15	19	22	25	28	30
	RH 5	11	18	24	31	37	44	51	58	64	71
40	DP -45	-18	-6	2	8	13	17	21	24	27	29
	RH 2	8	14	20	26	32	39	46	52	58	65
41	DP -29	-12	-2	5	10	15	19	22	25	28	30
	RH 4	10	16	22	28	34	41	47	53	59	66
42	DP -57	-20	-7	1	8	13	17	20	24	27	29
	RH 1	6	12	18	24	30	36	42	48	54	60
43	DP -33	-13	-3	4	10	15	19	22	25	28	30
	RH 3	9	14	20	26	31	37	43	49	55	61
44	DP -22	-8	1	7	12	17	20	24	26	29	32
	RH 5	11	16	22	27	33	38	44	50	56	62
45	DP -37	-14	-3	4	10	15	18	22	25	28	31
	RH 2	7	13	18	24	29	34	40	45	51	57
46	DP -24	-9	0	7	12	16	20	23	26	29	32
	RH 4	9	15	20	25	30	35	41	46	52	57
47	DP -41	-15	-4	4	10	14	18	22	25	28	31
	RH 2	7	12	17	21	26	31	37	42	47	53
48	DP -25	-9	0	7	12	16	20	23	27	29	32
	RH 4	9	13	18	23	28	33	38	43	48	53
49	DP -45	-16	-4	3	9	14	18	22	25	28	31
	RH 1	6	11	15	20	24	29	34	39	44	49
50	DP -26	-9	0	6	12	16	20	24	27	29	32
	RH 3	8	12	17	21	26	30	35	40	45	50

Dry Bulb	Wet Bulb 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
31	DP 31																			
	RH 55																			
32	DP 34	32																		
	RH 64	91																		
33	DP 37	35	33																	
	RH 73	92																		
34	DP 39	38	36	34																
	RH 82	92																		
35	DP 41	40	38	36	35															
	RH 91	92																		
36	DP 43	42	40	39	37	36														
	RH 99																			
37	DP 45	44	42	41	39	38	37													
	RH																			
38	DP 47	46	44	43	41	40	38	38												
	RH																			
39	DP 49	48	46	45	43	42	40	39	39											
	RH																			
40	DP 51	50	48	47	45	44	42	41	40	40										
	RH																			
41	DP 53	52	50	49	47	46	44	43	42	41	41									
	RH																			
42	DP 55	54	52	51	49	48	46	45	44	43	42	42								
	RH																			
43	DP 57	56	54	53	51	50	48	47	46	45	44	43	43							
	RH																			
44	DP 59	58	56	55	53	52	50	49	48	47	46	45	44	44						
	RH																			
45	DP 61	60	58	57	55	54	52	51	50	49	48	47	46	45	45					
	RH																			
46	DP 63	62	60	59	57	56	54	53	52	51	50	49	48	47	46	46				
	RH																			
47	DP 65	64	62	61	59	58	56	55	54	53	52	51	50	49	48	47	47			
	RH																			
48	DP 67	66	64	63	61	60	58	57	56	55	54	53	52	51	50	49	48	48		
	RH																			
49	DP 69	68	66	65	63	62	60	59	58	57	56	55	54	53	52	51	50	49	49	
	RH																			
50	DP 71	70	68	67	65	64	62	61	60	59	58	57	56	55	54	53	52	51	50	50
	RH																			

Temperature, relative humidity and dew point tables

Elevations between 6,101 and 8,500 feet (In Alaska, between 5,701 and 7,900 feet)

Wet Bulb Temperatures
31 to 70 F
(Read Down)

Dry Bulb Temperatures
51 to 70 F
(Read Across)

DP = Dew Point (°F)
RH = Relative Humidity (%)

Dry Bulb	Wet Bulb 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Dry Bulb
51	DP -44	-16	-5	3	9	14	18	22	25	28	31	33	36	38	40	42	44	46	48	49	51
	RH 1	5	10	14	18	23	27	32	36	41	46	51	56	61	66	72	77	83	88	94	
52	DP -27	-10	-1	6	12	16	20	24	27	30	32	35	37	39	41	43	45	47	49	50	52
	RH 3	7	11	15	20	24	28	33	37	42	47	52	57	62	67	72	77	83	88	94	
53	DP -50	-18	-5	3	9	14	18	22	25	28	31	34	36	38	40	42	44	46	48	50	51
	RH 1	5	9	13	17	21	25	30	34	38	43	48	52	57	62	67	73	78	83	89	94
54	DP -29	-11	-1	4	12	16	20	24	27	30	33	35	37	40	42	44	46	47	49	51	52
	RH 2	6	10	14	18	22	26	31	35	39	44	49	53	58	63	68	73	78	83	89	94
55	DP -57	-19	-6	3	9	14	18	22	26	39	31	34	36	39	41	43	45	47	48	50	52
	RH	4	8	12	16	20	24	28	32	36	40	45	49	54	59	64	68	73	79	84	89
56	DP -30	-11	-1	4	12	16	21	24	27	30	33	35	38	40	42	44	46	48	50	51	53
	RH 2	6	9	13	17	21	25	29	33	37	41	46	50	55	59	64	69	74	79	84	89
57	DP -19	-6	3	9	14	19	22	26	29	32	34	37	39	41	43	45	47	49	51	52	54
	RH 4	7	11	15	18	22	26	30	34	38	42	47	51	55	60	65	69	74	79	84	89
58	DP -22	-12	-1	6	12	17	21	24	28	31	33	36	38	40	42	44	46	48	50	52	53
	RH 2	5	9	12	16	20	23	27	31	35	39	43	47	52	56	61	65	70	75	79	84
59	DP -20	-6	3	9	15	19	23	26	29	32	35	37	39	42	44	46	48	49	51	53	54
	RH 3	7	10	14	17	21	25	28	32	36	40	44	48	52	57	61	66	70	75	80	85
60	DP -32	-12	-1	6	12	17	21	25	28	31	34	36	39	41	43	45	47	49	50	52	54
	RH 2	5	8	12	15	18	22	26	29	33	37	41	45	49	53	57	62	66	71	75	80
61	DP -20	-4	3	10	15	19	23	27	30	33	35	38	40	42	44	46	48	50	52	53	55
	RH 3	6	10	13	16	20	23	27	30	34	38	42	46	50	54	58	62	67	71	76	80
62	DP -32	-11	-1	7	13	17	21	25	28	31	34	37	39	41	43	45	47	49	51	52	54
	RH 2	5	8	11	14	17	21	24	28	31	35	39	43	46	50	54	59	63	67	72	76
63	DP -19	-5	4	10	15	20	24	27	30	33	36	38	40	43	45	47	49	50	52	54	55
	RH 3	6	9	12	15	19	22	25	29	32	36	40	43	47	51	55	59	63	68	72	76
64	DP -32	-11	0	7	10	13	18	22	26	29	32	35	37	40	42	44	46	48	50	52	53
	RH 1	4	7	10	13	17	20	23	26	30	33	37	40	44	48	52	56	60	64	68	72
65	DP -19	-5	4	11	16	20	24	28	31	34	36	39	41	43	45	47	49	51	53	54	56
	RH 3	6	9	12	15	18	21	24	27	31	34	38	41	45	49	52	56	60	64	68	73
66	DP -31	-10	0	8	14	18	22	26	29	32	35	38	40	42	44	46	48	50	52	54	55
	RH 1	4	7	10	13	16	19	22	25	28	32	35	39	42	44	49	53	57	61	65	69
67	DP -18	-44	5	11	16	21	25	28	31	34	37	39	41	44	46	48	50	51	53	55	57
	RH 3	4	8	11	14	17	20	23	26	29	33	34	39	43	46	50	54	57	61	65	69
68	DP -29	-9	1	8	14	19	23	27	30	33	34	38	41	43	45	47	49	51	53	54	54
	RH 1	4	7	10	12	15	18	21	24	27	30	33	37	40	44	47	51	54	58	62	66
69	DP -54	-16	-3	5	12	17	21	25	29	32	35	37	40	42	44	46	48	50	52	54	56
	RH	3	5	8	11	13	16	19	22	25	28	31	34	38	41	44	48	51	55	58	62
70	DP -27	-8	2	9	5	20	24	27	31	34	36	39	41	43	46	48	50	51	53	55	57
	RH 2	4	7	9	12	15	17	20	23	26	29	32	35	38	42	45	48	52	55	59	63

Dry Bulb	Wet Bulb 58	59	60	61	62	63	64	65	66	67	68	69	70	Dry Bulb
51	DP													51
	RH													
52	DP													52
	RH													
53	DP													53
	RH													
54	DP													54
	RH													
55	DP													55
	RH													
56	DP 55													56
	RH 95													
57	DP 56	58												57
	RH 90	95												
58	DP 54	56	58											58
	RH 85	90	95											
59	DP 53	54	56	58										59
	RH 80	85	90	95										
60	DP 52	54	55	57	59	60								60
	RH 75	80	85	89	95									
61	DP 53	55	56	58	60	61								61
	RH 76	80	85	90	95									
62	DP 52	54	56	58	59	61	62							62
	RH 72	76	81	85	90	95								
63	DP 52	54	55	57	59	60	62	63						63
	RH 68	72	76	81	85	90	95							
64	DP 52	53	55	57	58	60	61	63	64					64
	RH 64	68	72	77	81	86	90	95						
65	DP 54	56	58	59	61	62	64	65						65
	RH 60	64	68	73	77	81	86	90	95					
66	DP 55	57	59	60	62	63	65	66	66					66
	RH 57	61	65	69	73	77	82	86	91	95				
67	DP 57	58	60	62	63	64	66	67	67	68				67
	RH 61	65	69	73	78	82	86	91	95					
68	DP 54	58	59	61	62	64	65	67	68	68	69			68
	RH 58	62	66	70	74	78	82	86	91	95				
69	DP 56	57	59	60	62	63	65	66	68	69	69	70		69
	RH 62	66	70	74	78	82	87	91	95					
70	DP 57	58	60	61	63	64	66	67	68	69	70	70	71	70
	RH 63	66	70	74	78	82	87	91	95					

Temperature, relative humidity and dew point tables

Elevations between 6,101 and 8,500 feet (In Alaska, between 5,701 and 7,900 feet)

Wet Bulb Temperatures
42 to 81 F
(Read Down)

Dry Bulb Temperatures
71 to 90 F
(Read Across)

DP	DP
RH	RH

Dry Bulb	Wet Bulb 42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
71	-15	-2	4	13	18	22	26	29	32	35	38	40	43	45	47	49	51	53	54	56	58	59	61	63	64	65	67	68	70
	3	5	8	10	13	16	18	21	24	27	30	33	34	39	42	46	49	52	56	59	63	67	71	75	79	83	87	91	96
72	-25	-7	3	10	16	20	24	28	31	34	37	39	42	44	46	48	50	52	54	56	57	59	61	62	64	65	67	68	69
	2	4	6	9	11	14	17	19	22	25	28	31	34	37	40	43	46	50	53	56	60	64	67	71	75	7*9	83	87	91
73	-43	-13	-1	7	13	18	23	27	30	33	36	39	41	43	46	48	50	52	53	55	56	58	60	62	63	65	66	68	69
	1	3	5	8	10	13	15	18	20	23	26	29	32	34	37	41	44	47	50	53	57	60	64	68	71	75	79	83	87
74	-22	-6	4	11	16	21	25	29	32	35	38	40	43	45	47	49	81	53	55	56	58	60	61	63	64	66	67	69	70
	2	4	6	9	11	14	16	19	21	24	27	29	32	35	38	41	44	47	51	54	57	61	64	68	72	75	79	83	87
75	-37	-12	0	8	14	19	24	27	31	34	37	39	42	44	46	48	50	52	54	56	58	59	61	62	64	65	67	##	70
	1	3	5	7	10	12	15	17	20	22	25	28	30	33	36	39	42	45	48	51	55	58	61	65	68	72	76	80	83
76	-19	-4	5	12	17	22	26	30	33	36	38	41	43	45	48	50	52	53	55	57	59	60	62	63	65	66	68	69	71
	2	4	6	9	11	13	16	18	21	23	26	28	31	34	37	40	43	46	49	52	55	58	62	65	69	72	76	80	84
77	-32	-10	2	9	15	20	24	28	32	35	37	40	42	45	47	49	51	53	55	56	58	60	61	63	65	66	68	69	70
	1	3	5	7	10	12	14	17	19	21	24	26	29	32	35	37	40	43	46	49	52	55	59	62	66	69	73	76	80
78	-17	-3	4	13	18	23	27	30	33	34	39	42	44	46	48	50	52	54	56	58	59	61	63	64	66	67	69	70	71
	2	4	6	8	11	13	15	17	20	22	25	27	30	33	35	38	41	44	47	50	53	56	59	63	66	69	73	76	80
79	-27	-8	3	11	16	21	25	29	32	35	38	41	43	45	48	50	52	54	55	57	59	61	62	64	65	67	68	70	71
	1	3	5	7	9	12	14	16	18	21	23	26	28	31	33	36	39	41	44	47	50	53	56	60	63	66	70	73	77
80	-52	-14	-1	8	14	19	24	28	31	34	37	40	42	45	47	49	51	53	55	57	58	60	62	63	65	66	68	69	71
		2	4	6	8	10	12	15	17	19	22	24	26	29	31	34	37	39	42	45	48	51	54	57	60	63	67	70	73
81	-21	-3	5	12	17	22	26	30	33	36	39	42	44	46	48	50	52	54	56	58	60	61	63	64	66	68	69	70	72
	1	3	5	7	9	11	13	16	18	20	22	25	27	30	32	35	37	40	43	45	48	51	54	57	60	64	67	70	74
82	-40	-11	1	9	15	20	25	29	32	35	38	41	43	46	48	50	52	54	56	57	59	61	62	64	66	67	69	70	71
	1	2	4	6	8	10	12	14	16	19	21	23	25	28	30	33	35	38	41	43	46	49	52	55	58	61	64	67	71
83	-19	-3	4	13	19	23	27	31	34	37	40	42	45	47	49	51	53	55	57	59	60	62	64	65	67	68	70	71	73
	2	3	5	7	9	11	13	15	17	19	22	24	26	29	31	33	36	38	41	44	47	49	52	55	58	61	64	68	71
84	-31	-8	3	11	17	22	26	30	33	36	39	42	44	46	49	51	53	55	56	58	60	62	63	65	66	68	69	71	72
	1	3	4	6	8	10	12	14	16	18	20	22	25	27	29	32	34	37	39	42	44	47	50	53	56	59	62	65	68
85	-15	-1	8	14	20	24	28	32	35	38	41	43	46	48	50	52	54	56	58	59	61	63	64	66	68	69	70	72	73
	2	4	5	7	9	11	13	15	17	19	21	23	25	28	30	32	35	37	40	42	45	48	50	53	56	59	62	65	68
86	-25	-6	5	12	18	23	27	31	34	37	40	42	43	47	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73
	1	3	4	6	8	10	12	14	16	18	20	22	24	26	28	31	33	35	38	40	43	45	48	51	54	56	59	62	65
87	-44	-12	1	9	16	21	26	29	33	36	39	42	44	46	49	51	53	55	57	59	60	62	64	65	67	68	70	71	73
		2	4	5	7	9	11	13	14	16	18	20	22	25	27	29	31	33	36	38	41	43	46	48	51	54	57	60	63
88	-20	-3	7	14	19	24	28	32	35	38	41	43	46	48	50	52	54	56	58	60	62	63	65	66	68	69	71	72	74
	1	3	5	6	8	10	12	13	15	17	19	21	23	25	27	30	32	34	36	39	41	44	46	49	52	54	57	60	63
89	-33	-8	3	11	17	21	27	30	34	37	40	43	45	47	50	52	54	56	58	59	61	63	64	66	68	69	71	72	73
	1	2	4	5	7	9	11	12	14	16	18	20	22	24	26	28	30	32	35	37	39	42	44	47	49	52	55	58	60
90	-15	-1	8	15	21	25	29	33	36	39	42	44	47	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73	75
	2	3	5	6	8	10	11	13	15	17	19	21	22	25	27	29	31	33	35	38	40	42	45	47	50	52	55	58	61

Dry Bulb	Wet Bulb 75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
71	71															
	96															
72	72	72														
	96															
73	73	73	73													
	96															
74	74	74	74	74												
	96															
75	75	75	75	75	75											
	96															
76	75	76	76	76	76	76										
	96															
77	76	76	77	77	77	77	77									
	96															
78	75	77	77	78	78	78	78	78								
	96															
79	76	76	78	78	79	79	79	79	79							
	96															
80	77	77	77	79	79	80	80	80	80	80						
	96															
81	78	78	78	79	80	80	81	81	81	81	81					
	96															
82	79	79	79	80	80	81	81	82	82	82	82	82				
	96															
83	80	80	80	81	81	82	82	82	83	83	83	83	83			
	96															
84	81	81	81	82	82	83	83	83	84	84	84	84	84	84		
	96															
85	82	82	82	83	83	84	84	84	85	85	85	85	85	85	85	
	96															
86	83	83	83	84	84	85	85	85	86	86	86	86	86	86	86	86
	96															
87	84	84	84	85	85	86	86	86	87	87	87	87	87	87	87	87
	96															
88	85	85	85	86	86	87	87	87	88	88	88	88	88	88	88	88
	96															
89	86	86	86	87	87	88	88	88	89	89	89	89	89	89	89	89
	96															
90	87	87	87	88	88	89	89	89	90	90	90	90	90	90	90	90
	96															

Temperature, relative humidity and dew point tables

Elevations between 6,101 and 8,500 feet (In Alaska, between 5,701 and 7,900 feet)

Wet Bulb Temperatures, 50 to 85 F

(Read Down)

DP = Dew Point
RH = Relative Humidity

Dry Bulb (F)	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
91	DP	-5	5	13	19	24	28	32	35	38	41	43	46	48	50	53	55	57	58	60	62	64	65	67	68	70	71	73	74	76	77	78	80	81	82	84
	RH	2	4	5	7	9	10	12	14	16	17	19	21	23	25	27	29	31	34	36	38	40	43	45	48	50	53	56	58	61	64	67	70	73	76	79
92	DP	-11	2	10	17	22	27	30	34	37	40	43	45	48	50	52	54	56	58	60	61	63	65	66	68	70	71	73	74	75	77	78	79	81	82	83
	RH	2	3	5	6	8	10	11	13	15	16	18	20	22	24	26	28	30	32	34	36	39	41	43	46	48	51	53	56	59	61	64	67	70	73	76
93	DP	-18	-2	6	15	20	25	29	33	36	39	42	44	47	49	51	53	55	57	59	61	63	64	66	69	69	71	72	74	75	76	78	79	81	82	83
	RH	1	3	4	6	7	9	10	12	14	15	17	19	21	23	24	26	28	30	33	35	37	39	41	44	46	49	51	54	56	59	62	64	67	70	73
94	DP	-31	-7	4	12	18	23	28	32	35	38	41	44	46	49	51	53	55	57	59	61	62	64	66	67	69	70	72	73	75	76	78	79	80	82	83
	RH	1	2	3	5	6	8	9	11	13	14	16	18	20	21	23	25	27	29	31	33	35	37	40	42	44	47	49	51	54	57	59	62	65	68	71
95	DP	-13	1	10	16	22	26	30	34	37	40	43	45	48	50	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	77	79	80	81	83
	RH	1	3	4	6	7	9	10	12	13	15	17	18	20	22	24	26	28	30	32	34	36	38	40	42	45	47	49	52	54	57	60	62	65	68
96	DP	-22	-3	7	14	20	25	29	33	36	39	42	45	47	50	52	54	56	58	60	61	63	65	67	68	70	71	73	74	76	77	78	80	81	82
	RH	1	2	4	5	6	8	9	11	12	14	16	17	19	21	23	24	26	28	30	32	34	36	38	41	43	45	47	50	52	55	57	60	63	65
97	DP	-38	-9	4	12	18	23	28	32	35	38	41	44	46	49	51	53	55	57	59	61	63	64	66	68	69	71	72	74	75	77	78	80	81	82
	RH	2	3	4	6	7	9	10	12	13	15	16	18	20	21	23	25	27	29	31	33	35	37	39	41	43	45	48	50	53	55	58	60	63
98	DP	-16	0	3	16	22	26	30	34	37	40	43	46	48	50	53	55	57	59	61	62	64	66	67	69	71	75	74	75	76	78	79	81	82
	RH	1	2	4	5	6	8	9	11	12	14	15	17	19	20	22	24	26	27	29	31	33	35	37	39	41	44	46	48	51	53	55	58	60
99	DP	-26	-5	4	14	20	25	29	33	36	39	42	45	48	50	52	54	56	58	60	62	64	65	67	69	70	72	73	75	76	78	79	80	81
	RH	1	2	3	4	6	7	9	10	11	13	14	16	18	19	21	23	24	26	28	30	32	34	36	38	40	42	44	46	49	51	53	56	58
100	DP	-47	-10	3	11	18	23	28	32	35	39	42	44	47	49	51	54	56	58	60	61	63	65	67	68	70	71	73	74	76	77	79	80	81
	RH		1	3	4	5	7	8	9	11	12	14	15	17	18	20	21	23	25	27	28	30	32	34	36	38	40	42	44	47	49	51	54	56
101	DP	-18	-1	9	16	22	26	31	34	38	41	43	46	49	51	53	55	57	59	61	63	65	66	68	70	71	73	74	75	77	78	80	81
	RH	1	2	3	5	6	7	9	10	11	13	14	16	17	19	20	22	24	25	27	29	31	33	35	37	39	41	43	45	47	49	52	54
102	DP	-29	-4	6	14	20	25	29	33	37	40	43	45	48	50	53	55	57	59	61	62	64	66	68	69	71	72	74	75	77	78	80	81
	RH		2	3	4	5	7	8	9	11	12	13	15	16	18	19	21	23	24	26	28	29	31	33	35	37	39	41	43	45	47	50	52
103	DP	-12	2	11	18	23	28	32	36	39	42	45	47	50	52	54	56	58	60	62	64	66	67	69	70	72	74	75	76	78	79	81
	RH	1	2	4	5	6	7	9	10	11	13	14	15	17	18	20	22	23	25	26	28	30	32	34	35	37	39	41	43	46	48	50
104	DP	-20	-2	9	16	22	27	31	35	38	41	44	46	49	51	54	56	58	60	62	63	65	67	68	70	72	73	75	76	78	79	80
	RH	1	2	3	4	5	7	8	9	10	12	13	15	16	17	19	20	22	24	25	27	29	30	32	34	36	38	40	42	44	46	48
105	DP	-33	-6	6	14	20	25	30	33	37	40	43	44	48	51	53	55	57	59	61	63	65	66	68	70	71	73	74	76	77	79	80
	RH		1	3	4	5	6	7	9	10	11	12	14	15	17	18	20	21	23	24	26	27	29	31	33	34	36	38	40	42	44	46
106	DP	-13	2	11	18	24	28	32	36	39	42	45	48	50	52	55	57	59	61	63	64	66	68	69	71	73	74	76	77	79	80
	RH	1	2	3	4	6	7	8	9	10	12	13	14	16	17	19	20	22	23	25	26	28	30	31	33	35	37	39	41	43	45
107	DP	-21	-2	9	16	22	27	31	35	38	41	44	47	49	52	54	56	58	60	62	64	66	67	69	71	72	74	75	77	78	80
	RH	1	2	3	4	5	6	7	9	10	11	12	14	15	16	18	19	21	22	24	25	27	28	30	32	34	35	37	39	41	43
108	DP	-35	-7	5	14	20	25	30	34	37	41	43	44	49	51	53	56	58	60	62	63	65	67	69	70	72	74	75	77	78	79
	RH		1	2	3	5	6	7	8	9	10	12	13	14	15	17	18	20	21	23	24	26	27	29	31	32	34	36	38	39	41
109	DP	-13	2	11	18	24	29	33	36	40	43	45	48	51	53	55	57	59	61	63	65	67	68	70	72	73	75	76	78	79
	RH	1	2	3	4	5	6	7	9	10	11	12	13	15	16	17	19	20	22	23	25	26	28	29	31	33	34	36	38	40

Dry Bulb Temperatures
91 to 109 F
(Read Across)

Temperature, relative humidity and dew point tables

Elevations between 8,501 and 11,000 feet (In Alaska, above 7,900 feet)

Wet Bulb Temperatures
19 to 50 F
(Read Down)

Dry Bulb Temperatures
31 to 50 F
(Read Across)

DP = Dew Point
RH = Relative Humidity

Dry Bulb	Wet Bulb 19	20	21	22	23	24	25	26	27	28	29	30
31	DP -38	-18	-8	-1	5	10	14	17	21	23	26	28
	RH 4	11	18	25	33	41	49	57	65	73	82	90
32	DP -28	-13	-5	2	7	11	15	19	22	25	27	30
	RH 6	13	20	27	35	42	50	58	66	74	82	91
33	DP -49	-21	-9	-2	4	9	13	17	20	23	26	28
	RH 2	9	15	22	29	37	44	52	59	67	75	83
34	DP -33	-15	-6	1	6	11	15	19	22	25	27	30
	RH 4	11	17	24	31	38	46	53	61	68	76	84
35	DP -24	-11	-3	4	9	13	17	20	23	26	29	31
	RH 7	13	20	26	33	40	47	54	62	69	77	95
36	DP -39	-18	-7	0	6	11	15	19	22	25	27	30
	RH 3	9	15	22	28	35	42	49	56	63	71	78
37	DP -27	-13	-3	3	8	13	17	20	23	26	29	31
	RH 5	11	17	24	30	37	43	50	57	64	71	78
38	DP -47	-20	-8	0	6	10	15	18	22	25	27	30
	RH 2	7	13	19	25	32	38	45	52	59	65	72
39	DP -31	-14	-4	3	8	12	16	20	23	26	29	31
	RH 4	10	15	21	27	34	40	46	53	59	66	72
40	DP -60	-22	-9	-1	5	10	14	18	22	25	27	30
	RH 1	6	12	17	23	29	35	41	48	54	60	67
41	DP -35	-15	-5	2	8	12	16	20	23	26	29	31
	RH 3	8	14	19	25	31	37	43	49	55	61	67
42	DP -24	-10	-1	5	10	14	18	22	25	27	30	32
	RH 5	10	16	21	27	33	39	44	50	56	62	68
43	DP -39	-16	-6	2	8	12	17	20	23	26	29	31
	RH 2	7	12	18	23	29	34	40	45	51	57	63
44	DP -25	-11	-2	5	10	15	18	22	25	27	30	32
	RH 4	9	14	20	25	30	36	41	46	52	57	63
45	DP -43	-17	-6	2	8	13	16	20	23	26	29	31
	RH 2	6	11	16	21	27	32	37	42	47	53	58
46	DP -27	-11	-2	5	10	15	18	22	25	28	30	33
	RH 4	8	13	18	23	28	33	38	43	48	54	59
47	DP -46	-18	-6	2	8	13	16	20	23	26	29	31
	RH 1	6	10	15	20	25	29	34	39	44	49	54
48	DP -28	-11	-2	5	10	15	18	22	25	28	30	33
	RH 3	8	12	17	21	26	31	35	40	45	50	55
49	DP -49	-18	-6	2	8	13	17	20	23	26	29	32
	RH 1	5	10	14	18	23	27	32	37	41	46	51
50	DP -29	-11	-2	5	10	15	18	22	25	28	30	33
	RH 3	7	12	16	20	24	29	33	38	42	47	52

Dry Bulb	Wet Bulb 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
31	DP																			
	RH																			
32	DP 30	32																		
	RH 91																			
33	DP 28	31	33																	
	RH 83	92																		
34	DP 27	30	32	34																
	RH 76	84	92																	
35	DP 26	29	31	33	35															
	RH 69	77	95	92																
36	DP 25	27	30	32	34	36														
	RH 63	71	78	85	92															
37	DP 23	26	29	31	33	35	37													
	RH 57	64	71	78	85	93														
38	DP 22	25	27	30	32	34	36	38												
	RH 52	59	65	72	79	86	93													
39	DP 20	23	26	29	31	33	35	37	39											
	RH 46	53	59	66	72	79	86	93												
40	DP 18	22	25	27	30	32	34	36	38	40										
	RH 41	48	54	60	67	73	80	86	93											
41	DP 16	20	23	26	29	31	33	35	37	39	41									
	RH 37	43	49	55	61	67	74	80	87	93										
42	DP 14	18	22	25	27	30	32	34	36	38	40	42								
	RH 33	39	44	50	56	62	68	74	80	87	93									
43	DP 12	17	20	23	26	29	31	33	36	37	39	41	43							
	RH 29	34	40	45	51	57	63	68	75	81	87	93								
44	DP 10	15	18	22	25	27	30	32	35	37	39	40	42	44						
	RH 25	30	36	41	46	52	57	63	69	75	81	87	94							
45	DP 8	13	16	20	23	26	29	31	34	36	38	40	41	43	45					
	RH 21	27	32	37	42	47	53	58	64	70	75	81	87	94						
46	DP 5	10	15	18	22	25	28	30	33	35	37	39	41	43	44	46				
	RH 18	23	28	33	38	43	48	54	59	65	70	76	82	88	94					
47	DP 2	8	13	16	20	23	26	29	31	34	36	38	40	42	44	45	47			
	RH 15	20	25	29	34	39	44	49	54	60	65	71	76	82	88	94				
48	DP -2	5	10	15	18	22	25	28	30	33	35	37	39	41	43	45	46	48		
	RH 12	17	21	26	31	35	40	45	50	55	60	66	71	77	82	88	94			
49	DP -6	2	8	13	17	20	23	26	29	32	34	36	38	40	42	44	46	47	49	
	RH 10	14	18	23	27	32	37	41	46	51	56	61	66	72	77	83	88	94		
50	DP -11	-2	5	10	15	18	22	25	28	30	33	35	38	40	41	43	45	47	48	50
	RH 7	12	16	20	24	29	33	38	42	47	52	57	62	67	72	77	86	89	94	

Temperature, relative humidity and dew point tables

Elevations between 8,501 and 11,000 feet (In Alaska, above 7,900 feet)

Wet Bulb Temperatures
31 to 70 F
(Read Down)

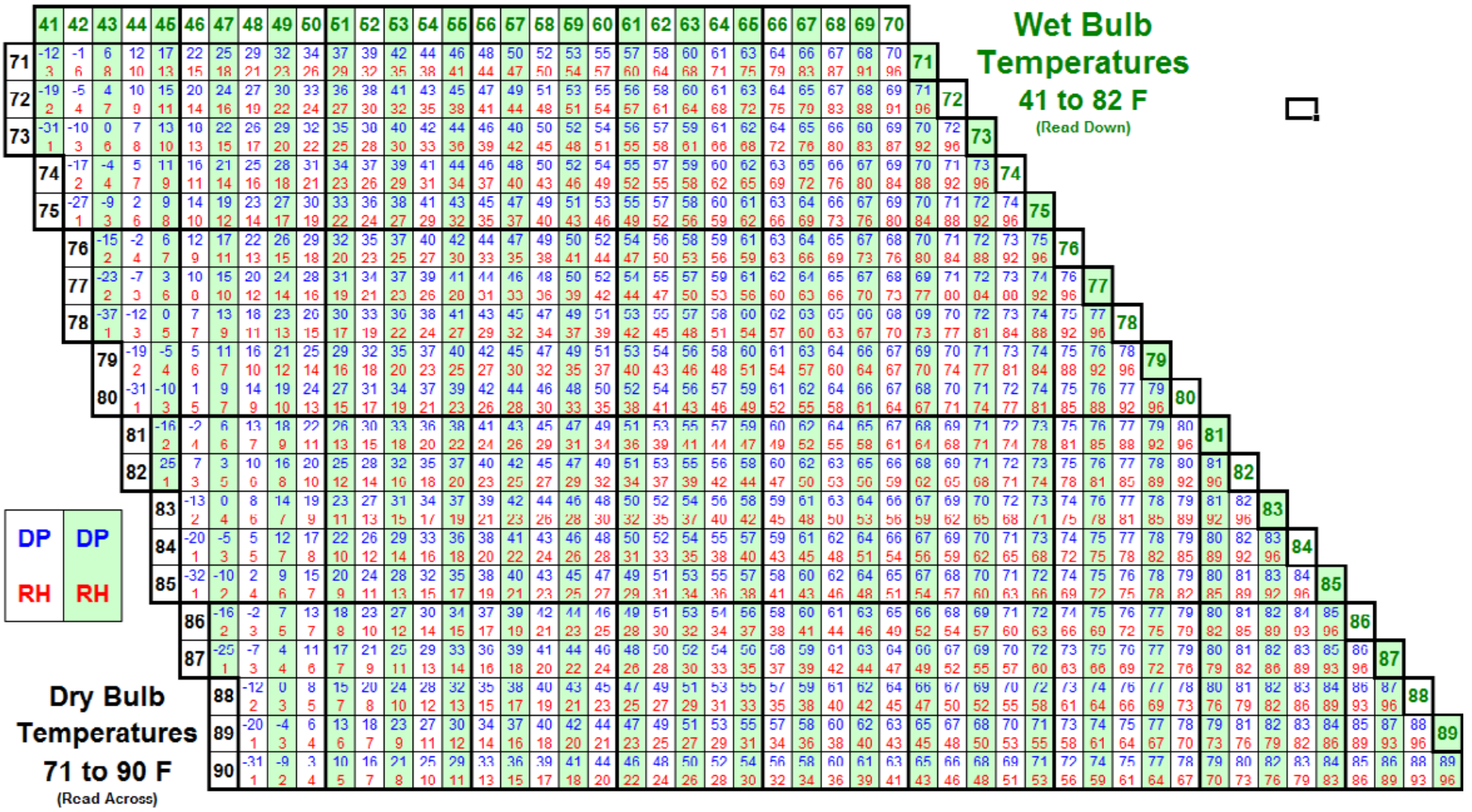
Dry Bulb Temperatures
51 to 70 F
(Read Across)

DP = Dew Point
RH = Relative Humidity

Dry Bulb	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Dry Bulb
51	DP -18 RH 5	-6 9	2 13	8 17	13 21	17 26	20 30	24 34	27 39	29 43	32 48	34 53	37 57	39 62	41 67	43 73	44 78	46 83	48 89	49 94	51
52	-29 3	-11 7	-2 11	5 15	10 19	15 23	19 27	22 31	25 35	28 40	31 44	33 49	36 53	38 58	40 63	42 68	44 73	45 78	47 83	49 89	50 94	52
53	-51 1	-18 5	-6 8	2 12	8 16	13 20	17 24	21 28	24 32	27 36	30 41	32 45	35 50	37 54	39 59	41 64	43 68	45 73	47 79	48 84	50 89	51 94	53
54	-28 3	-11 6	-2 10	5 14	11 17	15 21	19 25	22 29	25 33	28 37	31 42	34 46	36 50	38 55	40 59	42 64	44 69	46 74	48 79	49 84	51 89	52 95	54
55	-50 1	-18 4	-6 8	2 11	8 15	13 19	17 22	21 26	24 30	27 34	30 38	32 43	35 47	37 51	39 56	42 60	43 65	45 69	47 74	49 79	50 84	52 89	53 95	55
56	-29 2	-11 6	-2 9	5 13	11 16	15 20	19 24	23 27	26 31	29 35	31 39	34 43	37 48	39 52	41 56	43 61	45 65	46 70	48 75	50 80	51 84	53 90	54 95	56
57	-52 1	-19 4	-6 7	2 11	8 14	13 18	18 21	21 25	24 29	27 32	30 36	33 40	35 44	38 48	40 53	42 57	44 61	46 66	48 70	49 75	51 80	52 85	54 90	55 95	57
58	-29 2	-11 5	-2 9	5 12	11 15	16 19	20 22	23 26	26 30	29 33	32 37	34 41	37 45	39 49	41 53	43 58	45 62	47 66	49 71	50 75	52 80	53 85	55 90	56 95	58
59	-53 1	-18 4	-6 7	2 10	9 13	14 17	18 20	22 24	25 27	28 31	31 34	33 38	36 42	38 46	40 50	42 54	44 58	46 62	48 67	50 71	51 76	53 80	55 85	56 90	58 95	59
60	-29 2	-11 5	-1 8	6 11	11 15	16 18	20 21	24 25	27 28	30 32	32 35	35 39	37 43	39 47	42 51	44 55	46 59	47 63	49 67	51 72	53 76	54 81	56 85	57 90	59 95	60
61	-18 3	-5 6	3 10	9 13	14 16	18 19	22 22	25 26	28 29	31 33	34 36	36 40	39 44	41 47	43 51	45 55	47 59	49 63	50 68	52 72	54 76	55 81	57 86	58 90	60 95	61
62	-28 2	-11 5	-1 8	6 11	12 14	17 17	21 20	24 23	27 27	30 30	33 34	35 37	38 41	40 44	42 48	44 52	46 56	48 60	50 64	51 68	53 72	55 77	56 81	58 86	59 90	61 95	62
63	-17 3	-5 6	3 9	9 12	15 15	19 18	23 21	26 24	29 28	32 31	34 34	37 38	39 41	41 45	43 49	45 53	47 56	49 60	51 64	53 68	54 73	56 77	57 81	59 86	60 90	62 95	63
64	-27 2	-10 5	0 8	7 10	12 13	17 16	21 19	25 22	28 25	31 29	33 32	36 35	38 39	40 42	43 46	45 49	47 53	49 57	50 61	52 65	54 69	55 73	57 77	58 82	60 86	61 91	63 95	64
65	-47 1	-16 3	-4 6	4 9	10 12	15 14	20 17	23 20	27 23	30 26	32 30	35 33	37 36	40 40	42 43	44 46	46 50	48 54	50 58	52 61	53 65	55 69	56 73	58 78	59 82	61 86	62 91	64 95	65
66	-26 2	-9 5	1 7	7 10	13 13	18 16	22 18	25 21	28 24	31 27	34 31	36 34	39 37	41 40	43 44	45 47	47 51	49 54	51 58	53 62	54 66	56 70	58 74	59 78	60 82	62 86	63 91	65 95	66
67	-43 1	-15 3	-3 6	5 8	11 11	16 14	20 17	24 19	27 22	30 25	33 28	35 31	38 35	40 38	42 41	45 44	47 48	49 51	50 55	52 59	54 62	55 66	57 70	59 74	60 78	61 82	63 87	64 91	66 95	67
68	-24 2	-8 4	2 7	8 10	14 12	18 15	22 18	26 20	29 23	32 26	35 29	37 32	39 35	42 39	44 42	46 45	48 48	50 52	52 55	53 59	55 63	57 67	58 70	60 74	61 78	63 83	64 87	65 91	67 95	68
69	-39 1	-14 3	-2 6	5 8	12 11	17 13	21 16	25 19	28 21	31 24	34 27	36 30	39 33	41 36	43 39	45 42	47 46	49 49	51 52	53 56	54 60	56 63	58 67	59 71	61 75	62 79	64 83	65 87	66 91	68 96	69
70	-22 2	-7 4	3 7	9 9	15 12	19 14	23 17	27 20	30 22	33 25	35 28	38 31	40 34	42 37	44 40	46 43	48 46	50 50	52 53	54 56	56 60	57 64	59 67	60 71	62 75	63 79	65 83	66 87	67 91	69 95	70

Temperature, relative humidity and dew point tables

Elevations between 8,501 and 11,000 feet (In Alaska, above 7,900 feet)



Name _____

Fire effects monitoring worksheet

Instructions: Split into groups of no fewer than two to three students. After receiving instruction on how to use the belt weather kit, each group will pick a different outdoor station to start collecting fire effects monitoring data. Groups will rotate through each station and record the data below.

	Station 1	Station 2	Station 3	Station 4
Time of recording				
Aspect (N, S, E, W)				
Elevation (in feet)				
Exposure (sun, shade, partial)				
Dry bulb temp (F)				
Wet bulb temp (F)				
Relative humidity (calculated)				
Wind speed (knots or mph)				
Wind direction (N,S,E,W)				

Data analysis: Question

Based on your findings at each station, how might you expect fire to behave? Back up your answers referring to relative conditions, such as exposure, humidity and wind.

Scenario 1

Dispatch reports an escaped burn pile and asks you to respond. You are in a type 6 400-gallon fire engine with no crew person, as it is not fire season.

What do you do?

1. 1. Observe fire conditions
2. 2. Call for backup

Your co-workers and supervisor are curious as to why you didn't observe fire behavior and weather conditions before making your decision.

- Back to the classroom for you.

- Fire danger moderate
- Temperature 72°
- Winds 5 mph
- Gusts to 10 mph
- RH 30%

What do you want to do?

1. Can handle. No additional resources necessary.
2. Order 1 additional engine and 10-person hand crew.
3. Order 5 engines, 10-person hand crew and dozer.
4. BROKEN ARROW! I REPEAT BROKEN ARROW! SEND IN EVERYTHING YOU GOT!! SOMEBODY SAVE MEEEEEE!!!!

- While you were easily able to control your fire, the detection center reported another fire on the other end of the county.
- The resources you ordered now have a 1-hour delay and this other fire grew to 15 acres.
- Your supervisor would like a word or 10 with you.
- Try again

Success!

The second engine arrived just in time to back you up while you were repairing a broken hose.

The hand crew was able to check neighboring homes for any spot fires and quickly suppress them.

Things look good on the ground.

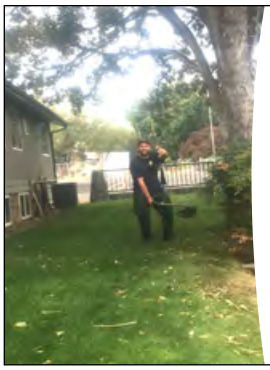
We can also learn from failures.

While attempting to suppress the fire by yourself, your hose lay was burned over.

While attempting to do repairs, the wind picked up and drove the fire into a neighboring home.

No one was injured, but you have some work to do on your decision making.

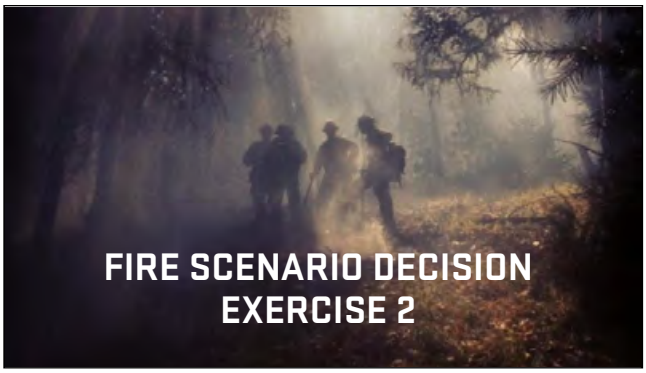
Try again.



Congratulations!

Your dreams of becoming a wildland firefighter are taking a permanent detour. Well, at least until you get fired.

▶ You were kidding, right?



You and your crew are first on scene of this fire.

Fire is quickly approaching the home.

What will you do?

- **Observe fire behavior and maintain situational awareness.**
- **Take immediate action to suppress fire.**

You take a moment to consider your surroundings and scout a passable route into the fire ground. You see and avoid a ditch, and also observe a power line running from the house to a utility pole.

You direct your engine and crews to the other side of the fire where they can anchor in and begin constructing handline and hose lays.

Work is going well when...

You rush in to save the home when you notice something isn't right. You are just a few feet from completing the line and radio communications are getting busy.

Should you:

- Bug dispatch
- Or just finish up?

Unfortunately, the power line was not de-energized. An active power line can pose a life-threatening risk to crew members.

There is no house or tree worth risking lives for. Assume power lines are energized until confirmed by a representative from the power company.

Next time, you will be better able to use your situational awareness to make the best decision for your crew.

At least it's just a sim!

Success! Great call.

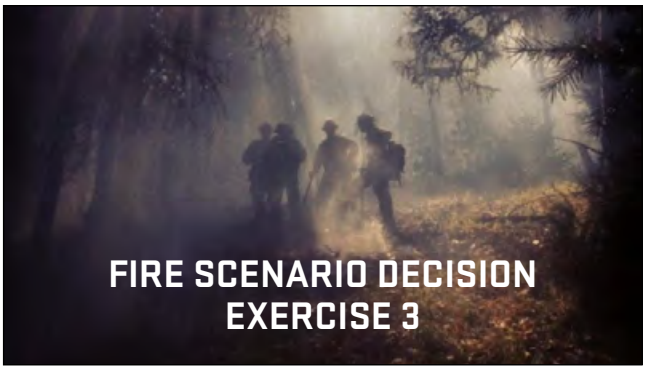
After radioing dispatch to get an ETA for the power company, you advised your crew to stay away from the power lines until they were confirmed to be de-energized. You had plenty of time after receiving confirmation from the power company to get resources around the fire and stop it from damaging any homes.

Learn from mistakes.

You charge in without hesitation and promptly get your vehicle stuck in a hidden ditch. You and your crew escape, but eventually the fire overtakes your vehicle. Don't worry, someone will put it out just as soon as the 30 gallons of diesel spilling out of the fuel tank are burned off.

Situational awareness will help you successfully avoid hazards.

Get a new truck and try again!



Scenario 1

You and two other crew bosses arrive at a 10-acre fire. The fire is large enough that each crew boss will be taking resources to a different part of the fire. The Task Force Leader is awaiting your input on required resources for the jobs.

The resources you will have available include:
1. One hand crew of 20 people
2. A bulldozer and engine with 4 person engine crew
3. Air support

Action needed

1.Observe fire conditions
2. Assign resources

The task force leader wonders how you will assign resources to uncertain fire conditions.

Back to the classroom for you to try again.

Good thinking. You each look at the conditions of the different parts of the fire. It looks like the fire is behaving differently at the head, the left flank and the right flank and will need to be approached differently.

Check out conditions on the ground:

The head of the fire is the most severe. The fire is climbing up a slight slope with the help of moderate winds. Flames reach 20 feet.

What else is going on with this fire?

The left flank of the fire has hit some ladder fuels and winds are pushing the fire along, resulting in 6- to 8-foot flame lengths

What else is going on with this fire?

Wind is low and blowing into the black, keeping flame lengths low, to about 2-4 feet

Ready to assign resources

All three crew bosses are in agreement. They tell their task force leader that they would like to request the following for each part of the fire:

Head	Hand crew	Dozer and engine	Air support
Left	Hand crew	Dozer and engine	Air support
Right	Hand crew	Dozer and engine	Air support

Head: air support
Left: hand crew
Right: dozer and engine

Head: dozer and engine
Left: hand crew
Right: Air Support

Head: hand crew
Left: dozer and engine
Right: air support

Head: air support
Left: dozer and engine
Right: hand crew

Head: hand crew
Left: air support
Right: dozer and engine

Head: dozer and engine
Left: air support
Right: hand crew

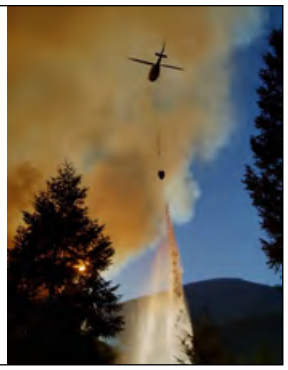
Results

Head: air support

The helicopter successfully suppresses the 20-foot flame lengths. How did the left flank fair?

Head: air support
Left: hand crew
Right: dozer and engine

Head: air support
Left: dozer and engine
Right: hand crew



Results

Head: dozer and engine

The fast-moving, hot and deadly 20-foot flames trapped the engine and dozer in a wall of flame, although the operators were able to escape. How did the left flank fair?

Head: dozer and engine
Left: hand crew
Right: air support

Head: dozer and engine
Left: air support
Right: hand crew

Results

Head: hand crew

Your crew attempted to attack the fire but the fast-moving fire quickly overtook them. Some of the crew suffered major smoke inhalation and burn injuries. Everyone made it out alive, thanks to their shelters.

Luckily, this is only a hypothetical wildfire. How did the left flank fair?

Head: hand crew
Left: dozer and engine
Right: air support

Head: hand crew
Left: air Support
Right: dozer and engine

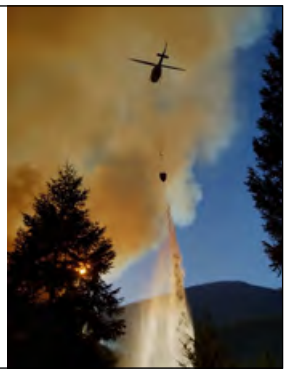
Results

Left flank: air support

The helicopter successfully suppresses the 6- to 8-foot flame lengths, but you wonder if this was the best use of resources.
How did the right flank fair?

Head: hand crew
Left: air support
Right: dozer and engine

Head: dozer and engine
Left: air support
Right: hand crew



Results

Left flank: dozer and engine

The bulldozer put in a nice fuel break while the engine crew laid out line. Those 6- to 8-foot flames were unable to cross the control line. Great use of the dozer and engine.
How did the right flank fair?

Head: hand crew
Left: dozer and engine
Right: air support

Head: air support
Left: dozer and engine
Right: hand crew

Results

Left flank: hand crew

Your crew attempted to attack the fire but quickly found themselves in a bad situation. Luckily, they had identified a suitable site to deploy their fire shelters. Nobody was seriously injured and hard lessons were learned.
How did the right flank fair?

Head: air support
Left: hand crew
Right: dozer and engine

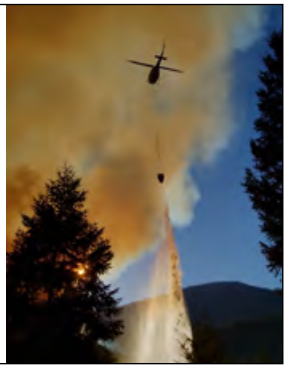
Head: dozer and engine
Left: hand crew
Right: air support

Results

Right flank: air support

The helicopter successfully suppresses the 2- to 4-foot flame lengths, but you wonder if this was the best use of resources.

Try something else?



Results

Right flank: dozer and engine

You set a control line using the dozer and lay hose. The 2- to 4-foot flame lengths have no chance of crossing the line, but you wonder if this was the best use of resources.

Try something else?

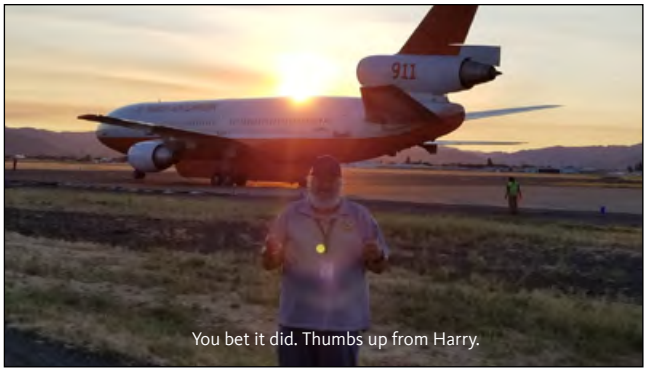
Results

Right flank: hand crews

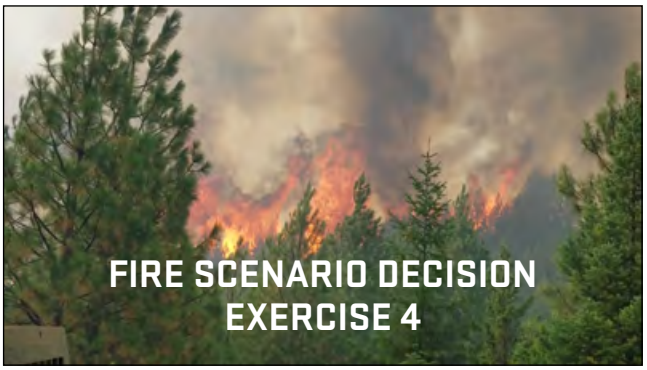
Your hand crews successfully put in line using their Pulaskis, McLoeds and shovels. The 2- to 4-foot flame lengths are not likely to cross. You set your crews to monitoring fire progression. Nice work.

Try something else?

Nah, everything went exactly according to plan.



You bet it did. Thumbs up from Harry.



Air support

You are the protection supervisor making decisions about sending air support. This exercise has three scenarios.

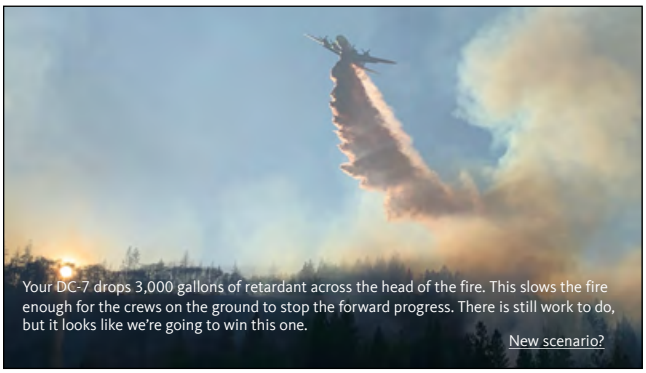
What first?

1. Scenario 1
2. Scenario 2
3. Scenario 3

Scenario 1

Recon plane reports this fire. Estimates it to be 50 acres with spotting, torching and running crown fire.

- Bring in a retardant drop
- Do not drop retardant



Your DC-7 drops 3,000 gallons of retardant across the head of the fire. This slows the fire enough for the crews on the ground to stop the forward progress. There is still work to do, but it looks like we're going to win this one.

New scenario?

The bad news is: Your fire blew up and burned 30,000 acres of national monument, costing the taxpayers millions of dollars, and you have been temporarily relieved of your duties as a protection supervisor. The good news is: This is a pretty awesome photo and you get to try again.

How could this have gone better?

Scenario 2

Structure fire with minimal spread to the forest fuels. Potential to spread to the adjacent barn. Landowner is frantic because his farm equipment is in there and he is not insured.

- Bring in a retardant drop
- Do not drop retardant

You ordered retardant to suppress a structure fire. The district forester (your boss's boss) would like to remind you of the mission of ODF, which is to suppress forest fires. The governor's wildfire council heard about this, as well as the Federal Aviation Administration. Enjoy your time in court.

Let's figure out how to avoid this outcome.

Meanwhile, the fire you diverted air support from grew to 12,000 acres, causing the city of Ashland to be evacuated.

Try again?

The local fire district is called and structural firefighters take over the job. The landowner has some losses, but this wasn't a job for wildland firefighters.

Good call.

Scenario 3

You have 5 engines and a bulldozer on this fire, as well as 3 helicopters. There is some group torching occurring, but the fire is laying down in the areas where the timber has been harvested. There is a town a couple miles north of your fire, but the winds are currently out of the east.

Bring in a retardant drop
Do not drop retardant

A successful drop helps to secure the lines that had been built with the dozer, but the fire could have been extinguished without spending the extra $20,000 on the airtanker. Now the finance folks are working overtime to get that bill paid and your supervisor is grumbling.

Was there a better way?

While you were able to suppress this fire without the air tanker, citizens complained about a perceived lack of effort in putting the fire out. Many people think that air tankers are the sole reason large fires go out. There is also political pressure regarding the use of aviation resources.

As long as you keep making decisions based on your situational awareness and focus on using the right tool at the right time, you will be successful.

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Bring in a retardant drop
Do not drop retardant

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As long as you keep making decisions based on your situational awareness and focus on using the right tool at the right time, you will be successful.

We already tried the other way.
Why are people still upset?

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You have 5 engines and a bulldozer on this fire, as well as 3 helicopters. There is some group torching occurring, but the fire is laying down in the areas where the timber has been harvested. There is a town a couple miles north of your fire, but the winds are currently out of the east.

Bring in a retardant drop
Do not drop retardant

A successful drop helps to secure the lines that had been built with the dozer, but the fire could have been extinguished without spending the extra $20,000 on the airtanker. Now the finance folks are working overtime to get that bill paid and your supervisor is grumbling.

We already tried the other way! Why are people still upset?

Sometimes you just can't win. ...

You are digging line downslope of the heel of a fire with your crew when suddenly the winds change and start blowing strongly in your direction. The fire is a visible distance away and activity kicks up, quickly cutting off your route to the safety zone and the rest of your crew.

What do you do?

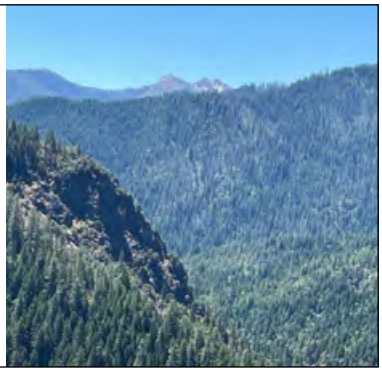
- Await orders from your squad boss
- Maintain situational awareness
- RUN!!!!!!

Cut off from your squad boss, you need to think on your own before the fire reaches you. Try something else here

You remember there is a steep canyon just downslope. It would be difficult to navigate and potentially dangerous. You navigate around the canyon.

Unfortunately, the fire is moving faster than you can run. You realize it will overtake you soon. You decide to drop a piece of equipment to help you run faster. What will you drop?

- My tool (Pulaski, etc.)
- My pack
- My emergency shelter



You break into a run. Unfortunately, you have forgotten that just downslope is a steep canyon. Movement slows as you try to navigate the terrain and you are caught in dense fuels.

Good thing this is just a game. Remember to maintain situational awareness when you try again.

Dropping your pack gives you a little more speed, but not enough. You realize you are going to have to shelter in place. You look left, straight ahead and to your right and see the following. Where will you make your stand?

Left **Straight ahead** **Right**

You make it to the grassy patch. What do you do next?

- Deploy the shelter
- Clear the area of debris using your tool

You use your tool to clear out an area so your shelter can be deployed in a fire-free area. You throw your tool aside. The fire is coming close, so you deploy your emergency shelter around yourself and get face-down on the ground. Your hands and feet keep the shelter down, so there is no opportunity for the hot air to flow in.

Soon the fire hits. You feel uncomfortable, but you stick to your plan and don't move until the fire has passed.

That was a close one, but you think you are going to make it.

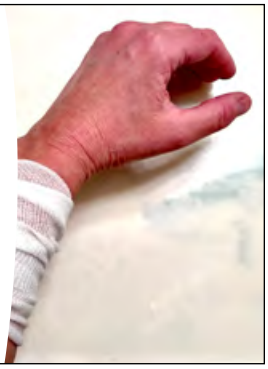
How could this have gone wrong?

The fire is coming fast. You deploy your emergency shelter around yourself and get face-down on the ground. Your hands and feet hold the shelter down, so there is no opportunity for flames to enter.

As the fire draws near, you become uncomfortable, but you know you are doing better than if you were outside the shelter.

Unfortunately, there was a patch of grass and twigs next to the shelter, so your shelter is exposed to direct flame. The fire warps and melts the material, burning your hands. But you manage to keep the shelter on. The fire eventually passes. You have survived, but you have third-degree burns.

Try again?



You make it to the brush field. What do you do next?

Deploy the shelter

Clear the area of debris using your tool

You look at the brush and realize there is no way you can cut through these thick, woody fuels in time to make a fire-free area.

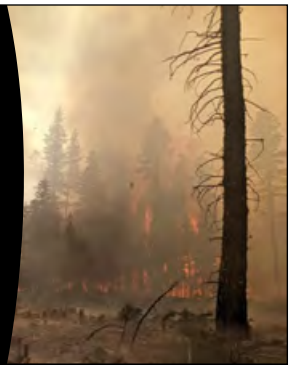
You have run out of time. You will need to deploy your shelter.

You don't want to waste any time. The fire is coming fast. You deploy your emergency shelter. Unfortunately, it is hard to properly deploy and get a good seal with your hands and your feet, but you do your best.

The brush burns hot — hotter than the 1,600 degrees a shelter is rated for. Luckily, this is only a simulation. You get to learn from this and try again.

You make it to the tree.
What do you do next?

- Deploy the shelter
- Clear the area of debris using your tool



You use your tool to clear an area for your shelter, then you throw the tool aside. The fire is coming close, so you deploy the shelter and get face-down on the ground. Your hands and feet hold the shelter down so the hot air can't flow in.

Soon the fire hits. You feel uncomfortable, but you don't move until the fire has passed.

Happy to have survived the fire, you exit the shelter. Unfortunately, that tree next to you didn't have the same luck. You barely get out of the way as it comes crashing down.

How could you have avoided that?

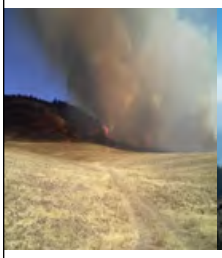
You don't want to waste time, the fire is coming fast. You deploy your emergency shelter and get face-down on the ground. Your hands and feet hold the shelter down so the flames won't enter.

As the fire draws near, you become uncomfortable, but you are grateful for the shelter. Unfortunately, a patch of grass and twigs next to the shelter ignites, exposing it to direct flame. The fire warps and melts the material a little, burning your hands, but you manage to keep the shelter on you.

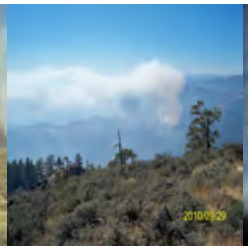
You have third-degree burns, making it difficult to escape when the tree next to you, having been burned, falls over your shelter.

Ouch. Try again?

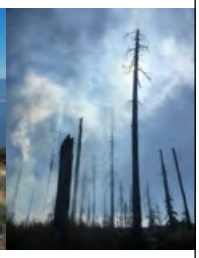
Dropping your tool gives you a little more speed, but not enough. You realize you are going to have to shelter in place. You look straight, to your left and to your right, and see the following. Where will you make your stand?



Left



Straight ahead



Right

You make it to the grassy patch.
What do you do next?

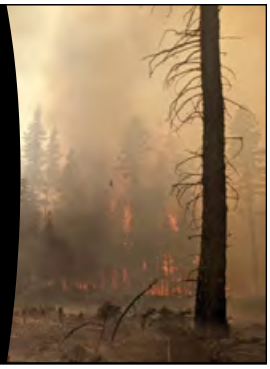
- Toss aside your pack and deploy the Shelter
- ~~Clear the area of debris using your tool.~~ You dropped your tool, remember!?

You make it to the brush field. What do you do next?

- Deploy the shelter
- ~~Clear the area of debris using your tool.~~ You dropped your tool, remember!?

You make it to the tree.
What do you do next?

- Toss aside your pack and deploy the shelter
- ~~Clear the area of debris using your tool.~~ You dropped your tool, remember!?



You pull your emergency shelter from your pack, ready to toss it aside, when you think to yourself,

"Wait a second, I'm throwing away an emergency shelter in an emergency wildfire situation."

You must have been thinking this was just a game and not real life. Luckily, you come to your senses and decide to keep the emergency shelter. Get back to surviving the wildfire.

5. PROTECTING YOUR COMMUNITY FROM WILDFIRE

This module looks at wildfire from the perspective of the community and provides students with knowledge and tools to help their community prepare.

Time considerations

Preparation: 3+ hours, including travel time

Procedure

Five 50-minute in-class sessions

A. How do homes burn in a wildfire? (two class sessions)
B. How do communities come together to mitigate risk? (one class session)
C. Using a trauma-informed approach when engaging communities (two class sessions)

Two field trips

A. One-hour visit to a firewise community
B. One half-day volunteer session on creating defensible space in a firewise community

2+-hour course final project

A. Running community meeting to develop a firewise community

Learning objectives

Students will be able to:

1. Assess the hazards on and around homes in wildland settings.
2. Recommend steps to improve their community's protection from wildland fire.
3. Give reasons for their recommendations.
4. Demonstrate an understanding of the process of and rationale for developing a firewise community.

Behavioral objectives

Students have completed

1. A home wildfire risk assessment
2. Initiation or enhancement of a firewise community
3. Reflect on and experiment with applying trauma-informed tools and strategies when engaging with others.

Standards connections

Oregon science standards

Performance expectations

- HS.ESS3.1: 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. [Activities A, B, field trips and final project]
- HS.ESS3.3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations and biodiversity. [Activity B, field trips and final project]
- 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. [Activities B, C, field trips and final project]

Disciplinary core ideas

- ESS3.B: Natural Hazards. Natural hazards and other geologic events have shaped the course of human history; they have significantly altered the sizes of human populations and have driven human migrations. [Activity A, B, field trips and final project]
- ESS3.C: Human Impacts on Earth Systems. The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. [Activity B, field trips and final project]
- ETS1.B: Developing Possible Solutions. When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. [Activity B, field trips and final project]

Science and engineering practices

- 6. Constructing Explanations and Designing Solutions. Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [Activity B, field trips and final project]
- 8. Obtaining, Evaluating, and Communicating Information. Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically). [Final project]

Oregon English language arts standards

- 9-10.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9–10 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activity B, field trips and final project]
- 11-12.SL.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts and issues, building on others' ideas and expressing their own clearly and persuasively. [Activity B, field trips and final project]
- 9-10.W.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to

task, purpose and audience. [Final project]

- 11-12.W.4. Produce clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience. [Final project]

Oregon CTE knowledge and skills statements

- KSS.C: Supervise the protection of natural resource environments and woodlands. [Field Trips]
- KSS.H: Describe ecological concepts and principles; investigate and explain the relationships between these principles and natural resource environment development. [Activities A, B, field trips and final Project]
- KSS.L: Acquire the specific academic knowledge and skills necessary to pursue a full range of career and postsecondary opportunities within natural resources management. [Activities A, B, field trips and final project]
- KSS.M: Use oral and written communication skills in creating, expressing and interpreting natural resource management information and ideas including technical terminology. [Activity B, field trips and final project]

Classroom activities

A. How do homes burn in a wildfire?

Materials

- *If Your Home Doesn't Ignite, It Can't Burn*, https://www.youtube.com/watch?v=RqKFDDBGd5o
- *Wildfire Ember Highlights*, https://www.youtube.com/watch?v=_Vh4cQdH26g
- *Wildfire Prevention Defensible Space video*, https://www.youtube.com/watch?v=nFQKw0kUrAo

School defensible space assessment

- Outdoor or in-lab live fire activity: Defensible space experiment and demonstration lab sheet
- Live fire lab materials: Aluminum roasting pan trays or metal cookie sheets, aluminum foil, cardboard for houses, popsicle sticks, sand or soil, matches, spray bottles filled with water and scavenged "landscaping" samples (such as dry leaves, cedar chips, pine needles, plant samples)

Background information

There are three ways a home can burn during a wildfire:

1. Embers landing on or near the home
2. *Direct flame contact*
3. Radiation of the heat from the wildfire

The cause of over 95% of home losses during a wildfire can be traced to *embers*. The *Home Ignition Zone* is the area on and around the home where the greatest impact can be made on determining whether or not the home is able to survive a wildfire. Homeowners create *defensible space* within the Home Ignition Zone to improve the chances their home will be spared in a fire, and to make it easier for firefighters to access.

The home itself, including the building materials and the area directly adjacent to it within 5 feet, is known as the *immediate zone*. Here, homeowners can work to reduce the chances of embers accumulating with several steps, including installing ⅛th-inch screens on vents and soffits, which can

reduce exposure to direct flame by reducing surrounding vegetation. Homeowners can also reduce home combustion through *radiation* by installing double-pane windows, among other steps.

The *intermediate zone* is the area from 5 to 30 feet from the home, where homeowners can reduce risk by selecting trees, bushes and other vegetation that are fire resistant. Homeowners should give attention to spacing and irrigating this vegetation, to reduce the availability of the vegetation as a fuel.

The extended zone is the area 30 to 100 feet or more from the home, where extra spacing between vegetation — both native and planted — is used to reduce fuel continuity. This reduces the chances that flames can be conveyed from one tree to the next.

Key vocabulary

Embers	Defensible space
Direct flame contact	Immediate zone
Radiation	Intermediate zone
Home Ignition Zone	Extended zone

Preparation

1. Prepare the three videos for the in-class session.
2. Identify an appropriate speaker who can speak on the topics and key words identified in the background. The local firewise community coordinator in your area is the most appropriate guest speaker. They are typically employed by the Oregon Department of Forestry or your local fire district. If a firewise community coordinator is unavailable, contact your local OSU Extension office for potential speakers. Be sure to contact your local coordinator many months in advance, as the coordinator's schedule fills up quickly.
3. Determine whether the defensible space assessment will be an in-class activity or a homework assignment on student homes. If it is an in-class activity, identify areas to assess, such as the school, outbuildings or a local community building.
4. Outdoor or in-lab live fire activity: Defensible space experiment and demonstration
    a. For each group of five to six students, acquire:
        - Three aluminum trays or metal cookie sheets
        - Student-created small-scale houses with representative construction materials (such as aluminum foil for a metal roof, flimsy tagboard, heavy-duty cardboard)
        - Sand
        - Ruler
        - Matches
        - Scavenged "landscaping" samples (such as dry leaves, cedar chips, pine needles,

plant samples)

- Fire extinguisher
- Spray bottles filled with water
- Empty metal trash can to dispose of waste after the experiment.

A view of the trays after the experiment, from left to right: Good defensible space, needs improvement and poor defensible space. CREDIT: Jennifer Payne

Procedure

1. Discuss key terms.
2. *If Your Home Doesn't Ignite, It Can't Burn* video.
3. *Wildfire Ember Highlights* video
4. Guest speaker: How do homes burn in a wildfire?
5. *CAL FIRE Inspects for Defensible Space*
6. Students complete the defensible space assessment as in-class activity: Walk the school site with students and discuss defensible space criteria. Students then work in groups with the firewise coordinator and teacher to assess assigned zones. If assigned for homework, students

complete in-class school site assessment first.

7. Student groups present their findings and recommendations.
8. Outdoor or in-lab live fire activity: Defensible space experiment — Students conduct experiment following instructions on the defensible space experiment lab worksheet. This lab requires advance prep: Students build model houses and scavenge for landscaping materials prior to setting up models on cookie sheets and arranging materials in home ignition zones.

Assessment

1. Defensible space assessment — Students complete the defensible space assessment as an in-class activity. Walk the school site with students and discuss defensible space criteria. Students then work in groups with Firewise coordinator and teacher to assess assigned zones. If assigned for homework, students complete in-class school site assessment first.
2. Defensible space description — In addition to the assessment worksheet, students create a sketch of their home or school grounds. The sketch should include the immediate, intermediate, and extended zones. Sketches must be labeled clearly and include key terms, such as fire-resistant vegetation, landscaping, vertical space, plant and tree spacing, fire-resistant zones, flammable plants, slope and buffers.

B. How do communities come together to mitigate risk?

Materials

Fire-wise Community in Bend, https://www.youtube.com/watch?v=8jQxdhuTzqA

Background information

A firewise community is a group of neighbors who come together with a shared interest in reducing wildfire risk in their community. Fire-wise communities are developed with the understanding that wildfire doesn't recognize property boundaries, and each person has an important role to play in protecting lives and property during a wildfire.

Fire-wise communities play a role in shifting conversations about wildfire from fear to empowerment for landowners. That is, firewise communities aim to create a culture where communities understand the risk of wildfire in their area and manage risk in the same way people understand the risk of injury in a car accident and accept their responsibility to wear a seat belt.

The steps to becoming a firewise community are fairly straightforward. Eight or more geographically close homeowners come together and identify the area they want to be included in the firewise community. They hold a community function to bring the interested homeowners and any potentially interested neighbors together to educate and plan on how the community can reduce risk. They ask the firewise community coordinator to assess the community. With the help of the coordinator, the group draws up an action plan. To maintain status, homeowners need to commit to continuing fire risk reduction activities each year.

However, in practice, it can be difficult to bring homeowners together in the first place. Homeowners

first need to be able to perceive that they live in a fire environment and that this poses a threat to their homes, lives and property. Next, they must have the perspective that this is a problem with tangible solutions that are achievable. Once a homeowner understands the problem and possible solutions, they are more likely to want to be a part of a community culture that prioritizes wildfire risk reduction, which is where the firewise community comes in. Fire-wise communities use the planning and efforts of the community to adapt to living in a fire-prone environment. Anyone wanting to develop a firewise community will need to assess where homeowners are in their understanding of wildfire as a problem and how to move them to a culture of adaptation.

Key vocabulary

Fire-wise community

Perception of living with wildfire

Perspective of living with wildfire

Culture of living with wildfire

Adaptation to living with wildfire

Preparation

1. Prepare *Firewise Community in Bend* for the in-class session.
2. Identify an appropriate guest who can speak on the topics and key words identified in the background. The local firewise community coordinator is the most appropriate guest speaker. They are typically employed by the Oregon Department of Forestry or your local fire district. If a firewise community coordinator is unavailable, contact your local OSU Extension office for potential speakers. Be sure to contact your local coordinator many months in advance, as the coordinator's schedule fills quickly.
3. Optional: Decision-making in firewise communities. Identify or create an imaginary community that is interested in becoming firewise. It has several hazards that reduce fire resilience. Examples of this could be: only one possible evacuation route, several homes without defensible space, fire-prone plants throughout the community, several homes made of fire-prone materials, proximity of the community to thick forest, etc. Develop a short description of the hazards in the community and use photos to illustrate the hazards. Find photos to illustrate community conditions. Students will determine which activities to mitigate hazards should be prioritized. A firewise coordinator may be able to provide photos and scenarios for this activity.

Procedure

1. Discuss key terms
2. *Firewise Community in Bend* video

3. Guest speaker: How do communities come together to mitigate risk?
4. Optional: Students develop a list of questions to ask an organizer of a firewise community in order to learn how to be successful at starting their own firewise community. Students should review their questions with the firewise community coordinator.
5. Optional: Decision-making in firewise communities: Break students into small groups. Assign groups a real or made-up community with specified conditions. Student groups discuss their assigned community's defensible space issues and prioritize two improvements to focus on. Each group should be prepared to defend their selection. Group presents decision to class for feedback.

Students share their reports on defensible space. CREDIT: Jennifer Payne

Assessment

Fire-wise community questions — A class discussion prior to this activity will help students formulate the questions that will guide them in their firewise community-building work to be carried out later in this module. Students formulate three to four questions about the process of becoming a firewise community, as well as how to maintain that status once it is attained. Students consider questions that support motivations for home and landowners, such as reduced fire risk, lower insurance premiums, drought-resistant landscaping that lowers water bills and a positive means to engage neighbors to create defensible space and offer greater protection for all.

C. Using a trauma-informed approach when engaging communities

Materials

- *Trauma-Informed Toolkit — A Resource for Educators*, EM 9348, https://catalog.extension.oregonstate.edu/em9348
- *Brené Brown on Empathy vs. Sympathy*, https://www.youtube.com/watch?v=KZBTYViDPlQ
- *15 Things to Say to Someone With Trauma*, Psych2Go, https://www.youtube.com/watch?v=nNJilE5dTKQ
- Trauma-informed strategies and tools for engaging with firewise community members
- Processing stations worksheets
- Scenarios: Practicing trauma-informed strategies and tools
- Doodle paper and pens, fidget toys and other stress-relieving materials

Background information

Educators are strongly encouraged to peruse the OSU Extension publication Trauma-informed Toolkit — A Resource for Educators prior to this lesson.This toolkit contains extensive background information on trauma, including the neurobiology of trauma, trauma-informed care and practical trauma-informed strategies and tools for educators. Below are a few highlights from the toolkit relevant to this lesson (see also Module 1).

Trauma-informed approach

A trauma-informed approach is a paradigm shift, not a checklist. It is usually embedded in daily language, beliefs and attitudes when interacting with anyone — whether they have experienced trauma in the past, are currently experiencing trauma, or to prevent future trauma-stress responses. It recognizes the prevalence of trauma in all environments and strives to understand and create physically, emotionally and mentally sound spaces for all, taking into account cultural differences and applying an equity lens.

Trauma resilience

Trauma resilience is the ability of a child or adult to cope, process and adapt to a traumatic event. As a general rule of thumb, the faster someone bounces back, resumes daily functioning and engages with healthy coping mechanisms, the higher the person's trauma resilience. Resilience exists on a spectrum — any amount of resilience helps us cope, adapt and function.

Trauma-Informed strategies and tools

Many different trauma-informed strategies and tools can be applied to different settings. Making sure your own nervous system is regulated first and your needs are met is crucial to being able to provide effective trauma-informed care for others. When possible, a person may use self-regulation tools to regulate and calm their own nervous system, such as deep slow breathing, exercise, creative expression and so on. Co-regulation tools and strategies can help someone else regulate their

nervous system. These include using a calm tone of voice and body language; practicing empathetic communication; honoring someone's voice, choice and agency; and emphasizing personal strengths and solutions to encourage resilience. Create spaces that are oriented for safety (for example, point out emergency exits, let people choose their own seat, etc.). It is also important to offer opportunities to process emotions, information and any other uncomfortable feelings that may arise before, during and after a class, conversation, interview or presentation. You can do this through verbal check-ins and check-outs, creative expression, going for a walk, etc. See module 1 for more information on integrating a trauma-informed approach into a lesson.

Key vocabulary

Trauma resilience	Orienting for safety
Empathy	Strengths- and solutions-oriented approach
Voice, choice and agency	Processing

Preparation

1. Review *Trauma-Informed Toolkit — A Resource for Educators* prior to class.
2. Identify an appropriate guest who can speak to the class about basic understandings of trauma — especially vicarious trauma for when students interact with community members —, trauma resilience and practical trauma-informed strategies and tools for interacting with community members. Consider a school counselor or social worker months in advance, as the counselor's schedule can fill quickly.
3. Make copies of the handout "Scenarios: Practicing trauma-informed strategies and tools" to distribute to students.
4. Make copies of "Trauma-informed strategies and tools for engaging with firewise community members" to distribute to students.
5. Prepare the *Brené Brown on Empathy vs. Sympathy* video clip.
6. Prepare the *15 Things to Say to Someone With Trauma* video.
7. Prepare the "Processing stations" worksheet

Trauma-informed strategy: This topic has the potential to be uncomfortable and stressful for adults as well as youth. Before, during and after class, use strategies to regulate your nervous system that are appropriate for you. For example, practice conscious deep breathing or yoga, take a walk in nature, or draw on community resources for support. Modify this lesson to make it manageable for you, or ask for parent volunteers or any other support as needed.

Procedure

1. Discuss key terms
2. Since the topic of trauma can be uncomfortable for some, invite students to take care of their needs and participate in whatever capacity is available to them, knowing that the content

will affect everyone's nervous systems differently. Students can play with fidget toys, doodle, get a sip of water or take a break when needed. It is important not to penalize students if they cannot participate fully, as they could be experiencing a trauma stress response, and disciplinary measures could be (re-)traumatizing. Make sure to check in with those students one-on-one to assess how they are doing and determine whether they need further support .

3. At the beginning and throughout the class — as needed — offer students the opportunity to ground and regulate their nervous systems using tools such as deep conscious breathing, physical movement, singing or vocalizations, journaling or drawing, or other mindfulness activities. Discuss the scientifically proven benefits these activities have on our nervous systems.
4. Invite students to pair-share, enter group discussion or reflect in silent writing.Activities may depend on the student's comfort level. (Always give students the option of quiet reflection if they don't have the capacity to share out loud.)
    a. Student understanding of trauma, the effects of trauma and how it might show up in a community.
    b. Student understanding of trauma resilience, factors that strengthen or weaken trauma resilience, and people they may know who have a high degree of resilience.
5. Guest speaker: Trauma with a special emphasis on vicarious trauma, since it may affect students as they interact with community members. The speaker should talk about trauma resilience, practical trauma-informed strategies and tools for interactions with community members impacted by fire.
6. Go over the handout "Trauma-informed strategies and tools for engaging with firewise community members." Talk about the challenges, differences possible positive outcomes and appropriate situations for each tool.
7. *Brené Brown on Empathy vs. Sympathy* video clip. Introduce the video by asking students how they understand the difference between empathy and sympathy. What are examples of expressing empathy or sympathy to community members impacted by fire?
8. *15 Things to Say to Someone With Trauma* video clip. Discuss how these tips may or may not apply when interacting with community members.
9. Emotional check-in: Ask students to use a word to describe how they are feeling in this moment. Ask them if there is anything they need to process the information shared so far, and if there is anything the teacher can do to support their learning about trauma.
10. Share the handout "Scenarios: practicing trauma-informed strategies and tools." Divide students into small groups and invite them to role-play or write a paragraph about their approach to each scenario.
11. Set up processing stations according to the "Processing stations" worksheet. Invite students to engage with stations based on their capacity and needs.

Trauma-informed strategy: Remind students that it is normal to experience heightened emotions about the information shared. Encourage them to continue digesting for information outside of class,

using the processing tools, and let an adult know if they would like some extra mental health support. Check in with students again in the following class and take appropriate action if needed. (For example, you could consider talking to a student's parents or making a referral to a school counselor.

Assessment

1. Consider practicing a trauma-informed approach to assessment that accounts for students whose nervous systems may have become dysregulated during this lesson may not have had the capacity to participate fully. A trauma-informed approach understands that students did the best they could and does not assess their performance based on their ability to participate. Shifting the learning objectives from outcome-based to experiential provides a platform for trauma-informed student assessment. Example questions that could be asked:
    a. Did the student explore their own emotions during or after this lesson? (This could occur through verbal or nonverbally, or a silent reflection)?
    b. Was the student able to identify their needs and take care of themselves (such as by taking a break, doodling, closing eyes or asking questions)?
2. Follow-up discussion: How has the students' knowledge and understanding of trauma and resilience changed from the beginning to the end of the lesson?
3. For those students who had the capacity to participate fully: Review the written responses to how they would respond using trauma-informed tools and strategies to each of the scenarios in the handout "Scenarios: Practicing trauma-informed strategies and tools."

Field content

Visit a firewise community

Preparation

1. Work with the firewise community coordinator to identify a local, active firewise community.
2. Contact a firewise community homeowner who is willing to host the students on the property. Invite additional members of the firewise community and encourage them to join.

Procedure

1. Arrive on-site and have the homeowner speak about the basics of their firewise community.
2. Have students conduct an interview with firewise community members on the reasons they developed a firewise community, their concerns and understanding of the fire danger in their area, how and why they decided to come together as a community, what they have done to reduce fire risk as a part of the community and what they envision going forward.
3. After the interview session, students take a tour of the property or the firewise community with the homeowner(s) and firewise community coordinator explaining the defensible space work that has been done.

Assessment

Fire-wise community interview responses essay — Students record the homeowner's answers to the interview questions. Then, either as a follow-up in-class essay or homework assignment, students work individually to integrate the homeowner responses into an essay format that includes key terms used in the "Defensible space assessment" assignments. Students include a background or history section as an introduction. For the body of the essay, students provide a description of the fire risk for the community and the steps the group has taken to mitigate their fire risk. For the conclusion, students discuss the community's goals to further reduce their risk, as well as lessons learned.

Creating defensible space in a firewise community

Preparation

1. Work with the firewise community coordinator to identify a local, active firewise community.
2. Contact firewise community homeowners who would like to have student help in creating or improving defensible space on their properties.
3. Develop a list of fuel-reduction activities for students to do at the properties. This may include raking, limbing small branches, helping to remove fire-prone plants, cutting small trees and brush with loppers or piling downed woody debris.
4. Work with the firewise community coordinator to secure tools.

Procedure

1. Arrive on-site and have the homeowner speak on property goals for defensible space.
2. After a demonstration of tool use, have students begin the work. Students should follow guidelines set out by the homeowner and firewise community coordinator, and the homeowner should be available if possible to help supervise work.

Assessment

Optional, informal assessment: Have a follow-up discussion of student observations. Assess student performance via participation, engagement and ability to follow directions .

Module assessment, evaluation and feedback

Students respond to the following:

1. Do you think that the work you have done in this unit has helped your community to be better prepared or more educated about reducing risks in the event of a wildfire? If yes, describe how your community is better prepared or is organizing for better preparedness. If no, describe your recommendations for better community preparedness.
2. Describe the steps involved in creating a firewise community.
3. How can you help to reduce wildfire risks around your own home?

Course final project

Raise public awareness of firewise best practices and engage communities in the creation of defensible space

Materials

- Take action – learn about ways you can interact with the community to protect it from wildfire, https://www.nfpa.org/en/Events/Wildfire-Community-Preparedness-Day
- Fire-wise sample flyer (This is far more detailed than your students need; however, it can be used to illustrate the zones and provide visuals.)
- How to prepare your home for wildfires fact sheet, https://www.nfpa.org/downloadable-resources/safety-tip-sheets/how-to-prepare-your-home-for-wildfires
- Trauma-informed role-play scenarios (handout)
- Various materials for students to use to create engaging, interactive activities, games and digital resources for PowerPoint presentations and flyers, etc.
- FireBright logo (banner style logo and larger print-quality files available online at www.sofrc.org and by request)

Background information

Student agency and personal responsibility to act in the community for fire resiliency stem from the ability to communicate defensible space and engage people in proactive fire resiliency activities. For students to see themselves as teachers of the public, they must develop confidence in their knowledge of wildfire science and defensible space. They must understand their role in raising awareness and building a culture of responsibility for fire preparedness. Hands-on experience, practice through role-play and the creation of outreach products (flyers, interactive activities, blogs, news articles) help students to develop the tools and confidence to engage with the public. Student-created outreach products provide people with digestible information and attainable solutions to protect themselves, their property and their community from fire.

Preparing students for community outreach through role-play gives them communication tools to respond to various situations and responses from the public. Anticipation of public responses is the first step toward creating firewise communities or effective outreach products. It sets the stage for student awareness of effective outreach strategies. These include:

- Devising messages that are specific to the target audience (homeowners, fellow students, people in different age brackets).
- Using positive, attainable “call to action” messaging to elicit positive change in behavior.
- Using interactive and engaging methods and materials (clear visuals, hands-on activities, takeaways, prizes, forums for ongoing interaction and support).

- Providing multiple opportunities for absorption and integration of information (games, takeaways, signage, online resources).
- Working with trusted spokespeople (such as the firewise coordinator or existing firewise community members) to build public trust in messages.
- Providing information on support and resources when implementing call-to-action steps.
- Conveying the impact of individual action to contribute to community resiliency.

The firewise outreach coordinator will be able to provide opportunities for hands-on experience, as well as input and feedback on the students' role-play and products. Contributing to the improvement of defensible space builds students' applied knowledge and confidence.

Preparation

1. Confirm the firewise community coordinator is available to work with students in class and provide feedback on student-produced materials.
2. Select a geographical area to target for firewise community development, or select an event or meeting for students to participate in.
3. Develop list of materials that students will create. Students may work in teams or groups.
4. Assign roles or shifts.
5. Determine materials needed (tables, chairs, tabling supplies, etc.)

Procedure

1. Take action – learn about ways you can interact with the community to protect it from wildfire, https://www.nfpa.org/en/Events/Wildfire-Community-Preparedness-Day
2. Share firewise education materials: sample flyer (This is more detailed than your students need, but you can use it to illustrate the zones.)
3. How to prepare your home for wildfires fact sheet, https://www.nfpa.org/downloadable-resources/safety-tip-sheets/how-to-prepare-your-home-for-wildfires

OPTION A — STEPS 4A–6A

4A. Have students work with the firewise community coordinator to identify an area near school that would be a good fit for a firewise community. If there is already a firewise community in the area, they may opt for another location or they may opt to work on expanding the current firewise community. (See section B for optional outreach activities, if working on a new or existing firewise community is not feasible for your students.)

5A. Students will plan a public community meeting to encourage homeowners to join in the Firewise Community. Students will work with the firewise community coordinator to:

- **a.** Select a venue for the meeting. Suggestions include the school library, the classroom, a public library or other public gathering place.
- **b.** Develop an agenda for the meeting that includes a presentation on defensible space, wildfire preparedness and time for the firewise community coordinator to go over

requirements for homeowners to initiate or build a firewise community.

c. Develop the presentation on defensible space and wildfire preparedness.

d. Work with the firewise community coordinator to make a plan to reach out to local homeowners. This may be in the form of flyers, a radio announcement, mailings to relevant homeowners, or word of mouth — all depending on the resources available in their community.

e. Develop a sign-in or contact sheet for meeting attendees.

6A. On the day of the meeting, students will:

a. Sign participants in and retain records of homeowners interested in taking the next steps towards forming or enhancing a firewise community.

b. Deliver the presentation on defensible space and wildfire preparedness.

OPTION B – STEPS 4B–6B

4B. Share photo of an example of outreach table that models positive public engagement.

Students staff an outreach table. CREDIT: Jennifer Payne

Students share their models. CREDIT: Jennifer Payne

5B. Provide students with the "Trauma-informed role-play scenarios" handout and review effective outreach strategies outlined in the background section. Divide students into groups of three to four to go through the scenarios together, taking turns playing the parts of the homeowners and the student outreach pair. Ideally, the firewise coordinator will be present to give feedback on students' experiences.

6B. Help students develop their own firewise outreach materials and work with the firewise community coordinator to table at an upcoming public or school family engagement event.

a. Students draft flyer, oversized postcard or presentation with top priority firewise messages. Check with the firewise coordinator to provide additional input.

- Defensible space zones – Immediate, Intermediate and Extended
- Clean gutters and roofs
- Remove combustibles
- Move wood piles and wood furniture 30 feet away from the home
- Mow dry grass

And with top-priority outreach and design parameters:

- Message: Make it positive. Keep it short and concise. Think of a Meme.
- Create a call to action that is doable for the public. Make sure it is affordable and something they can do themselves without heavy equipment.)
- Encourage students to translate materials into Spanish.
- Slogan
- Include contact information for the local firewise coordinator for help and information.
- Design: Keep a wide margin for readability; use a light background and bold, easy-to-read type; use an eye-catching, positive graphic (FireBright and Firewise logos).

b. If providing outreach at an event, students develop an interactive activity, like a game, or a model home with defensible space zones and student-created moveable items (such as shrubs, woodpiles, etc.).

- The activity or model conveys top-priority firewise messages and keeps participants engaged.

c. Students develop a script for either their part of a firewise meeting or outreach to passersby at an event.

- Students introduce themselves.
- Students verbalize top-priority firewise messages and share outreach materials.
- Students practice with role-play, and integrating trauma-informed approaches. They troubleshoot challenges.

Assessment

1. Student presentation on defensible space — Assign student groups to develop PowerPoint slides that include illustrations of all key terms covered in this module. Optional: Include homeowner interview responses from the "Visit a firewise community," Assessment 4, to provide case study comparisons for the audience.
2. Outreach materials: Assess integration of firewise community coordinator's recommendations, quality of work, effort and accurate application of key terms. Assess students' inclusion of positive, clear communication and practical calls to action to affect firewise behavior change.
3. Fire-wise community meeting or outreach event — Assign meeting tasks, roles or tabling shifts prior to the event. Evaluate student participation, responsibility and leadership.

Activity: Processing stations

After sharing uncomfortable or difficult information or engaging students in activities that may be stressful, it can be helpful to provide space for students (and the educator) to process and balance the nervous system.

In the activity below, the educator sets up three stations and invites students to rotate through and engage in any of the activities they choose, to try out and use healthy coping and processing tools.

Preparation

Suggested materials

- Poster paper, craft paper, loose blank paper
- Markers, crayons, colored pencils, pens
- Jump rope, dumbbells, yoga mats

Station 1: Verbal processing

- Set chairs in a circle.
- Arrange for a station facilitator.
- Provide the facilitator discussion invitation prompts (see below).

Station 2: Physical processing

- Clear an area of tables and chairs, or plan to go to an outdoor space for this station.
- Set up supports to be physically active, such as jump ropes, yoga mats, dumbbells.
- Arrange for a station facilitator.
- Provide the facilitator physical processing prompts (see below).

Station 3: Creative processing

- Set up a large table space (perhaps by pushing tables together).
- Lay out big poster paper, craft paper or a stack of individual blank paper and drawing/writing utensils.
- Arrange for a station facilitator.
- Provide the facilitator creative processing prompts (see below).

Procedure

Students are encouraged to participate in three separate processing stations and rotate through all three based on their capacity and needs. Some students may not have the capacity to participate in all three stations. Let students know they are welcome to skip stations if they wish.

If someone is not able to participate in any of the stations, invite them to process in other, nondisruptive ways such as journaling, doodling, listening to music with earphones, having quiet time, etc.

Set a timer for an appropriate length for each station and allow time for students to rotate through all three stations if they wish.

Station 1: Verbal processing prompts

You are welcome to use these or any other prompts that are appropriate to support students to digest and process information and emotions.

1. What is one piece of new information you learned in this class?
2. Was there anything that surprised you?
3. Was there anything that made you feel uncomfortable?
4. Any other prompts that might be appropriate.

Station 2: Physical processing prompts

Invite students to use their bodies to digest and process information and emotions.

1. Organize a walk outside.
2. Invite them to practice yoga.
3. Invite them to practice mindful deep breathing or another mindfulness exercise.
4. Engage in push-ups, jumping jacks or lifting weights. Practice jumping rope.
5. Express emotions with our bodies — acting out, making a movement or a sound that represents:
    - **a.** How you feel at this moment
    - **b.** How you feel about fire
    - **c.** How you feel about trauma
    - **d.** Any other prompts that might be appropriate

Station 3: Creative processing prompts

Invite students to use art and their creativity to digest and process information and emotions.

1. Practice drawing, poetry, creative writing, sketching, singing or using smartphones to find and play songs for each other that express how they feel:
    - **a.** In this moment.
    - **b.** About wildfire.
    - **c.** About what they learned about trauma.
    - **d.** Any other prompts that might be appropriate.

Scenarios: Practicing trauma-informed strategies and tools

1 A resigned community member says to you: *"There is nothing I can do about fires. Wildfires happen every year. Why bother?"* **How would you respond using trauma-informed strategies?**	2 A terrified community member says to you: *"My house burned down in the last fire. I'm really struggling and scared that it will happen again."* **What trauma-informed tools could you apply in this situation?**	3 A community member you are trying to talk to is showing body language that signals they are feeling tense and don't want to hear what you are saying (arms crossed, tight jaw, one-word answers, etc.). **What can you do to help put them more at ease?**
4 A community member says to you with an angry tone: *"I have lived this way for 20 years. I never clean my gutters or cut my trees, and I certainly don't see why I should start now!"* **What might be the most trauma-informed way you could respond?**	5 An annoyed community member says to you: *"My neighbor has so much junk in their yard and they never trim their shrubs. Their house is a bigger liability than mine — why aren't you talking to them?!"* **How might this make you feel? How would you respond?**	6 As you are talking to a group of community members you notice that one person in the back has gone very still with tears running down their cheeks. **What can you do in this scenario to address the needs of the crying person but also continue with the group discussion?**
7 You are talking to an elderly lady who is crying and telling you she lost everything in a fire. You notice yourself getting flustered. Your heart starts pounding, your palms are sweaty, and you forget what you wanted to say to her. **What do you think is going on in your nervous system at this moment? What can you do about it?**	8 You are talking to a man who is showing some signs of anger at being asked to think about defensible space. You feel frustrated. Your heart is beating fast. You notice that you are raising your voice as you are trying to talk to him. The conversation is becoming heated. **How would you respond to him using trauma-informed strategies? How can you tend to your own needs in this situation?**	9 In a group meeting, one community member stands up and starts assigning blame to others: *"Why doesn't the fire department do more? My neighbors don't care if my house burns down, their homes are huge fire hazards! Reducing fire risk is the government's responsibility, not mine!"* You notice the other people in the meeting become agitated, shifting around on their chairs. **What can you do to help put the group at ease?**

Defensible space experiment worksheet

Your group members: _____

Instructions: Each zone of defensible space around a home can carry one of three quality ratings: good, needs Improvement or poor. (Refer to your "Defensible space assessment worksheet" for guidance.) Each student group will create one of the three model homes or properties:

- Good
- Needs improvement
- Poor

We'll construct a scale model of the immediate (0–5 feet from the exterior) and intermediate (5–30 feet) home ignition zones. Depending upon the size of your trays, you may or may not be able to include the extended zone (30–100 feet). Many homes don't have extended zones.

If you're using a cookie sheet as a base, suggested structure size and zone areas are:

- Model house structure size: 3 inches x 4 inches
- Immediate (0–5 feet from exterior of home) = 1.5-inch to 2-inch area
- Intermediate (5–30 feet from the exterior of the home) = 3-inch to 4-inch area

Materials for each group

- A sheet pan or metal cookie tray for each group
- Ruler
- Sand
- Cardboard, aluminum, etc., to build home structures. Remember to include rain gutters. (aluminum foil for a metal roof, flimsy tagboard, heavy-duty cardboard)
- Scavenged landscaping and outdoor materials (dry leaves, cedar chips, pine needles or plant samples)
- Matches
- Water
- Timer, watch or phone to track time

(The teacher will have a fire extinguisher and an empty metal trash can for the class.)

Build your defensible space model home

- In advance, build your model houses and scavenge landscaping materials.
- Arrange sand on cookie sheet from ¼ to ½ inch deep.
- Place model house in center of cookie sheet.
- Measure and "draw" in the sand the representative immediate and intermediate defensible space zones in the rectangular space surrounding the home.
- Arrange landscaping and other items (such as sticks that represent wood piles or lawn furniture) within the zones according to the model you have been assigned. See photo for example.
- When it is your turn to ignite your four matches, place them strategically, two per zone, on your model.
- Set your timer and measure how long it takes for the house to ignite, or until the matches all burn out. Optional: If your house structure ignited, measure how long it takes to completely burn up.) This represents how much time you would have for firefighters to arrive.Record your data in the table below.
- Spray your tray and all items on it with water until it is thoroughly wet. Dispose of the contents in the metal trash can.

A view of the trays after the experiment, from left to right: Good defensible space, needs improvement and poor defensible space. CREDIT: Jennifer Payne

Rules

- Do not use any moisture on your tray or experiment setup before it is burned. If you do, your model will be disqualified.
- Allow the burn to complete before measuring results. Do not spray water on the model or tray until after all smoke has stopped.
- Do not wear loose fitting clothing and keep long hair contained.

Optional rules

In addition to recording the amount of time up to home ignition, if applicable, also measure the amount of time until the model house structure is completely burned to gain an idea of how much time firefighters would have to make it to the scene. Does your home burn quickly due to debris in the rain gutters or items placed near the house exterior, or does it burn incompletely or slowly before burning out? Groups can share feedback with the entire class and hold discussions.

Determining the results

Note whether your model house ignited below, and if so, whether it burned completely.

Assigned model	Model house ignition? (Yes or no)	If it ignited, did it burn completely?	Time to ignition or until last match burned out

Describe or sketch the arrangement of landscaping and other materials within the two defensible space zones below:

Defensible space worksheet

Instructions: In groups of two to five, walk around the home or building you have selected for a defensible space review. Start close to the building, observing the immediate zone (0–5 feet). Next, move a little farther out to the intermediate zone (5–30 feet). Finally, inspect the extended zone (30–100 feet from the structure). Fill out the following sheet based on your observations. When you have completed the assessment, speak to the building's owner about your observations and provide suggestions.

Initial considerations

Is the building on a slope greater than 25%?	☐ No	☐ Yes: Extend the defensible space zone to 200 feet.
Is the building in or at the edge of a canyon?	☐ No	☐ Yes: Take strict measures on vegetation spacing, building materials and the extent of defensible space.
Is the building on a south-facing slope?	☐ No	☐ Yes: Fuels will be even warmer and burn periods longer. Take even stricter measures on vegetation spacing.
Is the building within a structural fire district?	☐ No: Consider installing sprinklers, using only noncombustible building materials and recognize that firefighting resources will not go into saving your home if it is already on fire.	☐ Yes

Immediate zone

	Good	Needs maintenance	Needs major work
Roof peak to eaves (check one for each row)			
Roofing materials	☐ Class A (metal, tile, composition shingles, concrete), in good repair	☐ Roof is Class A but in disrepair.	☐ Cedar shake roof
Litter and debris	☐ Clear of pine needles, leaves, etc., in roof valleys, crevices, around skylights, in gutters	☐ A year's buildup of leaves and needles	☐ Leaf and needle debris deeply accumulated in parts of roof.

Recommendations

Eaves to foundation (check one for each row)			
Soffits, attic vents and foundation vents	☐ Soffits enclosed and vents covered with a 1/8th-inch metal screen	☐ Soffits enclosed but vents are screened with larger than 1/8th-inch metal screen.	☐ Soffits are bare wood or no screened vents.
Siding material	☐ Cement, stucco, brick or rock. Or, if wood siding, in good repair with no potential cracks or gaps for embers,	☐ Wood siding missing paint. Minor knotholes or cracks.	☐ Wood siding in extreme disrepair (rot, gaps, etc.).
Windows	☐ Double paned. Vegetation clear from window pane.	☐ Double paned. Vegetation overgrown around window frame.	☐ Single paned.

Recommendations

	Good	Needs maintenance	Needs major work
Foundation to 5 feet (check one for each row)			
Mulch	☐ Soffits enclosed and vents covered with a 1/8th-inch metal screen	☐ Soffits enclosed but vents are screened with larger than 1/8th-inch metal screen.	☐ Soffits are bare wood or no screened vents.
Vegetation	☐ Well-spaced plants appropriately irrigated, free of resin, waxes, oil and dead material	☐ Appropriate plants free of resin, waxes and oil, but unhealthy (underirrigated, dead material)	☐ Fire-prone plants (resin, waxy or oily)
Tree limbs	☐ Not overhanging the building and at least 10 feet away from any chimney/ stovepipe.	☐ Recent growth overhanging the building or approaching the chimney/stovepipe.	☐ Significant tree branches over the building or touching the chimney/stovepipe.
Firewood/ fuel storage	☐ No firewood, lumber or fuel within 30 feet of the building.	Firewood near the building outside of fire season (some years as short as November–April).	☐ Firewood, lumber or other fuel permanently up against the building.
Fencing	☐ No fencing attached to the building or fencing is noncombustible (metal, rock, concrete, etc.).	☐ Noncombustible fencing, but leaves, debris built up where fencing meets building.	☐ Wooden fencing up to the building.
Deck	☐ Made from noncombustible materials or no rotten wood. Underneath is enclosed, screened or high enough off the ground for easy access to remove needles, leaves, etc.	☐ Deck made from noncombustible or well-kept material, but underneath not screened or enclosed if a low deck, or there is a heavy buildup of flammable material.	☐ Deck is wooden and rotten, broken or otherwise has areas where embers can collect.
Patio	☐ Patio furniture is made of noncombustible material and free of polyurethane cushions. (Most foam cushions are made of polyurethane.)	☐ Removable polyurethane cushions	☐ Patio furniture combustible and polyurethane cushions not easily removed from the furniture.

Recommendations

Intermediate zone (5–30 feet)

	Good	Needs maintenance	Needs major work
Landscape (check one for each row)			
Grass	☐ Irrigated and mowed, or no grass	☐ Irrigated lawn not mowed, longer than 4 inches	☐ Lawn is dry and dead.
Shrubs	☐ Fire-resistant plants (no resins, waxes, oils or dead material), spaced at least 12 feet away from trees and other shrubs or shrub clusters	☐ Fire-resistant plants but overgrown and needing to be thinned or cleaned of dead material	☐ Fire-prone plants (contain resins, waxes, oils and dead material) serving as ladder fuels to trees and the building
Tree limbs	☐ Lower limbs of trees removed up to 6–10 feet (no more than one-third the height of the tree)	☐ Limbs below 6–10 feet. If a small tree, needs continued limbing until tree is tall enough to remove up to 6–10 feet.	
Tree spacing	☐ Trees or clusters of trees all spaced at least 12 feet from each other and the home.		☐ Trees or clusters of trees not spaced out at least 12 feet from each other and the building. Crowns are touching.

Recommendations

Urban fuels and outbildings (check one for each row)			
Firewood/ fuel storage	☐ No firewood, lumber or fuel within 30 feet of the building	☐ Firewood near the building outside of fire season (some years as short as November–April)	☐ Firewood, lumber or other fuel permanently within 30 feet of the building.
Urban fuels	☐ No junk cars, trash piles, chemicals, etc., within 30 feet		☐ Junk cars, trash piles, chemicals, etc., within 30 feet
Out-buildings	☐ Outbuildings adhere to the same defensible space needs as the building.		☐ Outbuildings require defensible space work.
Power lines	☐ Vegetation cleared back from power lines	☐ Vegetation not cleared back from power lines	

Recommendations

Extended zone (30–100 feet)

	Good	Needs maintenance	Needs major work
Access and egress (check one for each row)			
Fire truck access	☐ Easy to turn around in the driveway. Driveway approach to the building cleared of vegetation and fuels 10 feet on either side and 13.5 feet above.	☐ Easy turnaround, but vegetation around the driveway is overgrown.	☐ Driveway is difficult to access and turn around in, and vegetation is overgrown.
Address sign	☐ Reflective address sign posted at all driveway intersections and visible from the public road.	☐ Address signs obscured, unreadable at night, or missing from intersections or at the public road.	

Recommendations

Shrubs (check one for each row)			
Nonriparian shrubs	☐ Highly combustible shrubs kept 18–20 feet apart from other vegetation, not acting as a ladder fuel.		Highly combustible shrubs closer than 18–20 feet and acting as a ladder fuel
Shrubs in the riparian zone	☐ Free of dead material, not directly adjacent to trees that would cause it to be a ladder fuel.		Has a buildup of dead material or is acting as a ladder fuel to surrounding trees.

Recommendations

	Good	Needs maintenance	Needs major work
Grass and other fuels (check one for each row)			
Grass	☐ Irrigated or mowed to under 4 inches before the start of fire season	☐ Not mowed	
Surface fuels	☐ Small surface fuels (dead twigs, leaves, needles) not present in large, continuous clumps.	☐ Surface fuels need to be periodically raked to break up fuel continuity.	
Large downed wood	☐ Not accumulated in piles or continuous along the surface		☐ Larged downed wood continuous throughout the property or accumulated in piles
Fuel storage	☐ Fuel tanks have vegetation removed in a 10-foot radius.	☐ Fuel tank overgrown with vegetation	

Recommendations

APPENDIX A

Forestry professional interview questions

The specifics of the interviewee's job.

- Daily job duties
- Is the majority of time spent indoors or outdoors?
- Responsibilities (such as data collection and report writing)
- Supervisory roles
- Scientific data collected
- Tools used

The goals of the interviewee's company or organization.

- Private company or public organization?
- Does the company or organization have requirements, policies or mandates that it must follow? (provide habitat for wildlife, supply timber, contribute to clean water and air, provide recreation space, etc.)

What the company or organization produces.

The role of the interviewee's company or organization in the community, including any volunteer work or sponsorships the company or organization contribute to the community.

The skills the interviewee needs to do the work.

Compensation for employees at the company or organization.

- Starting wage vs. current wage or salary
- Other jobs the interviewee did within the company or organization and the salary range
- Does the company or organization pay for additional training or education?
- Benefits?

The public opinion of the interviewee's job, company or organization.

- Is the interviewee required to deal with the public?
- Does public opinion affect the interviewee's ability to perform the job?

Job satisfaction

- What are future opportunities that the interviewee could pursue from the path chosen? (additional training and/or education, promotions, other agencies or companies)

APPENDIX B

The FireBright Curriculum is best implemented with support from firefighting and wildfire education organizations and agencies. Consider contacting the Oregon Department of Forestry or your local Forest Protection Association office as well as your local OSU Extension office for potential guest speakers and resources.

Contact list

Forest protection associations

Coos Forest Protection Association Bridge Unit Office
98247 Bridge Lane, Myrtle Point, OR 97458
Phone: 541-572-2796 | Fax: 541-572-4316

Coos Forest Protection Association Brookings Office
415 Redwood St., Brookings, OR 97415
541-469-5040

Coos Forest Protection Association Headquarters
63612 Fifth Road, Coos Bay, OR 97420
Phone: 541-267-3161 | Fax: 541-266-8452

Coos Forest Protection Association Gold Beach Unit
94276 Gauntlett St., Gold Beach, OR 97444
541-247-6241

Coos Forest Protection Association Reedsport Sub Unit
2925 Longwood Drive, Reedsport, OR 97467
Phone: 541-271-2224 | Fax: 541-271-9494

Douglas Forest Protective Association
1758 NE Airport Road, Roseburg, OR 97470
Phone: 541-672-6507 | Fax: 541-440-3424

Oregon Department of Forestry offices

ODF Astoria District Office
92219 OR-202, Astoria, OR 97103
Phone: 503-325-5451 | Fax: 503-325-2756

ODF Baker City Sub-Unit Office
2995 Hughes Lane, Baker City, OR 97814
541-523-5831

ODF Central Oregon Interagency Dispatch Center
1605 SE Ochoco Way, Redmond, OR 97756
541-316-7700

ODF Columbia City Unit Office
405 E St., Columbia City, OR 97018
Phone: 503-397-2636 | Fax: 503-397-6361

ODF Dallas Unit Office
825 Oak Villa Road, Dallas, OR 97338
Phone: 503-934-8146 | Fax: 503-623-9034

ODF Eastern Lane Unit Office
3150 Main St., Springfield, OR 97478
Phone: 541-726-3588 | Fax: 541-726-2501

ODF Florence Unit Office
2660 Kingwood St., Florence, OR 97439
Phone: 541-997-8713 | Fax: 541-997-3737

ODF Forest Grove Office
801 Gales Creek Road, Forest Grove, OR 97116
Phone: 503-357-2191 | Fax: 503-357-4548

ODF Fossil Sub-Unit Office
45945 OR-19, Fossil, OR 97830
Phone: 541-763-2575 | Fax: 541-763-2027

ODF Grants Unit Office
5375 Monument Drive, Grants Pass, OR 97526
Phone: 541-474-3152 | Fax: 541-474-3158

ODF John Day Unit Office
415 Patterson Bridge Road
P.O. Box 546, John Day, OR 97845
Phone: 541-575-1139 | Fax: 541-575-2253

ODF Klamath Unit Office
3200 DeLap Road, Klamath Falls, OR 97601
Phone: 541-883-5681 | Fax: 541-883-5555

ODF La Grande Unit Office
611 20th St., La Grande, OR 97850
Phone: 541-963-3168 | Fax: 541-962-1058

ODF Lakeview Interagency Fire Center
1000 S. Ninth St., Lakeview, OR 97630
Phone: 541-947-6315 | Fax: 541-947-6317

ODF Medford Unit Office
5286 Table Rock Road, Central Point, OR 97502
Phone: 541-664-3328 | Fax: 541-664-4340

ODF Molalla Unit Office
14995 OR-211, Molalla, OR 97038
Phone: 503-829-2216 | Fax: 503-829-4736

ODF Pendleton Unit Office
1055 Airport Road, Pendleton, OR 97801
Phone: 541-276-3491 | Fax: 541-276-0710

ODF Prineville Unit Office
3501 NE Third St., Prineville, OR 97754
Phone: 541-447-5658 | Fax: 541-447-1469

ODF Sisters Sub-Unit Unit Office
16721 Pine Tree Lane, Sisters, OR 97759
Phone: 541-549-2731 | Fax: 541-549-9422

ODF Sweet Home Unit Office
4690 US-20, Sweet Home, OR 97386
Phone: 541-367-6108 | Fax: 541-367-5613

ODF The Dalles Unit Office
3701 W. 13th St., The Dalles, OR 97058
Phone: 541-296-4626 | Fax: 541-298-4993

ODF Tillamook District Office
5005 Third St., Tillamook, OR 97141
Phone: 503-842-2545 | Fax: 503-842-3143

ODF Toledo Unit Office
763 NW Forestry Road, Toledo, OR 97391
Phone: 541-336-2273 | Fax: 541-336-5261

ODF Wallowa Unit Office
802 OR-82, Wallowa, OR 97885
Phone: 541-886-2881 | Fax: 541-886-9085

ODF Western Lane District Office
87950 Territorial Hwy, Veneta, OR 97487
Phone: 541-935-2283 | Fax: 541-935-0731

Oregon State University Extension offices

Baker County
2600 East St., Baker City, OR 97814
541-523-6418

Benton County
4077 SW Research Way, Corvallis, OR 97333
541-713-5000

Clackamas County
200 Warner Milne Road, Oregon City, OR 97045
503-655-8631

Clackamas County — North Willamette Research and Extension Center
15210 NE Miley Road, Aurora, OR 97002
503-678-1264

Clatsop County
2001 Marine Drive, Room 210, Astoria, OR 97103
503-325-8573

Columbia County
505 North Columbia River Highway, St Helens, OR 97051
503-397-3462

Confederated Tribes of Warm Springs
1110 Wasco St., PO Box 430, Warm Springs, OR 97761
541-553-3238

Coos County
631 Alder St., Myrtle Point, OR 97458
541-572-5263

Crook County
498 SE Lynn Boulevard, Prineville, OR 97754
541-447-6228

Curry County
29390 Ellensburg Ave., Gold Beach, OR 97444
541-247-6672

Deschutes County
3800 SW Airport Way Building #4, Redmond, OR 97756
541-548-6088

Douglas County
1134 SE Douglas Ave., Roseburg, OR 97470
541-672-4461
douglas.extension@oregonstate.edu

Gilliam County
135 S. Main St., Suite 219, Condon, OR 97823
For Appointments Call: (541) 442-2271

Grant County
116 NW Bridge St., Suite 1, John Day, OR 97845
541-575-1911

Harney County
450 N Buena Vista Ave., Burns, OR 97720
541-573-2506

Hood River County
2990 Experiment Station Drive, Hood River, OR 97031
General number: 541-386-3343. *Please leave a voicemail (press 1 for a directory), or enter a direct staff extension and leave a voicemail.*

Jackson County — Southern Oregon Research and Extension Center
569 Hanley Road, Central Point, OR 97502
541-776-7371

Jefferson County
850 NW Dogwood Lane, Madras, OR 97741
541-475-7107

Josephine County
215 Ringuette St., Grants Pass, OR 97527
541-476-6613

Klamath County
6923 Washburn Way, Klamath Falls, OR 97603
541-883-7131

Lake County
103 S. E St., Lakeview, OR 97630
541-947-6054
office.lakeco@oregonstate.edu

Lane County
996 Jefferson St., Eugene, OR 97402
541-344-5859, lane.extension@oregonstate.edu

Lincoln County
1211 SE Bay Boulevard, Newport, OR 97365
Phone: 541-574-6534 | Fax: 541-265-3887

Linn County
33630 McFarland Road, Tangent, OR 97389
541-967-3871

Malheur County
710 SW 5th Ave., Ontario, OR 97914
541-881-1417

Marion County
1320 Capitol St. NE, Suite 110, Salem, OR 97301
503-588-5301 or 503-373-3775

Morrow County
54173 Highway 74, Heppner, OR 97836
541-676-9642

Portland Metro Extension, with options for Multnomah, Washington and Clackamas counties
3880 SE 8th Ave. #170, Portland, OR 97202
503-821-1137

Polk County
289 E. Ellendale, Suite 301, Dallas, OR 97338
503-623-8395

Sherman County
66365 Lonerock Road, Moro, OR 97039
541-565-3230

Tillamook County
4506 Third St., Tillamook, OR 97141
503-842-3433,
TillamookExtensionOffice@oregonstate.edu

Umatilla County
2411 NW Carden Ave, Umatilla Hall, PO Box 100
Pendleton, OR 97801
541-278-5403
umatilla.county@oregonstate.edu

Umatilla County — Hermiston
2121 S First St., Hermiston, OR 97838
541-567-8321

Umatilla County — Milton-Freewater
418 N. Main St., Milton-Freewater, OR 97862
541-938-5597

Union County
10507 N McAlister Road, Room 9, La Grande, OR 97850
541-963-1010, unioncountyextension@oregonstate.edu

Wallowa County
668 NW First St., Enterprise, OR 97828
541-426-3143

Wasco County
400 E. Scenic Drive, Suite 2.278 (Building 2, Level 2)
The Dalles, OR 97058
541-296-5494

Washington County
1815 NW 169th Place, Suite 1000, Beaverton, OR 97006
503-821-1150

Wheeler County
401 4th St., PO Box 407, Fossil, OR 97830
541-763-4115

Yamhill County
2050 Lafayette Ave, McMinnville, OR 97128
503-434-7517 or 888-373-4628