Elementary FireWorks Curriculum for the Northern Rocky Mountains and North Cascades.

Most of these activities are best-suited for students in 3-5th grades (4th and 5th are probably best). Lesson E14 is best for K-2nd grade students.

Lessons with 🔥 symbol use fire.

Lessons with 📦 symbol use materials in FireWorks trunks. Lessons without 📦 symbol have downloadable materials.

15-minute video with overview of the FireWorks program available here.

Unit	Lesson	Overview	Notes
Unit I. Introduction to Wildland Fire	E01. Visiting Wildland Fire in the Northern Rocky Mountains and North Cascades	Students view a narrated photo presentation that shows wildland fires and some of the local plants and animals they are going to learn about in this curriculum. During the presentation, students record their observations about fire behavior. Afterwards, they discuss their observations and feelings about the presentation.	Photo presentation, discussion, project/sketch handout on board; record student's responses.
Unit II. Physical Science of Wildland Fire	E02. Making Fires Burn or Go Out 1: Introduction to the Fire Triangle	Students describe and organize what they already know about fire, so it fits into the conceptual model of the Fire Triangle (fuel, oxygen, and heat). They examine the geometric stability of a triangle and how that property applies to fire.	Students construct the fire triangle using gum drops/gummies and toothpicks.
Unit III. The Wildland Fire Environment	E03. Making Fires Burn or Go Out 2: Demonstrating the Fire Triangle and Heat Plume	Students observe three demonstrations of real fires (burning individual matches) on a stand to see how the conceptual model of the Fire Triangle applies to combustion. Students can explain what happens if one side of the triangle is removed.	3 demos that burn individual matches on a stand; 1 of them uses vinegar & baking soda or dry ice (OK for most classrooms). 🔥📦
	E04. How Wildland Fires Spread 1: Experiment with a Matchstick Forest	Students use a physical model to learn how slope and the density of trees (or other kinds of standing fuels) affect fire spread.	Demo using matches on Masonite boards (outside or in lab with hood is best). 🔥📦
	E05. Fuel Properties: The Campfire Challenge	Students explore how different properties of fuels affect fire behavior - especially how easy or hard it is to ignite different fuels and how long they are likely to burn. Students consider various combinations of fuels ("fuel recipes"), predict how they will burn, then test their hypotheses.	Students burn 4 different fuel recipes in pie pans. Fuels include pine needles, twigs, and sticks. Discussion on fuel arrangement & moisture, fire behavior, etc. (outside or lab with hood is best). 🔥📦
	E06. Effect of Wind: How Wildland Fires Spread	Students participate in a human model that shows how wind affects fire spread.	Students model/role play wind and how fire spreads. Quick and easy classroom or outdoor activity.

Unit IV. Fire Effects on the Environment	E07. Smoke from Wildland Fire: Just Hanging Around?	Students learn that smoke from wildland fires can either disperse readily or stick around, reducing visibility on the earth's surface and making it difficult to breathe. Then they apply health guidelines regarding smoke to a very important question: Can Physical Education (PE) Class proceed with the scheduled 1-km run, or do we need to change plans?	Slide show with handouts; Students make decisions as to what school activities can safely take place given smoke guidelines.
Unit V. Fire's Relationship with Organisms and Communities	E08-1. What's a Community? All the Living Things in the Ecosystem	Students learn about the nature of biological communities. This concept is important to the science of wildland fire because fire behavior, fire history, fire effects, and even management of fire depend on what plant communities are burned.	3 student teams create different feltboard ecosystems; Teams present their ecosystem to class; Students sketch 3 organisms from each ecosystem 
	E08-2. Who Lives Here? Adopting a Plant, Animal, or Fungus	Introduces a suite of organisms that live in 3 forest communities of the northern Rocky Mountains and North Cascades (forests dominated by ponderosa pine, lodgepole pine, and whitebark pine). Each student "adopts" an organism, learns about its characteristics and its relationship to fire from short essays in the FireWorks Encyclopedia (younger grades, older grades).	3-5th grades. Students learn about an organism, then create relevant artwork & give 2-3 min presentation about the organism. Alternatively, classes can play charades based on the organisms.
	E09. Tree Parts and Fire: The Class Models a Living Tree	Students learn to name many parts of a tree, describe their functions, and explain how some trees can survive fire or reproduce well after fire.	Students roleplay tree parts then label tree parts on a handout
	E10. Tree Identification: Using a Key to Identify "Mystery Trees"	Students examine botanical specimens of tree species and learn to use a dichotomous key to identify them.	Students work individually or in teams to identify classroom specimens. 
	E11. Recipe for a Lodgepole Pine Forest: Serotinous Cones	Students extract seeds from serotinous cones of Rocky Mountain lodgepole pine, count the seeds, report their results, and analyze their pooled data. Then they calculate the number of seeds from serotinous cones that might germinate in a small forest after a crown fire.	Cones are heated so that seeds can be extracted. (This is done at least 1 day before seeds will be extracted). Students can heat the cones in hot water as part of the activity or teachers can heat cones in oven at home. As a class, students create a histography of the number of seeds extracted per cone. 

	E12. Buried Treasure: Underground Parts that Help Plants Survive Fire	Students look at specimens of 9 plant species - grasses, wildflowers, and shrubs - and examine their underground parts. They learn how these parts enable the plants to survive and/or reproduce after fire.	Students examine 9 plant specimens, sketch their underground parts, then design a new plant that can survive fire using the adaptations they learned about. 
Unit VI. Fire History and Succession	E13-1. My Tree Autobiography: Seeing History through Trees' Annual Rings	Students examine a fire-scarred tree cross section (sometimes called a "tree cookie") and/or a display that shows tree growth rings. Then they record their personal histories using growth rings as a metaphor.	Students examine a fire-scarred tree cross-section or poster & create their own story using growth rings.
	E13-2. Tree Biography, Forest Biography	Students learn that trees can sometimes survive fire. They create a human model that demonstrates how trees survive fire and how fire scars form. Then they will describe the fire history of tree cross-sections ("tree cookies") from fire-scarred trees.	Class creates a human model roleplaying how fire scars form; students view presentation & examine tree x-sections; students answer questions in handout. 
	E14. Story Time: Fire and Succession	Students use feltboard materials to tell the story of fire and succession in 3 ecosystems of the northern Rocky Mountains and the North Cascades - forests dominated historically by ponderosa pine, lodgepole pine, and whitebark pine.	Students help teacher tell the stories using felt pieces that they place on feltboards. There are 3 different stories. Can do as many stories as you want. This activity is a good one for K-2nd grade. 
Unit VII. People in Fire's Homeland	E15. Carrying Fire the Pikunni Way	Learn about how and why the Pikunii (Blackfeet) people transported fire from one camp to another as they traveled along historical migration routes. This activity includes a complete lesson plan, examination of a Fire Carrier model, and a 12-minute video interview with Pikunii elder Marvin Weatherwax as he describes the importance, technology, and use of the Fire Carrier.	3 Parts: Build or imagine a campfire; examine reproduction of fire carrier; view video; discussion. Can do all parts of activity, or only watch the video.
	E16. Homes in the Forest: An Introduction to Firewise Practices	Students use their knowledge about vegetation, fuels, and fire behavior to develop some rules that can help people protect their homes from wildland fire. Then they apply their rules by assessing photos of wildland homes, ask how 'firewise' they are, make recommendations to reduce fire risk, and justify their recommendations.	View slides of homes & determine possible ignition zones; recommend actions to reduce likelihood of home ignition

	E17. Revisiting Wildland Fire	Students view the same presentation they saw in Activity E01, which shows wildland fires in a variety of plant communities and ecosystems, and some of the plants and animals that they learned about in the curriculum. When they first saw this presentation, it was accompanied by a short narrative. This time, they narrate the presentation themselves. Afterward, they discuss their feelings about wildland fire and whether they have changed from the feelings recorded in Activity E01. Finally, in the Assessment, they consider whether a fire manager's job is easy or hard.	Students narrate presentation and discuss whether they view the photos differently compared to when they first saw them in lesson 1.

Middle School FireWorks Curriculum for the Northern Rocky Mountains and North Cascades.

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15-minute video with overview of the FireWorks program available here.

Unit	Lesson	Overview	Notes
Unit I. Introduction to Wildland Fire	M01. Visiting Wildland Fire in the Northern Rocky Mountains and North Cascades	Students view a narrated photo presentation that shows wildland fires and some of the local plants and animals they are going to learn about. During the presentation, students record observations about fire behavior. Afterwards, they compare & contrast the kinds of fire they observed, and they also describe their feelings about wildland fire.	Students view photo presentation while taking notes and answering questions in handout. Students write two paragraphs about the slide show and a few words describing their feelings about wildland fire.
Unit II. Physical Science of Wildland Fire	M02. Where Does Heat Go? The heat Plume from a Fire	Students observe the heat from a burning candle and a single match so they can describe the shape and size of a heat plume and explain how the energy from a fire is transferred (conduction, convection, radiation). Like all activities that use fire, safety procedures together are reviewed and discussed.	Students role-play 3 types of heat transfer. Students in small groups measure the shape of the heat plume from a single burning match on a stand. They describe where most of the heat goes and describe the types of heat transfer observed. (Okay for most classrooms). 🔥📦
	M03. What Makes Fires Burn? The Fire Triangle 1 – Heat and Fuel	Students learn about the concept of the Fire Triangle (fuel, heat, oxygen), then test it experimentally. This activity focuses on fire's requirement for fuel and a heat source.	Students in small groups measure and record observations about heat and burning time for single burning matches. Students learn about the chemical change that occurs during combustion. (Okay for most classrooms). 🔥📦
	M04. What Makes Fires Burn? The Fire Triangle 2 – Oxygen	Students learn more about the Fire Triangle and continue to test it experimentally. This activity focuses on fire's requirement for oxygen. There are 2 options for doing the experiment: Option 1 uses vinegar and baking soda; Option 2 uses dry ice.	Students in small groups try to light a candle in an oxygen deprived environment. They describe their observations and use the fire triangle to explain them (OK for most classrooms). 🔥📦
Unit III. The Wildland Fire Environment	M05. How Do wildland Fires spread? The Matchstick Forest Model	Students use a physical model to learn how slope and the density of trees (or other kinds of standing fuels) affect fire spread. Short video clip showing stand density and slope	Students work in small groups to create and test hypotheses about how fires will behave on small Masonite boards. They change one variable at a time and record their measurements. (Outside or lab with hood is best). 🔥📦

	M06. Ladder Fuels and Fire Spread: The Tinker Tree Derby	Students use a physical model to learn how the vertical arrangement of fuels affects the potential for fires to spread into tree crowns. It is especially relevant to ponderosa pine/Douglas-fir forests in the northern Rocky Mountains and North Cascades, where surface fires have been excluded for nearly a century. Short video clip	Students work in small groups to create a 'tree' that will survive wildfire using newspaper strips (foliage) and metal support stand. (Outside or lab with hood is best). 
	M07. Fuel Properties: The Campfire Challenge	Students explore how different properties of fuels affect fire behavior - especially how hard it is to ignite fuels and how long they are likely to burn. Students consider various combinations of fuels ("fuel recipes"), predict how they will burn, then test their hypotheses.	Students work in small groups and attempt to burn 4 different fuel recipes in pie plates. Students discuss and record observations of how fuel properties affect how fires burn. (Outside or lab with hood is best). 
	M08. Fire Behavior, Fire Weather, and Climate	Students study the history of a real wildland fire, the Lolo Peak Fire of 2017 in western Montana. They view and discuss a presentation and 2 short videos to learn how managers used information on weather, fuels, and topography to manage the fire. Then they identify patterns in weather data that are correlated with fire behavior. They synthesize day-by-day reports from the official records of the *Incident Command* (*IC*) *Team* and news articles to create podcasts on the fire's progress. Finally, they interpret maps and slides in a presentation that shows the fire's growth and the variety in its severity.	3-4 Class Periods: Students view videos and presentation. Students work in teams to explain why a wildland fire showed rapid spread at times and showed little or no spread at other times, interpret maps and photos that illustrate the fire's growth and severity, synthesize information on the progress of a wildland fire into a podcast for a national audience. 
Unit IV. Fire Effects on the Environment	M09. Smoke from Wildland Fire: Just Hanging Around?	From a lab demonstration or video, students learn how smoke disperses (or doesn't), depending on atmospheric conditions. They learn how smoke affects visibility and human health, especially if it sticks around for days or weeks instead of dispersing into the upper atmosphere. Finally, they apply health guidelines regarding smoke to the issue of protecting students' breathing while planning athletic events on smoky days.	Likely 2 class periods. Students view presentations. Option to conduct demo in class or view video of demo. Students work in teams to plan athletic events given smoke guidelines. 

	M10. Fire, Soil, and Water Interactions	Students view and take notes on a presentation. Then they either observe or conduct an experiment that illustrates how wildland fires affect the potential for soil erosion. They learn that soil burn severity varies greatly and that when fires remove the litter, duff, and plant cover on the ground, the risk of soil erosion increases.	Option to conduct experiment or watch video of experiment. **Prep:** If doing the demonstration in class, you need a container containing young grass stems that were started from seed 4-8 weeks before. You may be able to use a cut piece of sod instead.
Unit V. Fire's Relationship with Organisms and Communities	M11. Who Lives Here? Adopting a Plant, Animal or Fungus	Introduces a suite of organisms that live in forests of northern Rocky Mountains and North Cascades. It features species representative of 3 forest communities: those dominated by ponderosa pine, lodgepole pine, and whitebark pine. Each student "adopts" an organism, learns about its characteristics and its relationship to fire from essays in the FireWorks Encyclopedia, and gives a presentation on it to the class - illustrated by some form of art work.	Students learn about an organism, then create relevant artwork. They give 3-4 min presentation about their organism while class takes notes. This will take a few class periods for student to give presentations.
	M12. Tree parts and Fire: "Working Trees" Jeopardy-style Game	Students learn to name the parts of a tree, describe their functions, and describe how some of these plant parts can help the tree survive fire, avoid the effects of severe fire, or reproduce after fire.	Each student presents 1-2 tree terms to class. The class then competes in a Jeopardy-style game.
	M13. Tree Identification: Figure out the "Mystery Trees"	Students observe and record information on botanical specimens, then use each other's observations to identify 10 tree species of the northern Rocky Mountains and North Cascade range.	2 class periods. Teacher needs to photocopy handouts from the first period to use in the second period. **Another version** of the mystery trees activity that uses a dichotomous key and takes 1 class period is available here.
	E11. (Appropriate for Middle School) Recipe for a Lodgepole Pine Forest: Serotinous Cones	Students extract seeds from serotinous cones of Rocky Mountain lodgepole pine, count the seeds, report their results, and analyze their pooled data. Then they calculate the number of seeds from serotinous cones that might germinate in a small forest after a crown fire has swept through.	Cones are heated so that seeds can be extracted. **Cones are heated at least 1 day before seeds will be extracted**. Students can heat the cones in hot water as part of the activity or teachers can heat cones in oven at home. As a class, students create a histography of the number of seeds extracted per cone.

	M14. Who Lives Here and Why? Modeling Forest Communities	The class assembles a graphic model of forest communities in the northern Rocky Mountains and the North Cascades. They use feltboard materials from the trunk to show illustrate the optimal environmental conditions for each species and show how individual tree species are associated with each other in ecological communities. Then they use the model to predict the effects of changing climate conditions on the distribution of species.	After assembling the graphic model on the feltboard. Students answer handout questions either individually or as a class. 
	M15. Bark and Soil: Nature's Insulators	This activity explores the use of insulation to slow the transfer of heat through materials. Bark (on stems of trees and shrubs) and soil are two kinds of materials that insulate living things from the heat of fires.	Students use a physical model of either a tree trunk or soil and test how quickly the cambium or buried seeds/roots heat up with various layers of insulation when heated with a blow dryer. Students take measurements, graph data, and test hypotheses. **There is only one set of materials in the trunk, so this activity can be done as a class demonstration or has a station with a few students at a time.** 
	M16. Buried Treasures: Identifying Plants by their Underground Parts	Students examine specimens of nine plant species - grasses, wildflowers, and shrubs - and use a dichotomous key to identify them based on their "buried treasures" - underground parts that can sprout after fire and grow new plants.	Students draw and define terms for underground plant parts. They identify plant species from specimens of underground parts using a dichotomous key. 
Unit VI. Fire History and Succession	M17-H16. Dating Fires using Dendrochronology.	Students discuss the current prevalence of wildfires in their region and ways to find out if those fires are typical for the 3 forest types they have been studying - forests historically dominated by ponderosa, lodgepole, and whitebark pine. Then they either view a presentation or complete an electronic tutorial covering 10 terms that are important for understanding fire history.	Photo presentation (digital or print) and class discussion followed by optional handout with matching exercise using terms learned during presentation.
	M18-H17. History of Stand-replacing Fire	Students use information from 11 cross-dated increment cores to figure out the approximate age of a forest stand that originated after stand-replacing fire.	Students work in teams and use increment cores (photos) to determine the age of individual trees. Collectively, they assemble a stand history diagram to estimate the forest age and its possible fire history. 

	M19-H18. History of Low-severity Fire	Students create a living model to demonstrate how fire scars form. They use dendrochronology to describe the history of low-severity fire for a single tree and then a whole forest. They assemble a stand history diagram and use it to identify years when low-severity fire occurred and to describe the spatial uniformity of past fires. Then they use information from the stand history diagram to discuss the policy of full fire suppression.	This lesson builds on previous lesson, but **you can only do the living model (role play) to demonstrate how fire scars form** and how trees with thick bark can survive surface fire. In the second part of the lesson, teams of students examine tree cross-sections (posters) to identify fire scars and then collectively assemble a stand history diagram. 
	M20. Fire History in Ponderosa, Lodgepole, and Whitebark Pine Forest Communities	Students use the stand history diagrams that they assembled in the 2 previous activities to learn about mixed-severity fire regimes. They interpret stand history diagrams for plots from each of the 3 forest types they've been studying. Then they read articles about fire regimes in these forest types and summarize an article in a news blog.	After examining the mixed severity fire regimes from the stand history diagram created in the previous 2 lessons, students view a presentation where they further examine and interpret stand histories from research in several plant communities. Students read short articles on fire regimes of the 3 forest types and summarize it in a blog. The articles could probably be a stand-alone lesson. 
	M21. Drama in the Forest: Fire and Succession, a Class Production	Students prepare and produce three short plays. Each play depicts the role of fire, succession, and other changes over time in one of 3 ecosystems: forests dominated by ponderosa pine and Douglas-fir; lodgepole pine and subalpine fir; and whitebark pine and subalpine fir.	Students work in three teams to produce/present a drama depicting 3 forest ecosystems. Builds on concepts learned in previous lessons. Great if you can use student projects from M11. Who Lives Here? Adopting a Plant, Animal or Fungus.
	M22. Fire Ecology Puzzler	Uses a set of jigsaw puzzles (printed on laminated paper) to review species interactions and the role of fire in 3 forest ecosystems of the northern Rocky Mountains and the North Cascades (dominated by ponderosa pine/Douglas-fir, lodgepole pine/subalpine fir, and whitebark pine/subalpine fir).	Students use their knowledge of fire behavior, species adaptations, fire history, etc. to assemble 3 puzzles describing the 3 forest communities they've been learning about. The activity can be done in 2 ways (at least): as a classroom "grab-bag" competition among student teams, or as a quiet activity to be done singly or in small groups at stations.

Unit VII. People in Fire's Homeland	M23. Carrying Fire the Pikunni Way	Learn about how and why the Pikunii (Blackfeet) people transported fire from one camp to another as they traveled along historical migration routes. This activity includes a complete lesson plan, examination of a Fire Carrier model, and a 12-minute video interview with Pikunii elder Marvin Weatherwax as he describes the importance, technology, and use of the Fire Carrier.	This activity has several parts. You can do all parts or only watch the video. **The video can stand alone.** You can borrow a model fire carrier from the Missoula Fire Lab (it is not part of the trunk).
	M24. Homes in the Forest: An Introduction to Firewise Practices	Students use their knowledge about vegetation, fuels, and fire behavior to develop some rules that can help people protect their homes from wildland fire. Then they apply their rules by assessing photos of wildland homes, making recommendations to the home owners, and justifying their recommendations. Finally, they assess fire safety in a photo of a whole neighborhood.	This lesson *may* be okay to use even if you didn't do the rest of the curriculum (but it would be better with previous knowledge).
	M25. Revisiting Wildland Fire	Students return to the presentation that they viewed in Activity M01. This time, they narrate the presentation themselves. Then they compare and contrast their current feelings about wildland fire with their earlier ones. Finally, they assess the difficulty of a fire manager's job.	This activity should only be done if students did M01 and then several other activities in the curriculum.

High School FireWorks Curriculum for the Northern Rocky Mountains and North Cascades.

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15-minute video with overview of the FireWorks program available here.

Unit	Lesson	Overview	Notes
Unit I. Introduction to Wildland Fire	H01. Introduction to Wildland Fire in the Northern Rocky Mountains and North Cascades	Students consider their thoughts and feelings about wildland fire before and after a photo presentation. Then, using a reading activity, students read and analyze a chapter from a book about the fires of 1988 in Yellowstone National Park.	
Unit II. Physical Science of Wildland Fire	H02. The Fire Triangle: Fuel, Heat, Oxygen	Students explore the shape of the heat plume and the three components of the Fire Triangle (fuel, heat, oxygen). The lesson includes a total of 3 experiments and 1 technical reading activity.	3 ~20-minute experiments. Student groups use individual matches and a votive candle to investigate the fire triangle, heat transfer, and combustion. (Okay for most classrooms). 🔥🟫
	H03. The Fire Triangle, Combustion, and the Carbon Cycle	Students use an experiment, a presentation, and a technical article to explore how the Fire Triangle relates to the chemical equation (model) for combustion and the carbon cycle.	Burning activity uses a votive candle and a hot plate (not in trunk) (PREP: Freeze water in fence caps 1 day prior to lesson). 🔥🟫
	H04. Heat Transfer	Students work in small groups to create demonstrations that show the three ways (radiation, conduction, convection) that heat can be transferred.	Have various props (e.g., candy, yarn, balls, etc.) available.
Unit III. The Wildland Fire Environment	H05. Fuel Properties	Students explore the properties of wildland fuels through reading, a fuel scavenger hunt, and by designing and conducting experiments with fuels.	Student groups ignite newspaper manipulated in different ways in pie tin. PREP: H05-1 Handout/outdoor scavenger hunt prior to lesson. (Conduct outdoors or under a hood) 🔥🟫
	H06. Pyrolysis	Students learn the steps of combustion and pyrolysis through videos, class discussions, and an optional activity.	Students watch 30-sec video and may conduct this demonstration (using a votive candle, optional) and describe their observations. Students watch another short video or teacher demonstrates pyrolosis (as shown in video). 🔥 optional (Okay for most classrooms).

	H07. Fire Spread Processes: Putting it all together: Heat transfer, fuel properties, and pyrolysis	This culminating lesson on the physical science of wildland fire challenges students to expand their understanding and link their knowledge of heat transfer processes, fuel properties, pyrolysis, and ignition through a series of thought-provoking videos and a presentation about current research - in particular, research currently underway at the Missoula Fire Sciences Laboratory on heat transfer and ignition.	Presentation with class discussion followed by handout questions. This lesson is quite advanced.
	H08A. Fire Environment Triangle and Fire Spread: The Matchstick Model	Students design and conduct an experiment to investigate how slope and the density of trees (or other kinds of standing fuels) affect fire spread. Video clips of matchstick boards with different stand densities and slope are available.	Student groups use matchsticks on Masonite boards to test their hypotheses. Outside or lab with hood is best. 
	H08B. Fire Environment Triangle and Fire Spread: The Landscape Matchstick Model	Students design a model landscape to investigate the relationships among fuels, topography, weather, and fire spread.	Student groups design a model landscape using various materials (e.g., clay, matches, toothpicks, foil, cardboard-not in trunk) and ignite it. Outside or lab with hood is best. 
	H09. Ladder Fuels and Fire Spread	Students create a physical model to learn how the vertical arrangement of fuels affects the potential for fires to spread into tree crowns. Short video clip	Student groups to create a 'tree' that will survive wildfire using newspaper strips (foliage) and metal support stand. PREP: Complete H09-1 one day prior or as homework. Outside or lab with hood is best. 
	H10. Fire Behavior, Fire Weather, and Climate	Students study the history of a real wildland fire, the Lolo Peak Fire of 2017 in western Montana. They read excerpts from an official planning document to learn how fire managers predicted fire spread. Then they use weather data to make their own predictions of fire spread. Finally, they synthesize day-by-day reports from the official records of the Incident Command (IC) Team and other sources to create 'Weather Channel'-type reports on the fire's progress for a national audience. In a closing section of the activity, students review the IC Team's use of models and a map that shows the variety in fire severity in the area burned.	Homework and 2-3 class periods  M08 is a somewhat simpler version of this activity.

Unit IV. Fire Effects on the Environment	H11. Smoke from Wildland Fire: Just Hanging Around?	Students learn how smoke from wildland fires can reduce visibility, degrade air quality, and threaten human health. They look for patterns in data on weather and air quality from a wildland fire that occurred in 2017. They explain patterns in the data by applying the concepts of inversions and stable vs. unstable air. Then they use their knowledge to develop an editorial for a newspaper or news blog that makes recommendations to specific groups (citizens, health experts, fire managers, etc.) about what to do regarding smoke from wildland fires.	2-3 class periods. Presentation, optional demonstration  or short video, short writing assignment.
	H12. Fire, Soil, and Water Interactions	Students discuss a presentation that describes fire's effects on soils and how these effects are measured. Then they either observe or conduct an experiment that illustrates how wildland fires affect the potential for soil erosion. They learn that soil burn severity varies greatly and that when fires remove the litter, duff, and plant cover on the ground, the risk of soil erosion increases.	2 class periods. Presentation, option to conduct experiment or watch video of experiment, reading assignment with questions.
Unit V. Fire's Relationship with Organisms and Communities	H13. Tree Identification: Create a Dichotomous Key	Students use photographs and botanical specimens to create a dichotomous key for 10 tree species native to forests of the northern Rocky Mountains and the North Cascades.	Student groups create dichotomous key for 10 tree species using photographs and specimens. Groups then identify all 'mystery trees' using another groups keys.
	H14. Researching a Plant, Animal, or Fungus	Each student selects a plant, animal, or fungus to study. He/she writes a research paper on this species and shares the results with the class in a multimedia presentation. During presentations, classmates take notes to be used later for an open-note book quiz.	Homework and 2-3 class periods for student presentations.
	H15. Forest Communities and Climate Change	Students assemble a graphical model of the forest communities on a mountainside in the northern Rocky Mountains/North Cascades region. They use the model to describe specific forest communities and to assess the potential for tree distributions to change in response to climate change. Then they read and take a stand on the use of assisted migration to conserve species.	1-3 class periods depending on how you teach it. Presentation with class discussion, handout, reading assignment, and short class activity.

Unit VI. Fire History and Succession	M17-H16. Dating Fires Using Dendrochronology	Students discuss the current prevalence of wildfires in their region and ways to find out if those fires are typical for the 3 forest types they have been studying - forests historically dominated by ponderosa, lodgepole, and whitebark pine. Then they either view a presentation or complete an electronic tutorial covering 10 terms that are important for understanding fire history.	Photo presentation (digital or print) and class discussion followed by optional handout with matching exercise using terms learned during presentation.
	M18-H17. History of Stand-replacing Fire	Students use information from 11 cross-dated increment cores to figure out the approximate age of a forest stand that originated after stand-replacing fire.	Students work in teams and use increment cores (photos) to determine the age of individual trees. Collectively, they assemble a stand history diagram to estimate the forest age and its possible fire history. 
	M19-H18. History of Low-severity Fire	Students create a living model to demonstrate how fire scars form. They use dendrochronology to describe the history of low-severity fire for a single tree and then a whole forest. They assemble a stand history diagram and use it to identify years when low-severity fire occurred and to describe the spatial uniformity of past fires. Then they use information from the stand history diagram to discuss the policy of full fire suppression.	This lesson builds on previous lesson, but **you can only do the living model (role play) to demonstrate how fire scars form** and how trees with thick bark can survive surface fire. In the second part of the lesson, teams of students examine tree cross-sections (posters) to identify fire scars and then collectively assemble a stand history diagram. 
	H19. History of Mixed-severity Fire	Students use the stand history diagrams that they assembled in the 2 previous activities to learn about mixed-severity fire regimes. They check their skill in identifying historical fire regimes by interpreting stand history diagrams. Finally, in the assessment, they describe or depict the appearance of a forest that has had a historical regime of low-, mixed-severity, or stand-replacing fire.	Class discussion using stand history diagram created in previous two lessons along with presentation. Students complete a handout and create a visual (art), written, or verbal description of a forest stand in a particular year. Builds on previous two lessons. 
	H20. Why Do Historical Fire Regimes Matter?	Students apply their knowledge about fire regimes (low-, mixed-, and stand-replacement) to 3 forest types that occur from the northern Rocky Mountains to the North Cascades - forests historically dominated by ponderosa, lodgepole, and whitebark pine. Students read a technical article about 1 of these forest types and summarize it for a high -school science blog.	Slide presentation to review fire regimes. Student groups write a blog about a fire regime in 1 of 3 and forest types using handouts and provided articles. Students describe contemporary changes about their forest type.

	H21. Carrying Fire the Pikunni Way	Learn about how and why the Pikunii (Blackfeet) people transported fire from one camp to another as they traveled along historical migration routes. This activity includes a complete lesson plan, examination of a Fire Carrier model, and a 12-minute video interview with Pikunii elder Marvin Weatherwax as he describes the importance, technology, and use of the Fire Carrier.	This activity has several parts. You can do all parts or only watch the video. **The video can stand alone.** You can borrow a model fire carrier from the Missoula Fire Lab (it is not part of the trunk).
	H22. Changing Landscapes, Changing Fires	Students envision how they would like a wildland area to look in the future and how that might be achieved. First, they study photos and read articles that describe changes over the past 100 years in landscapes, fire regimes, fire management, and other issues. Then they create artwork that shows their own vision of a future landscape, and they write an editorial explaining their vision and what should be done (or not done) to achieve it.	2-3 Class Periods. Day 1: Class views historical and contemporary images and describes the changes they see. Day 2-3: Students read assigned articles and present information to class in groups.