Elementary FireWorks Curriculum for the Sierra Nevada.

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 Sierra Nevada	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) 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). 🔥📦 Video clips: Matchstick slope video Matchstick stand video
	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 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. Who Lives Here? Adopting a Plant, Animal, or Fungus	Introduces a suite of organisms that live in forests and shrublands of the Sierra Nevada. 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 Baker Cypress Grove: Serotinous Cones	Students extract seeds from serotinous cones, count them, and estimate the number of seeds that might fall in an area after a large, severe fire.	Knobcone pine cones are heated so that seeds can be extracted. Students examine closed cones then heat the cones in hot water. The next day, students examine and count the number of seeds fallen from the open cones. Need at least 1 knobcone pine cone (may not be in trunk).

	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' Growth 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. Story of a Fire-Scarred Tree	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 view an animated, narrated presentation of the *The Storrie Story*. *The Storrie Story* describes the Storrie Fire of 2000 in the Plumas and Lassen National Forests and succession after fire. It covers forest communities and wildlife that occur in Sierra Nevada lower and upper montane forests.	The story (available online) has 5 chapters and may be best shared over a few days or classes. Students participate in the presentation by contributing sound effects on cues. This activity is a good one for K-2nd grade.
Unit VII. People in Fire's Homeland	E15. 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

	E16. 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 Sierra Nevada.

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Unit	Lesson	Overview	Notes
Unit I. Introduction to Wildland Fire	M01. Visiting Wildland Fire in the Sierra Nevada	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. 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 with low fire danger 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 learn about the behavior, weather, and other aspects of a real wildland fire – the Storrie Fire of 2000 on the Plumas and Lassen National Forests. Then they create a podcast about the fire and potential effects of global climate change on wildland fires.	2 Class Periods: Students use a narrative and data from slides to create a podcast that: gives some reason to care about the fire, the fire's recent behavior and how the weather in the last day or two has affected it, and where you might see more fires like the Storrie Fire because of climate change.
Unit IV. Fire Effects on the Environment	M09. Smoke from Wildland Fire: Just Hanging Around?	From a lab demonstration, students learn how smoke disperses (or doesn't), depending on atmospheric conditions. They learn how smoke affects human health, and they apply health guidelines regarding smoke to the issue of protecting students' breathing while planning athletic events on smoky days.	1-2 class periods. Students view a presentation and a demonstration that describes stable and unstable air and inversion. 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 4-6 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 lower and upper montane forests and shrublands. 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 12 tree species that live in the Sierra Nevada.	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. Recipe for a Baker Cypress Grove: Serotinous Cones (appropriate for middle school)	Students extract seeds from serotinous cones, count them, and estimate the number of seeds that might fall in an area after a large, severe fire.	Knobcone pine cones are heated so that seeds can be extracted. Students examine closed cones then heat the cones in hot water. The next day, students examine and count the number of seeds fallen from the open cones. Need at least 1 knobcone pine cone (may not be in trunk).
	M14. Who Lives Here and Why? Modeling Forest Communities	Students create a graphical model of forest communities in the northwestern Sierra Nevada. Students then use the model to describe the species composition of current forest communities and to predict the potential 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 * Consider replacing M17 and M18 with M17-M19 from the Northern Rocky Mountains curriculum	**M17. Fire History 1: Long Stories Told By Old Trees** *	Students study the scars left by low-severity fires on tree trunks – how these scars form, how many have marked a tree, and how many years went by between fires. With this information, they can describe the history of low-severity fire for that tree. With data from the whole class, they can describe the history of low-severity fire for a whole stand or forest.	2-3 class periods. This activity has 3 parts. • Students view a slideshow to learn about fire scars and how we study fire history. • Students model how fire scars form. • Students examine 17 tree cookies and then pool their data to better understand the history of low-severity fire.
	M18. Fire History 2: History of Stand Replacing Fire *	Students learn how to use increment cores from trees to discover the history of stand-replacing fire in a forest. They use what they have learned in both this activity and the previous one to depict how fire history influences the composition and structure of forest over a landscape.	1-2 class periods. 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. Drama in the Forest: Fire and Succession, a Class Production	Students prepare and produce two short plays, each depicting the role of fire, succession, and on-going changes in a forest community.	1-2 class periods. Students will work in teams to present a drama that describes the history of two forest communities (lower and upper montane mixed-conifer forests in the Sierra Nevada) from about 1700 to the present.
Unit VII. People in Fire's Homeland	M20. 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. Students assess the safety of photos of wildland homes and make recommendations for home owners.	Students view a slideshow of homes in the forest and make recommendations about how to reduce the risk of the house from burning. 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).
	M21. 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 Siera Nevada.

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Unit	Lesson	Overview	Notes
Unit I. Introduction to Wildland Fire	H01. Introduction to Wildland Fire in the Sierra Nevada	Students consider their thoughts and feelings about wildland fire before and after a photo presentation. Then, using a reading activity, students read and analyze an article about the Storrie Fire of 2000 on the Plumas and Lassen National Forests.	
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	Using slides and handouts, students learn about the behavior, weather, and other aspects of a real wildland fire – the Storrie Fire of 2000 on the Plumas and Lassen National Forests. They create a podcast about the fire, which describes potential effects of different weather, and potential effects of global climate change.	Probably 2 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 about the composition of smoke from wildland fire, how it disperses, and its health impacts. They do a pre-class reading assignment and worksheet. During class, they discuss the pre-class reading, watch a video or demonstration of an inversion, and analyze Plumas county smoke data from two years when large wildland fires occurred.	Pre-class reading + 1 class period. Optional demonstration or short video, short presentation, students answer questions on handouts.

	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. PREP: if you do the experiment, you need to plant seeds about 4 weeks in advance or you may be able to use a piece of sod instead. Can consider doing a simpler M15 instead.
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 12 tree species native to montane forests of the Sierra Nevada.	Student groups create dichotomous key for 12 tree species using photographs and specimens. Groups then identify all 'mystery trees' using another group's keys.
	H14. Researching a Plant, Animal, or Fungus	Each student selects a plant, animal, or fungus to study. They write a research paper on this species and share 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 graphic model of a forest community in the northwestern Sierra Nevada and then discuss species distributions in the context of 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* Consider replacing H16 – H18 with M17/H16-M19/H18 from the Northern Rocky Mountains curriculum. It is a bit newer and made to be applicable **in any forested ecosystem.**	H16. Fire History 1: Long Stories Told by Old Trees	Students study the scars left by low-severity fires on tree trunks – how these scars form, how many have marked a tree, and how many years went by between fires. With this information, they can describe the history of low-severity fire for that tree. With data from the whole class, they can describe the history of low severity fire for a whole stand or forest. Finally, they can compare their results with those of two research studies and two efforts to summarize information on the history of low-severity fire in California.	2-3 class periods. This activity incorporates a considerable amount of information from the scientific literature and has 4 parts: Introduction, **Living model of fire scar formation**, Telling the story of a whole forest, How do our results compare? Even if you don't do the entire activity, the "model of fire scar formation" is quick and very useful to teach students how some trees can survive fire and form scars.

	H17. Fire History 2: History of Stand Replacing Fire	Students learn how to use increment cores from trees to discover the history of stand-replacing fire in a forest. They use what they have learned in both this activity and the previous one to depict how fire history influences the composition and structure of forest over a landscape.	1-2 class periods.
	H18. Fire History 3: Fire Regime across a Sierra Nevada Landscape	Students learn about mixed-severity fire and the complexity of actual historical fire regimes. They study information from a published research project, model results, and maps showing present patterns of fire severity. Then they use their understanding to create a stand age diagram for a hypothetical forest in the Sierra Nevada with a mixed-severity fire regime and decide if their imagined forest has a fire regime that is substantially different from its historical fire regime.	1-2 class periods. Slide presentation and a handout. Do not do this activity without doing H16 and H17 first. Fairly advanced.
	H19. Sierra Nevada Forests Today	Students will view a slide show that displays historical and recent photos of conditions in lower and upper montane Sierra Nevada forests. They will consider how current conditions differ from those of the past. A professional wildland manager will visit the classroom to discuss and answer student questions about historical and current forest conditions and the challenges of forest management.	Ideally, you contact someone with expert knowledge of local fire management and/or ecology and they visit your classroom (or video conference) and speak with your students. Otherwise, students can still analyze paired photos, but you will have to alter the lesson.