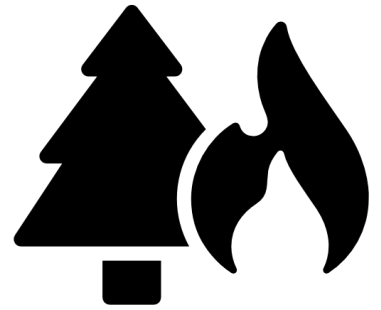


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# Ladder Fuels and Fire Spread

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## Purpose:

Increase students' understanding of the relationship between fuel arrangement and vertical fire spread, especially in forests, shrublands, and woodlands.

## Objectives:

- Students will design a model tree that can keep a surface fire from spreading into the crown.
- Students will differentiate between forest stands based on the spatial arrangement of fuels.
- Students will describe the kinds of fuels that contribute to surface fires and crown fires.

**Time Required:** 45-50 minutes

**Appropriate grades:** 6th - 8th

**NGSS and Common Core Standards:**

NGSS: Earth and Human Activity, ESS3.C Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to the Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)

CCSS: Speaking/Listening 6 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

## Materials:

Provided in the kit:

- 1 Tinker Tree support stand (To make new Tinker Tree support stands, see the instructions here).
- 1 pair of safety goggles
- 1 oven mitt
- 1 metal tray
- 6 segments of wire rod
- 1 spray bottle, filled with water
- 4 pieces of ponderosa pine bark
- 1 Fire Safety Poster

Not provided in the kit:

- pens/pencils/markers
- Paper
- 1 fire extinguisher

- newspapers
- 1 box of kitchen matches
- A handful of hair ties, in case students need them
- An empty METAL trash can WITHOUT A PLASTIC LINER

## Activity:

<p><b>Introduction</b></p>	<p>This activity explores the potential for a surface fire (burning in vegetation on the forest floor) to spread up into the crowns of overhanging trees. The more continuous the fuels, the more likely this will happen. Fuels that enable fire to climb from the forest floor to the crowns of trees are known as ladder fuels. Once fire is in a tree crown, it could spread directly from one tree crown to the next, especially if the winds are strong.</p> <p>Ladder fuels have increased in many forests of the Southern Oregon landscape and over the past century, increasing the likelihood of crown fire. This is especially typical of ponderosa pine/Douglas-fir forests in the CSNM, where large trees were harvested in the 1900s and surface fires, which had reduced Douglas-fir regeneration in the past, were suppressed by people.</p> <p>Each teams goal is to design and draw a comparison of a tree that can “survive” a fire passing beneath (surface fire) and still has plenty of leaves in its crown so it can photosynthesize against a tree that wouldn’t survive surface fire. Then, as a whole group, students will construct a “tinker tree” from a support stand, wire rods, and newspaper fuels.</p>
<p><b>Body</b></p>	<p>Step 1: Explain to students: In this activity, we’ll look more carefully at the Fuels side of the Fire Environment Triangle known as the fire triangle. We’ll think about how fuels are arranged – especially in forests and in understory shrubs of the forest – and how the arrangement of fuels changes as plant communities change over time, a process called succession.</p> <p>Step 2: Project or show a picture of ladder fuels burning beneath a tree. Explain: If fuels are continuous from the forest floor into the tree crowns, we call them ladder fuels. A surface fire can climb them like a ladder and get into the crowns, where it becomes much more powerful than a surface fire and more difficult to control. Questioning: as trees get older, would they benefit keeping all their lower branches? What are some ways keeping lower branches could benefit the tree? Or hurt it?</p>

	<p>Step 3: Have the students break into 4 groups and do a think-draw-pair-share on what a pre-burn forest would look like and a post-burn forest with mature ponderosa pine trees that survived. Hand each group a piece of the ponderosa pine bark and have them brainstorm while in their groups why they think this tree might be adapted for fire. (10 minutes)</p> <p>Step 4: Bring the students back together and explain: We're going to construct a tree with lower branches and ladder fuels and light the ladder fuels to see what happens. then we're going to do the same thing except the tree will have no lower branches.</p> <p>Step 5: Procedure:</p> <ol style="list-style-type: none"> <li>1. Place a support stand (metal post) in the center of the metal tray.</li> <li>2. Crumple up two half-pages of newspaper. These are your litter and other surface fuels. Flatten them out a bit, but make sure that some air can get between the lay.</li> <li>3. Cut or tear a line from one edge of the newspaper pieces to the middle. Then place both layers on the support stand base, with the stand's post at the center.</li> <li>4. Slide all 6 wire "branches" through the holes in the post.</li> <li>5. 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.</li> <li>6. Ignite ladder fuel.</li> <li>7. Repeat process only using 4 or fewer wires as top branches.</li> </ol>
<p><b>Closure</b></p>	<p>Have students regroup with their drawing team. Have them explain their comparing trees and why one tree might survive fire and the other not. What would you change differently? Do you think fire suppression helped fight fire or prolonged more intense fire? According to your drawings, do you think fire can help older trees? Why might we want to keep older trees in the CSNM?</p> <p>As they think about forest and fire, conclude that fire can be used as a beneficial tool to help restore and maintain CSNM. Fire needs to be used very cautiously, and by professionals. But fire can be used as a tool to help the trees we want to see grow older to maintain habitat, and get rid of some trees that are crowding larger trees like ponderosa pines.</p>

## Modifications:

- **Elementary:** Explain about ladder fuels and why they can increase a tree's chance to burn and die. Have students help build the ladder tree and simulate what ladder fuels may look like in a fire surface fire.
- **High School:**
  1. Take a field trip to the Monument, or recently burned site, to see some of the plant species in the area. What species do you see a lot of? What species do you not see as many of? How recently do you think the last fire was in this area? Which type of strategy do you see the most of? Why?
  2. Walk to a nearby forested area, park, or neighborhood natural area and try to determine how plant species in this area would deal with a fire. Would the majority survive as they are resisters? Or would you see large amounts of regrowth from sprouters? Have students hypothesize on what the landscape would look like 1? 5? 20? years after a fire.

## Additional Information:

Ladder Fuel and Fire Spread PP:

[https://www.frames.gov/documents/fireworks/curriculum/NRockies-NCascades/HighSchool/H09/H09\\_LadderFuelAndFireSpread.pptx](https://www.frames.gov/documents/fireworks/curriculum/NRockies-NCascades/HighSchool/H09/H09_LadderFuelAndFireSpread.pptx)

[M06: FireWorks Safety Poster](#)