

Matchstick Forest

Learning Objectives:

- Learn about the wildfire cycle.
- Learn about how wildfires affect people.
- Design, test, and build a matchstick forest.

Prep Time: 25-85 minutes

Duration: 35 minutes

Learning Content:

Forests change over time in the process called succession. Fire is a dramatic force for change, but change occurs without fire, too. Some plants need sunny openings to grow well, so they thrive in the first years after fire, and some animals thrive on these plants. Other plants reproduce almost anywhere, even in deep shade. They may thrive in places not burned for a long time, and the animals that depend on them are present only in old forests. Some plants and animals can live almost anywhere, regardless of when a fire occurred or how the forest changes. Most wildfires occur in hot, dry months and start with a lightning strike. Wildfires are a natural part of the seasonal cycle, but have become more frequent and extreme due to climate change. Wildfires affect humans when they are near population centers. Wildfires are affected by variations in weather, topography, and fuel, known as the Wildfire Triangle.

Knowing how a wildfire may behave is key to control and management. Many factors affect how a wildfire burns, how fast it moves and how difficult it is to control. The three sides of the fire behavior triangle are weather, topography and fuels.

Weather includes wind, temperature, cloudiness, moisture and air pressure. High temperatures and low humidity cause vegetation to dry and wildfires to burn rapidly. Wind not only moves wildfires across landscapes, but also supplies oxygen that can cause fires to grow swiftly. Wind also blows embers for miles, igniting new spot fires. Rain and high humidity can slow or extinguish fires, while storms can cause fire activity to increase or become completely unpredictable.

Topography describes the physical features of an area, including slope and aspect (the direction it faces). Wildfires burn more rapidly when moving up a slope by preheating unburned fuels and making them more combustible. Wind also moves more rapidly up slopes, increasing the speed at which a fire can spread. Draws can act like chimneys and funnel flames upwards. South- and west-facing slopes have drier fuels than north- and east-facing slopes.

Fuels are vegetation and structures. Their characteristics have a great effect on wildfire behavior. Large, dense trees burn for hours and generate a lot of heat. Dried grasses,

on the other hand, produce a flashy fire that burns quickly and does not generate much heat.

(Missoula Fire Sciences Laboratory)

Research around home destruction vs. home survival in wildfires point to embers and small flames as the main way that the majority of homes ignite in wildfires. Embers are burning pieces of airborne wood and/or vegetation that can be carried more than a mile through the wind can cause spot fires and ignite homes, debris and other objects. There are methods for homeowners to prepare their homes to withstand ember attacks and minimize the likelihood of flames or surface fire touching the home or any attachments. Experiments, models and post-fire studies have shown homes ignite due to the condition of the home and everything around it, up to 200' from the foundation. This is called the Home Ignition Zone (HIZ). The concept of the home ignition zone was developed by retired USDA Forest Service fire scientist Jack Cohen in the late 1990s, following some breakthrough experimental research into how homes ignite due to the effects of radiant heat. The HIZ is divided into three zones.

The Immediate Zone: The home and the area 0-5' from the furthest attached exterior point of the home; defined as a non-combustible area. Science tells us this is the most important zone to take immediate action on as it is the most vulnerable to embers. Prevent fire by: Moving any flammable material away from wall exteriors – mulch, flammable plants, leaves and needles, firewood piles – anything that can burn; removing anything stored underneath decks or porches; cleaning roofs and gutters of dead leaves, debris and pine needles that could catch embers. Start with the house itself, then move into the landscaping section of the Immediate Zone.

Intermediate Zone: 5-30' from the furthest exterior point of the home. Prevent fire by: employing careful landscaping or creating breaks that can help influence and decrease fire behavior; clearing vegetation from under large stationary propane tanks; keeping lawns and native grasses mowed to a height of four inches.

Extended zone: 30-100 feet, out to 200 feet. Landscaping – the goal here is not to eliminate fire but to interrupt fire's path and keep flames smaller and on the ground. Prevent fire by: disposing of heavy accumulations of ground litter/debris; removing dead plant and tree material; removing small conifers growing between mature trees.

TREE SPACING

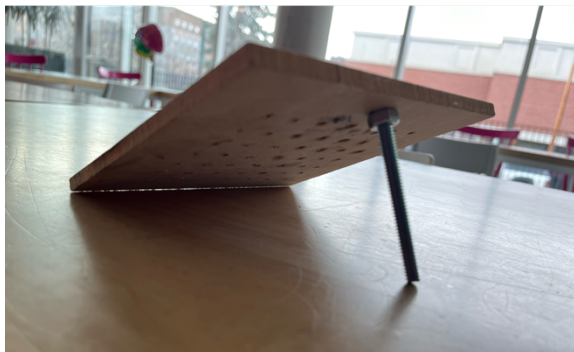
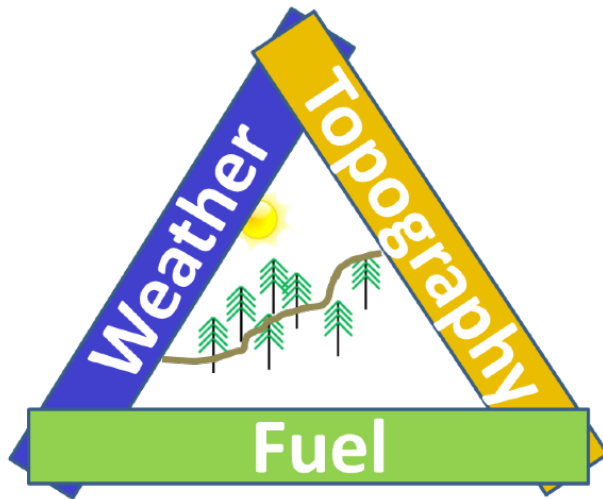
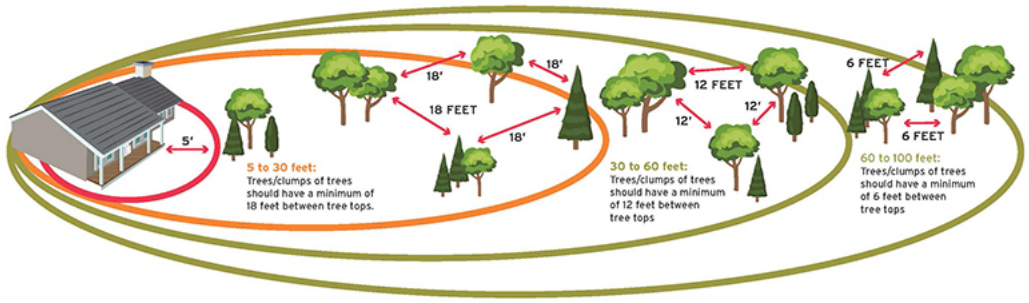


Figure 2: underneath matchstick board



Figure 1: above view of matchstick board

Supplies:

- Matches
- Matchstick boards (flame resistant 6” by 6” board with 49 holes in a grid for students to insert matches, see photo below)
- Baking trays
- Fire extinguisher
- Spray bottles filled with water
- Matchstick board nuts and bolts (to adjust slope of board)
- Lighter

Set Up:

- Using the matchstick board nuts and bolts, set each board at the same slope.
- Place matchstick boards on baking trays.
- Count the same number of matchsticks for each board and set aside.
- Set up a “control” board by placing matches in every slot in a board at the same height with no variable.
- Indicate on each matchstick board where a building might be by marking that spot with an “X”. Note that they should be in different locations for each matchstick board. Break a matchstick in half and place in the slot where the building is supposed to be.
- Locate a safe space outdoors to light the matchstick forests.

Safety:

Set boundaries and expectations for students to remain safe during fire experiments.

- Baking trays, matchstick boards, fire extinguisher, and spray bottle should be made readily available to ensure the fire is contained.
- Matchstick forests should be lit outdoors on a paved surface and on a baking sheet, under the supervision of an adult, with a fire extinguisher and spray bottle handy.

Activity:

1. Introduce the activity. What happens during a wildfire?
2. Introduce the Wildfire Triangle. What changes might cause a wildfire to behave differently? What changes can people make to be safer around wildfires?
3. Split the class into groups and introduce the problem they will be solving. Scientists use small models to test their hypotheses: There is a wildfire happening near a building, how can you landscape the ground to save the building from burning?
4. Students must use all the matches. Students may break matches to use as “fallen trees” or understory. Students may not make any other alterations to their matches or board. Students may not light their matchstick forest.
5. When matchstick forests are complete, each group should share their design with the class and make predictions about how a wildfire will behave on their board.
6. Lead students outside with their matchstick boards and discuss what external

things may affect the behavior of their wildfires using the Wildfire Triangle. Discuss how the wildfire triangle might impact their matchstick forests – what are the weather, topography, and fuel conditions?

7. Review ways to stay safe.
8. Light matchstick forests and invite students to make observations and comparisons. Note: using a lighter rather than matches will ignite the forests more easily in outdoor conditions.
9. Light the control forest: in scientific experiments a control is one in which the subject or a group would not be tested for the dependent variable(s).
10. Bring students inside to discuss their observations.
11. Use the Fire on the Land book to reflect and learn Indigenous perspectives about wildfire and land management.

Extension:

- Limiting changes during an experiment and making comparisons across the group helps students learn how that change impacts fire behavior. Extend the activity by experimenting with more variables:
 - Changing slope – how does fire behave on a steeper mountain or flat prairie?
 - Changing fuel – how does fire behave with more or less matchsticks?
 - Changing weather – how does fire behave with a fan or wet matches?
- Use sensors to explore how fire changes humidity, temperature, or carbon dioxide levels.

spectrUM Pedagogy:

Inspire Curiosity: Ask open-ended questions and encourage creative thinking.

Encourage Growth Mindset: Encourage students to use critical thinking when changing the landscape of the matchstick forest. Praise their patience and be available to help when invited. Do not give away the answer right away.

Make Meaning: Create personal connections between science and students by asking them about their relationship with fire and land.

Navigate Your Future: Let students know about resources and opportunities for them to continue to pursue an interest in wildfire, such as classes, clubs, camps, and higher education.

Collaborate With Communities: spectrUM has collaborated with many tribal representatives to connect science with Indigenous traditions. These resources can be found on spectrUM's website, umt.edu/spectrUM.

Try It: Encourage student autonomy by providing them the opportunity to participate as much as possible.