

# The Fire Triangle

---

## Learning Objectives:

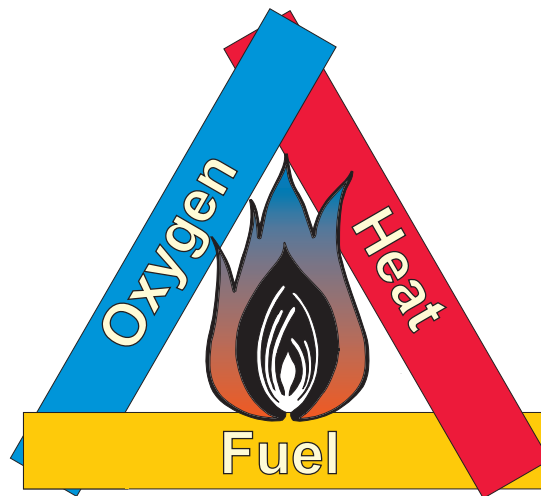
- Learn about the wildfire cycle.
- Learn about how wildfires affect people.
- Learn about the fire and wildfire triangles.

**Prep Time:** 15 minutes

**Duration:** 30 minutes

## Learning content:

Fire is a chemical reaction that converts a fuel and oxygen into carbon dioxide and water. It is an exothermic reaction, in other words, one that produces heat. The three requirements for fire are conceptualized in the Fire Triangle: oxygen, fuel, and heat. If a fire runs out of any of these things, it will stop. Combustion, or burning, is a high-temperature exothermic redox chemical reaction between a fuel and an oxidant, usually atmospheric oxygen, that produces oxidized, often gaseous products, in a mixture termed as smoke. (Missoula Fire Sciences Laboratory)



## Supplies:

- Baking tray(s)
- Matchstick stand (such as a ring stand with alligator clips, see photo below)

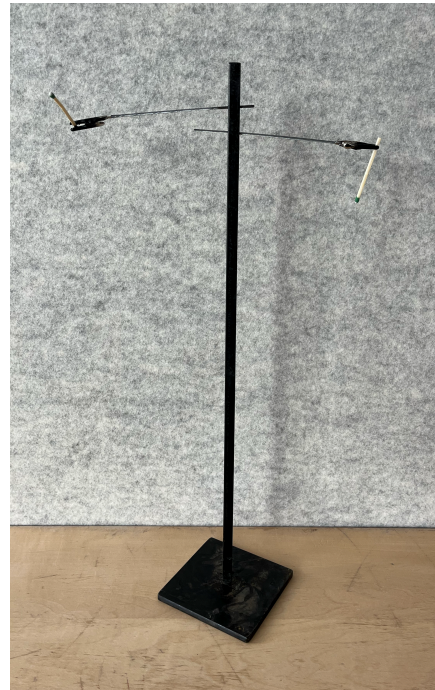
## Set Up:

- Soak a matchstick in a bowl of water for use later. Note: the matchstick must soak for at least ten minutes to begin to saturate enough.

- Matchsticks
- Ash tray
- Spray bottle full of water
- Fire extinguisher
- Small bowl of water
- Plastic take-out container (note: the container must be a few inches wider and taller than the candle)
- Candle (votive candles work best)
- Baking soda
- Vinegar
- Graphic of the fire triangle (optional)

Figure 1: matchstick stand

- Put matchstick stand on baking tray
- Put candle in the Tupperware container
- In the matchstick stand, clip one match head-up, and on the opposite side, another match head-down
- Practice testing the fire triangle before doing the experiments with students for best results.



### Safety:

Set boundaries and expectations for students to remain safe during fire experiments. Baking trays, ash trays, matchstick stand, fire extinguisher, and spray bottle should be readily available to ensure the fire is contained.

### Activity:

1. Introduce the activity: What do you use to build a camp fire? How are you safe around fire? How can we be safe doing fire experiments today?
2. Show students the fire triangle and discuss. How does the fire triangle relate to wildfires?
3. Test fuel:
  - a. Ask students to make predictions about which match will burn faster, the

- one head-down or head-up?
- b. Light both matches at the same time.
  - c. Discuss the results. The head-down match should burn faster because heat rises, and the fuel is above the head of the match.
4. Test heat:
- a. Ask students to make predictions about what might happen when attempting to light a wet match.
  - b. Attempt to light the wet match.
  - c. Discuss the results. The match should not catch fire as quickly as a dry match because the heat needs to first evaporate the water before it can access and burn the fuel. The wet match cannot get hot as quickly. Note: ensure that the wet match is thoroughly saturated with water, if only a little wet it will still catch fire quickly.
5. Test oxygen:
- a. Ask students if they have ever mixed vinegar and baking soda together. Mixing vinegar and baking soda produces bubbles of carbon dioxide, the same gas that humans exhale. Fire needs oxygen, the same gas humans need to breathe.
  - b. Light the candle and place inside the plastic container. Ask students to make predictions about what might happen if you mix baking soda and vinegar at the bottom of the container. Clarify that you won't pour the mixture on top of the flame, but create the bubbles around the bottom of the candle.
  - c. Carefully pour  $\frac{1}{2}$  a table spoon of baking soda and 3-4 table spoons of vinegar at the bottom of the container beside the candle. Note: measurements will vary based on the height of the candle and volume of the container, take care to try the experiment in advance to find the best measurements.
  - d. Discuss the results. The candle should extinguish because the baking soda and vinegar mixture produces carbon dioxide. Carbon dioxide is heavier than oxygen and will fill the container, which displaces the oxygen needed to produce fire.
6. Use the Fired up for Land Preservation book to reflect and learn from Assiniboine and Sioux perspectives about wildfire and land management.

### **Extension:**

- Older students may test the fire triangle with you.

### **spectrUM Pedagogy:**

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

**Encourage Growth Mindset:** Encourage critical thinking skills as students predict changes and make observations.

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

**Navigate Your Future:** Let students know about resources and opportunities for them to continue to pursue an interest in fire, 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](http://umt.edu/spectrUM).

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