Matchstick Forest Demonstration/Activity

Created by: IRRC, Adapted from Forest Service Fire Trunk Activities	**Time Required:** 30-45 min.
Subject: Science	**Grade Level:** 2+

Overview	Participants will build model forests and compare the effects of slope, tree arrangement and understory growth on fire behavior.
Goal(s) & Objective(s)	Students will be able to identify and compare the effects of slope, tree arrangement and understory growth on fire behavior.
Prerequisites & Materials	**Prerequisites:** (Optional for teachers & students) Review Fire PowerPoint or Fire Fact Sheet for background information **Materials needed for each group (4 groups):** 1. 30 wooden strike on box "safety" matches – toothpicks or short pieces of wheat straw also work 2. 1 large ball of potters clay/stiff clay mud/fresh play dough (do not use modeling clay – it may melt or burn) 3. 1 aluminum baking pan 4. 1 water-filled spray bottle 5. 1 watch/clock with a second hand 6. 1 hot pads/oven mitts 7. Spray bottles 8. Newspaper and scissors 9. Safety goggles or eye glasses 10. Fire Extinguisher 11. Hot Question Worksheet (included) 12. Fire Fact Sheet- 1 overhead copy or enough copies for students
Teaching Activities: ***Instructional Approaches/Strategies***	**Introduction** Read over Fire Fact Sheet- so students will understand about fire. **Procedures** This can be done as a demonstration for younger audiences. 1. Review safety procedures. 2. Divide the participants into four groups. Explain each group assignment as follows: Group 1: will build and burn a matchstick forest on a flat slope; Group 2: will build and burn a matchstick forest on a 20 degree slope by lighting the matches at the bottom edge of the slope; Group 3: will build and burn a matchstick forest on a 20 degree slope by lighting the matches at the top of the slope; Group 4: will build and burn a matchstick forest on a 40 degree slope by lighting the matches at the bottom edge of the slope. 3. Have each team appoint a timekeeper.

	4. Pass out worksheets to each group. 5. Start Matchstick forest fire- 1 at a time while whole group watches, and then discuss/compare after each fire. **Closure** 1. Discussion of fire & completion of Hot Discussion worksheet
Assessment:	Hot Discussion Questions

Attachments:

Detailed Instruction for building Matchstick Forest
Activity extension
Hot Discussion Question
Fire safety guidelines
Fire Fact Sheet

Detailed instruction for building Matchstick forest:

To build a matchstick forest, have each group:

a. Place aluminum pans on a heat resistant surface.
b. Create a base for the forest by flattening the potters clay/ mud into the bottom of the pans.
c. Place the untreated ends of the unlit matches into the modeling clay so the tips are about ½ inch apart.

4. To establish the slope of the matchstick forests:

a. The tray for Group 1 should be flat.
b. One end of the trays for Groups 2 and 3 should be elevated lengthwise to about 20 degrees (about 3-4 inches).
c. One end of the tray for Group 4 should be elevated lengthwise to about 40 degrees (about 6 inches).

5. Once all groups have set up their forest, bring them together to talk about the next step. Ask them to look at the set-ups and predict how and why fire behavior will differ among them. Remind them that any inaccurate predictions are celebrated because it shows participants are learning something new.

6. Telling participants that they will light one pan at a time so all participants can observe what happens. When the timekeeper says "go," each group should light one row of matches along the specified edge of their 1st pan. All participants should record the following observations about the fire's behavior: the time to burn, the density of the fuel (matches), the topography (slope), the number of unburned matches, point of ignition (bottom or top of the slope) and any other observations to explain fire behavior.

7. After all forests have been set on fire, have the participants share their observations of different fire behavior. Use question 1 in "Hot Questions To Discuss" to guide this discussion.

8. Remove the burned matches from the pan. Have the participants brainstorm different ways to rearrange the matchstick forest so fire behavior will change. Some possible changes are rearranging the trees (examples: densities, heights, standing, fallen),
blowing lightly on the burning matches to simulate the effects of wind, using small paper wads placed between the matches to simulate understory vegetation and forest litter, dampening the matches and/or paper wads with water to simulate higher fuel moisture.

9. Then have each group select a different matchstick forest matchstick forest model to try. After the groups have set up their new forests, have all participants observe as the forests are lit one at a time.

10. Discuss the participants' observations and reasons for the differences in fire behavior by discussing "Hot Questions" 2-6.

Extension Activities

1. Information about the topography, fuels and weather all help firefighters decide which type of fire fighting strategies would be most effective in controlling the fire. Challenge participants to devise firefighting strategies for different fire scenarios.

2. Invite agency personnel (i.e., BLM, Forest Service, local parks and recreation) to talk about the challenges in different fire fighting situations. Have them demonstrate the tools, clothing and equipment of wildland fire fighters as compared to structural fire fighters.

4. Encourage participants to find out the requirements to be a wildland fire fighter and what the safety and emergency guidelines are for fire fighters when they are fighting fires.

5. Investigate current research on fire behavior at www.firelab.org.

5. **Hike *Optional, if time allows**
Students will go on a short hike to look at the effect the 8th Street Fire had on the foothills. Students will be shown noxious weeds, native plants, and will be able to talk about how animals respond to a change in their habitat because of wildfire. Ask the students if they can see any evidence of the 8th street fire, discuss how this habitat heals itself and how it is forever changed because of noxious weed invasion, erosion, etc.

6. Fire Prevention

Since students will be experimenting with fire, it is important to stress fire safety and prevention. After the lesson is complete, reiterate the fact that they should *never* use fire without an adult present. If time allows, you could discuss calling 911 in the event of a fire, etc.

Hot Discussion Questions Worksheet

1. How did the slope affect each fire's spread? How well did fire burn downhill? Did the slope affect how many trees (matches) burned? Explain.

2. What happened when the arrangement of matches was changed?

3. What happened when an understory layer (paper wads) was added to the matchstick forest?

4. How did other changes that you made in the matchstick forest affect the way it burned?

5. How does this experiment/ demonstration of fire behavior differ from fire behavior in a wildland setting?

Read the information below, and then answer the question.
Ground fires burn organic matter in soil beneath the surface litter. Surface fires burn surface litter, fallen branches, and other fuels at ground level. Crown fires burn in the tops of trees. Most wildland fires are a combination of ground fire, surface fire and crown fire.

6. What forest arrangement and conditions would cause wildland fires to spread at ground level, at surface level, at crown level?

Read the information below, and then answer the question.
Another important concern for firefighters is spot fires. Glowing embers and sparks carried by wind ignite spot fires outside of the area of the main fire.The most serious spot fire activity is associated with crown fires and high winds. Spotting from the main fire can rapidly spread fire into unburned areas that are miles from the main fire. When fire consumes a tree (or small group of trees) from bottom to top in a matter of seconds, it is called torching. Unlike spot fires, torching occurs when a surface fire is burning in hot, dry and windless conditions.

7. What forest arrangement and conditions would encourage spot fires? What arrangement and conditions would encourage torching?

Activity Safety Tips:

1. Notify, in advance, any individuals or agencies (principal, local fire protection unit, and/or maintenance staff) that would want to know that your activities involve fire.
2. Choose open, well ventilated, debris and vegetation free location for this activity to reduce the chances of building fire alarms being triggered.
3. Be aware of wind direction and force. Postpone this activity if it is too windy and you will be working outdoors.
4. Instruct participants on the use of the spray bottles and fully charged fire extinguishers that must be in the activity area.
5. Instruct all participants to NOT attempt these activities without an adult present.
6. Participants/demonstrator should wear safety goggles; tuck in loose clothes and tie back long hair.
7. Have emergency phone numbers readily available.
8. Inform the students that they should never use fire without an adult present.
9. Talk to the students about the fact that they are taking safety precautions for this experiment, i.e., they are using burn pans, have extinguishers and water nearby, there is adult supervision. Talk to them about the fact that they should **never** try this at home or anywhere without an adult present.

Fire

Fire is a normal part of nature, like precipitation or wind. Many plant and animal species have adapted to fire and can benefit from it. Fires can clean out diseased or dead forage and trees. However, just like floods and other natural disasters, fire can produce dramatic change in a short period of time. Even fire-dependent ecosystems can be damaged by an extremely intense fire.

How Fire Helps

- **Fire leads to new plants-**Some plants need fire. For example Lodgepole pine trees have *serotinous* cones – this means that they require fire to open. Other plants such as bunch grasses need old, dead leaves to be removed before new grass can grow.

- **Fire cleans up -** without fire, fuels in the form of dead trees and brush build up. Fire creates openings that allow seeds to sprout in sunlight. It recycles minerals from plant materials into the soil. It clears out undergrowth, destroys insect infestations and kills diseases. All of this clean up can improve wildlife habitat.

BLM- Red Canyon Fire

- **Fire controls unwanted plants:** Fire can check the growth of invasive woody plants like Junipers, which can take over grasslands.

Detriments of Fire

- **Fire leaves no trace-**Intense fires can burn so hot that they destroy all plant life. It can take years for a forest or rangeland to recover because, there are no seeds to germinate or roots to grow back.

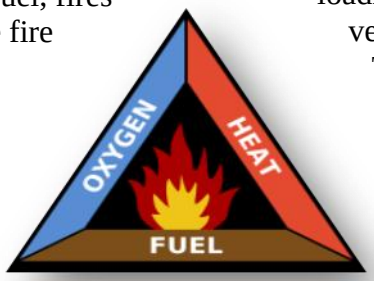
- **Fire changes ecosystems -** After an intense fire, the original vegetation is no longer present, so new vegetation replaces it. New plants are reseeded by people, wind, or animals, and can be very different than the plants originally in the ecosystem. Since there are no roots to hold the soil, erosion can occur rapidly.

- **Fire welcomes unwanted guests-** Some invasive plants are faster to germinate and grow back more quickly after fires. Without competition, these plants can take over before "desirable" vegetation is able to come back.

Elements of Fire: What is Fire? How does it burn?

Fire is the result of a chemical reaction that requires the presence of heat, fuel, and oxygen – which create the "Fire Triangle."

Fuel is any material that will burn. **Heat** from the fire's ignition decomposes compounds, releasing the flammable gases that react with **oxygen** to burn.
With intense heat and adequate fuel, fires create their own winds (which brings in more oxygen). As long as there is fuel, fires will create the other elements of the fire triangle (heat and oxygen) to keep burning.



Influences on Fire Behavior

Fire behavior has 3 main influences: fuel, topography and weather.
Fuels are the living or dead plant material above the ground's surface that can burn.
The density and moisture of ground and aerial fuels (trees/shrubs) affect the severity of fire. The more compact the ground vegetation, the hotter the fire and the quicker it spreads.

Topography includes land features like slope and aspect (i.e. south/north side of mountains). Steeper slopes will burn more rapidly, because the fire has more access to oxygen and it is going uphill. A Southern aspect will burn quicker, because it is hotter and drier due to sunlight, where a northern aspect is cooler and moister due to it being shaded from the sun.

Weather affects fire because of the humidity (moisture in the air) and temperature of the atmosphere. This affects fuel moisture, which determines how quickly or slowly fuels will ignite and burn. Fire creates its own weather. When the hot air from a fire rises, fresh air rapidly moves in producing wind; bringing more oxygen to the fire.

Fuel Management

Fuel management on rangelands changes fire behavior by affecting the amount of fuel on the surface and in the top layer of soil. It also affects how much fuel is available (fuel loading), and ladder fuels (vertical vegetation – grasses to shrubs to trees).
There are different treatments that can be used to manage fuels such as:

Livestock and wildlife grazing- Animals eat plants, which reduces fuel and recycles nutrients as manure.

Mechanical treatments - involve different mechanized tools to remove plants. Some examples include:

- Tilling
- Chaining
- Mowing
- Mastication & Feller Bunchers- which chop trees or shrubs

Manual treatment- The use of hand tools to remove plants.

Herbicides- chemicals that kill or injure plants.

Prescribed Burning- The intentional application of fire when the weather conditions will not likely lead to an intense fire. This can change the amount of fuel, and also where fires will or will not burn in the future.

Brought to you by the Idaho Rangeland Resource Commission with information from: "Fuel Treatments on Rangelands" by Philip S. Cook & Jay O'Laughlin- University of Idaho, and "Exploring Wildland Fires"- Educators Guide by BLM.