



The Science of Fire

Correlation to Learning Standards

Next Generation Science Standards: MS-LS2-3, MS-LS2-4

What is Fire?

Fire is a significant force in the forest environment. Depending upon the specific land management objective and a host of environmental variables, fire will sometimes be an enemy, sometimes a friend, and frequently its effects will be mixed between the two extremes.

Fire Triangle:

In order to have a **FIRE**, there must be three elements:

Fuel -- something which will burn (such as paper, wood, etc.)

Heat -- enough to make the fuel burn

Oxygen -- air we breathe

Usually these three elements are expressed as a triangle, called the **FIRE TRIANGLE**. Remove one of these three elements, and the fire will go out.

Fire Behavior Triangle:

Fire Behavior is one of the most important aspects of wildfires because almost all actions taken on a fire depend on how it "behaves." Success in presuppression planning and actual suppression of wildfires is directly related to how well Fire Managers understand and are able to predict fire behavior. The safety of all fire fighting personnel also depends on this knowledge.

What makes some wildfires burn so hot and others not? What makes fires spread fast one day and slow on another day? A wildfire behaves according to the environment in which it is burning. This environment consists of various elements of fuels, topography and weather. These elements and their reactions with one another - and the fire itself - determine the behavior of fire.

Fire Behavior is defined as: the manner in which fuel ignites, flame develops, and fire spreads as determined by the interaction of fuel, weather, and topography

There are many elements under each of the three major components of the fire's environment that affect how a fire behaves. A change in any one of these elements will cause a change in the behavior of the fire--and this change can be very abrupt and rapid.

Fire Behavior Triangle Elements:

Weather	Wind Temperature Relative Humidity Precipitation	Wind can push a fire along, fires also create their own wind currents. Low relative humidity can dry out fuels causing them to ignite more easily. Precipitation can put out a fire and conversely a lack of precipitation can make fire more likely by drying out the fuels.
Topography	Flat or Slopes Aspect	A fire moves more rapidly up hills. A fire is more likely on southern and western aspects which are dryer.
Fuels	Light or Heavy Arrangement Fuel Moisture	The dryer and lighter the fuels the more easily they will ignite. A continuous layer of fuels on the forest floor can aid in the spread of a fire.

Fuel:

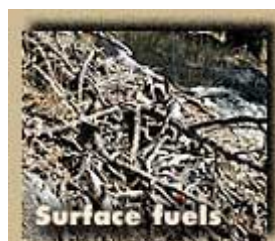
What is a fuel? It's anything that will burn.

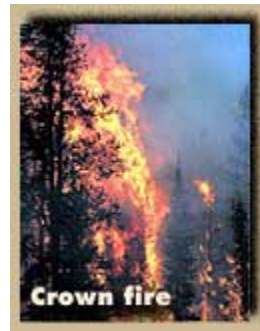
What fuels do you find in a forest?

Forests have plants at different levels - canopy, understory, and forest floor. So, the fuels in the forest will be at different levels, too. "**Aerial fuels**" do not in touch the ground. They are at least 1 meter (39 inches) above the ground. Aerial fuels could be branches, leaves, and bark still on the tree or tall bushes. "**Surface Fuels**" are on the ground. Here you'd find bushes, logs, stumps and fallen leaves, needles, branches, and cones. "**Ground fuel**" is anything that will burn below the surface fuels. That could be roots or rotting branches, leaves and needles.

Ground fires burn the ground fuels. These fires usually don't have much flame, they smolder. Surface fires burn the surface fuels. Crown fires burn the aerial fuels. Crown fires spread from tree to tree and are the most destructive.

Here's another way fires spread: **fuel ladders**. Fuel ladders form when fuels at different levels touch. Fuel ladders move fire up from the ground into the tree tops.





The Science of Fire Teaching Activity

Fires: Good, Bad or Just Ugly?

Part 1-Prescribed Fires-Good Fires

Fire is an important natural force that causes change in an ecosystem. Prescribed fires are fires intentionally set when the conditions are correct, reintroducing the beneficial effects of fire into an ecosystem. The beneficial effects are many: reducing fuel build-up so that wildfires that do start will not become catastrophic, releasing plant nutrients back into the soil enhancing plant growth, and keeping areas open and free of shrub and tree growth among others.

Effects of Fire on Plants and Animals

If fire is a natural force that has always been around it makes sense that plants and animals have adapted to surviving fires. To explore the effects of fire on plants go to this website and complete the chart below.

<http://www.pbs.org/wgbh/nova/fire/plants.html>

Plant	How is it adapted to fire?	How can fire help the plant?
Larch		
Ponderosa Pine		
Scrub Oak		
Lodgepole Pine		

To explore the effects of fire on birds and mammals go the following website and complete the chart below. <http://www.feis-crs.org/feis/>. Find the common name for a bird or mammal, click on the abbreviated scientific name, and click on "Fire Effects and Use."

Mammal	How is it adapted to fire?	How can fire help the animal?
White-tailed deer		
Eastern Cottontail Rabbit Black Bear		
Bird	How is it adapted to fire?	How can fire help the bird?
Mallard		
Kirtland's warbler		

To explore what happens when fire is taken out of the ecosystem, read the following story "Smokey Gets Smoked."

http://whyfiles.org/shorties/058fire_ecorest/.

1. What were the problems that developed for squirrels after fire suppression started about a century ago?

A. _____

B. _____

2. Explain the statement "Fire is an important to the ecosystem as rain or snow."

Part 2-Wildfires-the Bad and the Ugly

Wildfire is one of the most destructive natural forces known to mankind. While sometimes caused by lightning or volcanoes, nine out of ten wildfires are caused by people. Put simply "wildfire" is the term applied any unwanted and unplanned fire burning in the forest, shrub, or grasslands.

What do you think is causing more wildfires today?

The current increase in wildfires can be explained by four factors:

1. Past fire suppression policies, including one of "total suppression" which allowed for the accumulation of fuel in form of fallen leaves, branches, and excessive plant undergrowth in forest.
2. Increasingly hot, dry weather.
3. Changing weather patterns across the U.S.
4. Increased residential development in forested areas.



**Did you know?? Every year ...
There is an average of 106,400 wildfires.
Over 4 million acres of land are burned.
9 out of 10 fires are started by people.**

Human-caused wildfire case studies:



Where: Northern Wisconsin
When: July, 1999
Type: Wildfire

Cause: bottle rockets shot from a tree set a hay meadow on fire destroying a barn.



Where: Wisconsin
When: July 5, 2001
Type: Wildfire

Cause: a blow-torch set some tall, dry grass on fire. The fire spread and damaged a neighbor's cabin.



Cause: a utility vehicle ignited some dry grasses. This fire eventually consumed 120,000 acres or 35 square miles.

What do you think could have been done differently to prevent any one of these situations from happening?

Summary

Now that you have read and studied about fire from both sides, you need to make a decision. Fill out the chart below and then present your opinions about fire by answering the following questions.

	Advantages of Fire	Disadvantages of Fire
Animals		
Plants		
People		

1. Are all forest fires bad?

2. What is the difference between a "good" fire and a "bad" fire?

3. When should a fire be allowed to burn?

4. How have people moving into what once were wild areas changed the way we fight fires?

5. Do you think Smokey Bear's message of Only You Can Prevent Forest Fires is still a good one, why or why not?

6. How would you rewrite Smokey Bear's message?

This publication is a product of the United State Forest Service and may be accessed online at http://www.na.fs.fed.us/fire_poster/science_of_fire.htm.