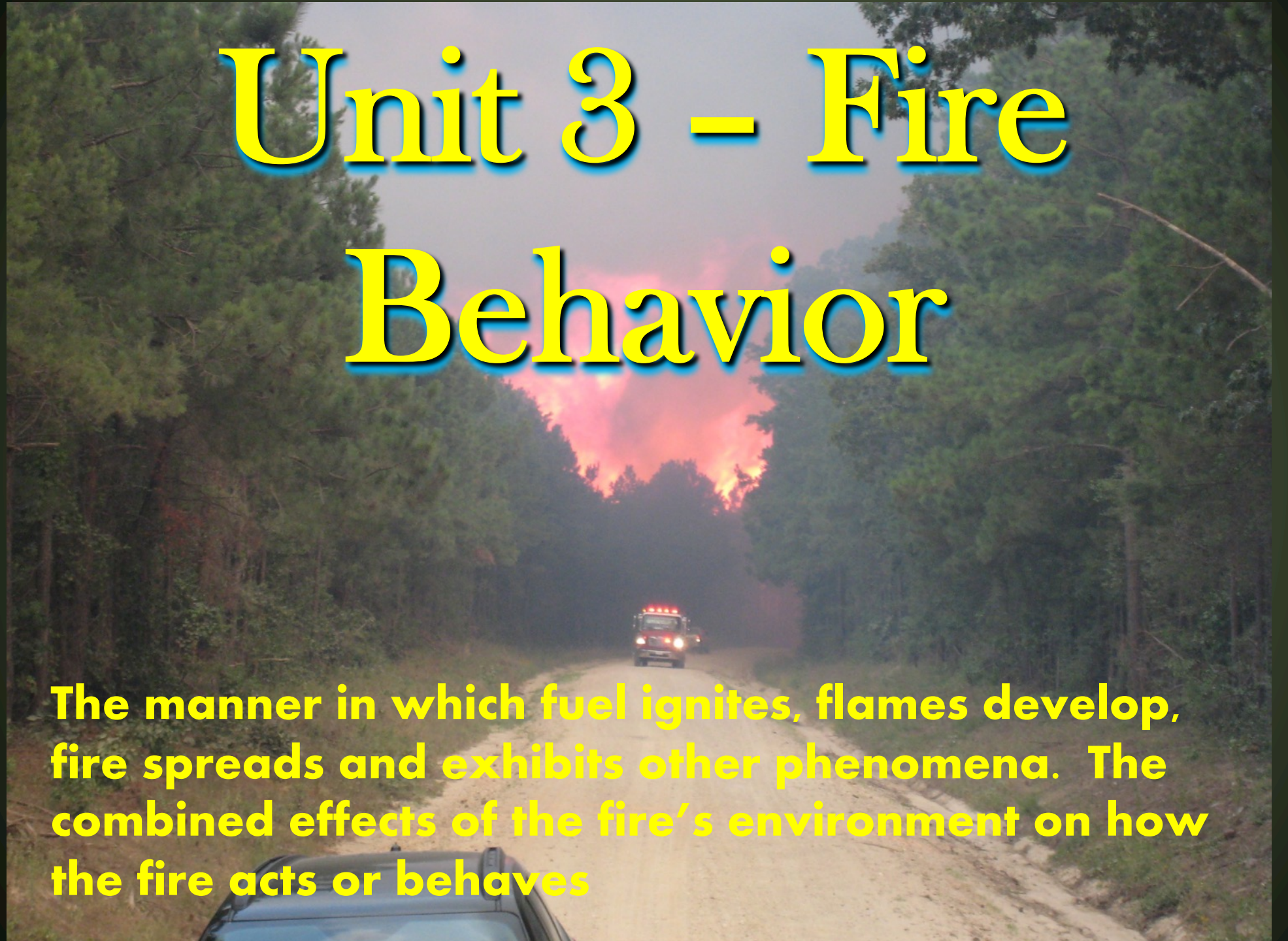
Unit 3 – Fire Behavior



The manner in which fuel ignites, flames develop, fire spreads and exhibits other phenomena. The combined effects of the fire's environment on how the fire acts or behaves

Fire Behavior - “Really Not good.”

video

Unit 3 Objectives

- Define a fire triangle
- Effects of fire by:
    1. Fuel volume
    2. Fuel size
    3. Fuel arrangement
    4. Topography
- Define rating system used for media/news

Unit 3 Objectives -Continued

- List actions your department can do to promote fire prevention in relation to fire danger ratings

How a fire burns

Historically, the fire triangle has been used for understanding the ingredients necessary for most fires.
Removal of any element results in the fire going out.

3 Elements of burning:

1. Heat
2. Oxygen
3. Fuel

Fire Spreads Because Of The Effects Of 3 Things

- Conduction
- Radiation
- Convection

Conduction

The transfer of heat through an object. This method has the least effect on the spread of a wildland fire because wood is a poor conductor of heat.

Radiation

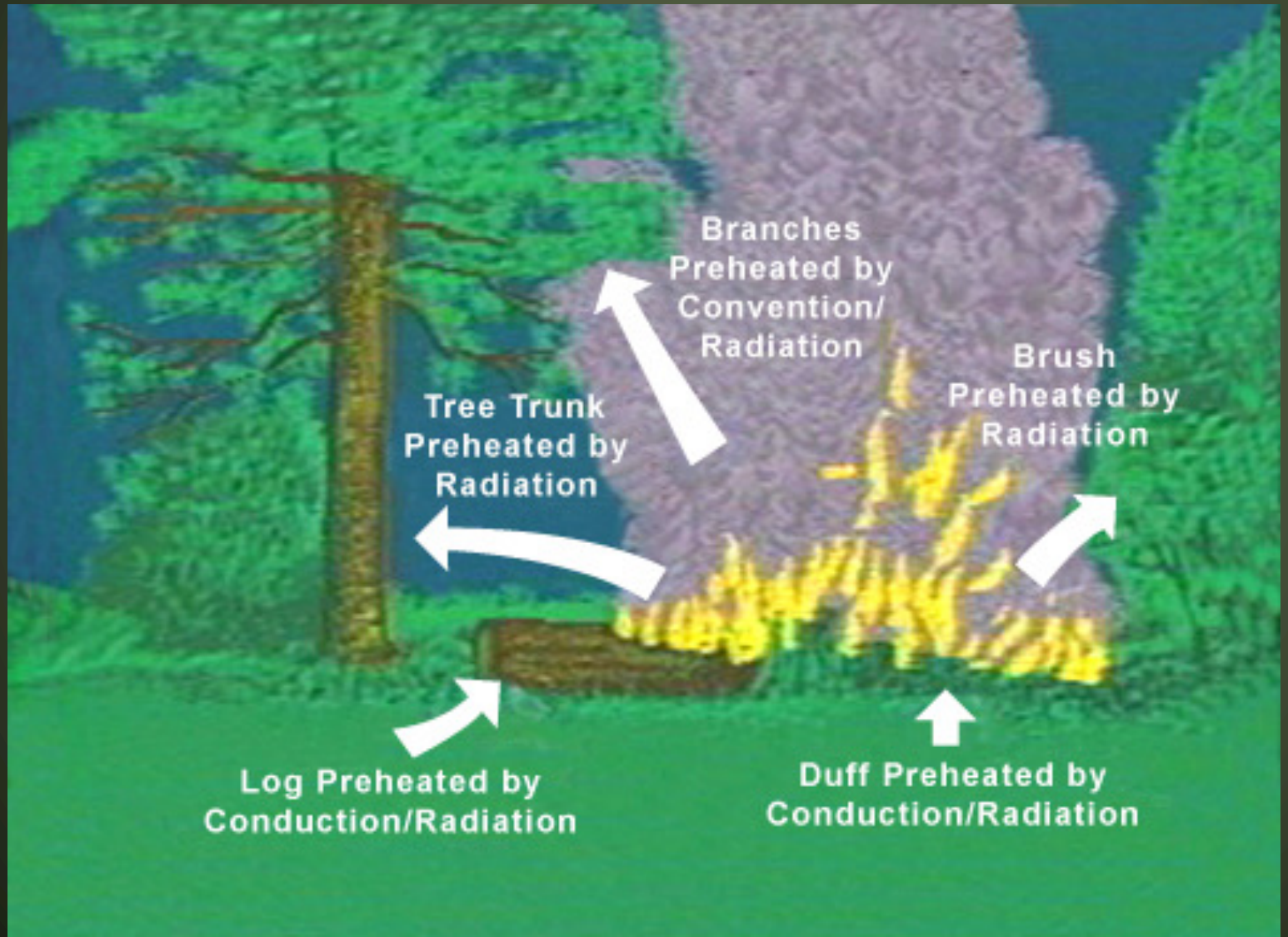
Radiant heat, or thermal radiation, is heat emitted from the surface of an object which is due to the object's temperature.

Radiant heat is what you can feel from a distance.

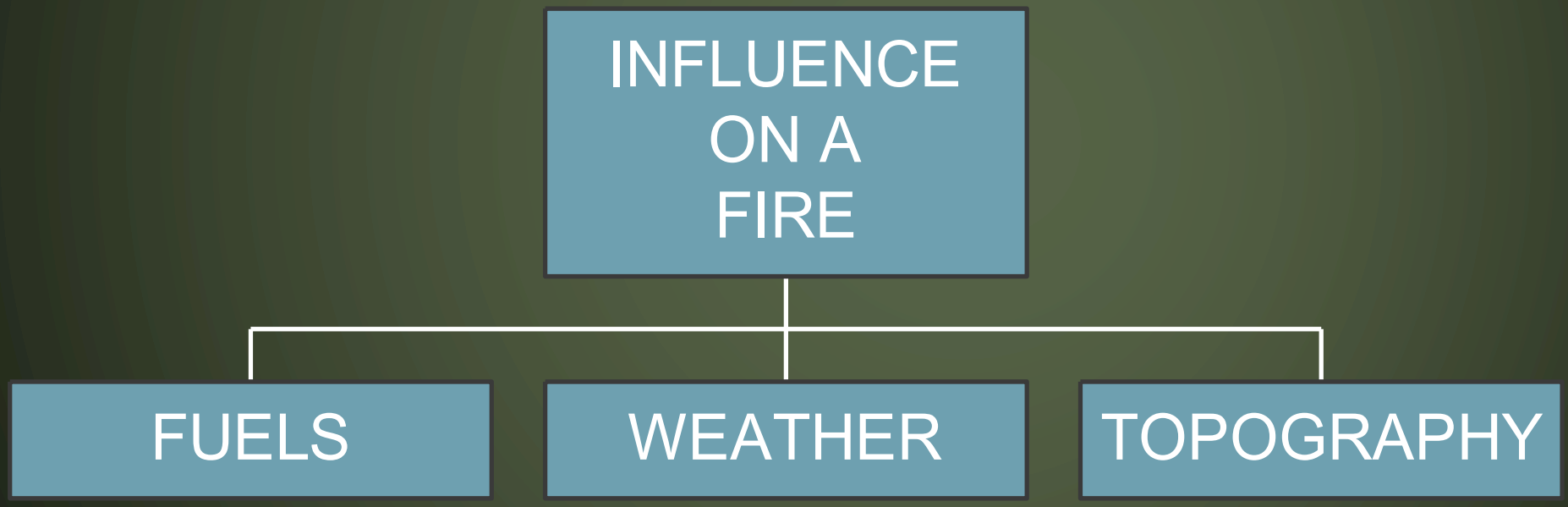
Convection

Heat is transferred by the movement of hot air and smoke rising and heating the fuels above.

Conduction, Convection, Radiation Combined



Factors That Influence Ignition And Spread



Fuel Characteristics

Fuel size

Fuel moisture

Fuel continuity

Fuel Size

Smaller fuels ignite and burn easier and faster. Small fuel size contributes to a faster spreading fire that has a shorter duration. Larger fuels ignite and burn slower. Large fuel size contributes to a slower spreading, longer duration fire.

This is why you use kindling to start a camp fire.

Fuel Size

Size Classes of Dead Fuels

1-hour = Grasses, litter and duff; < 1/4”

10-hour = Twigs & small stems; 1/4”-1”

100-hour = Branches; 1”-3”

1000-hour = Large stems & branches; > 3”

Fuel Moisture

Amount of water in a fuel

The more moisture in a fuel the more heat is required to ignite it

Fuel size is a factor- smaller fuel burn quicker than larger at the same moisture content.

Fuel Moisture

When fuel moisture is low, you can expect rapid runs. You can also expect spot fires

The amount of moisture in the air also determines the amount in the fuels

Live fuels vs. Dead fuels- Live Fuels will have more moisture.

Fuel Continuity

Another factor which influences the spread of a fire is continuity of fuels

This is thought of as horizontal and vertical spacing.

Fuel Continuity

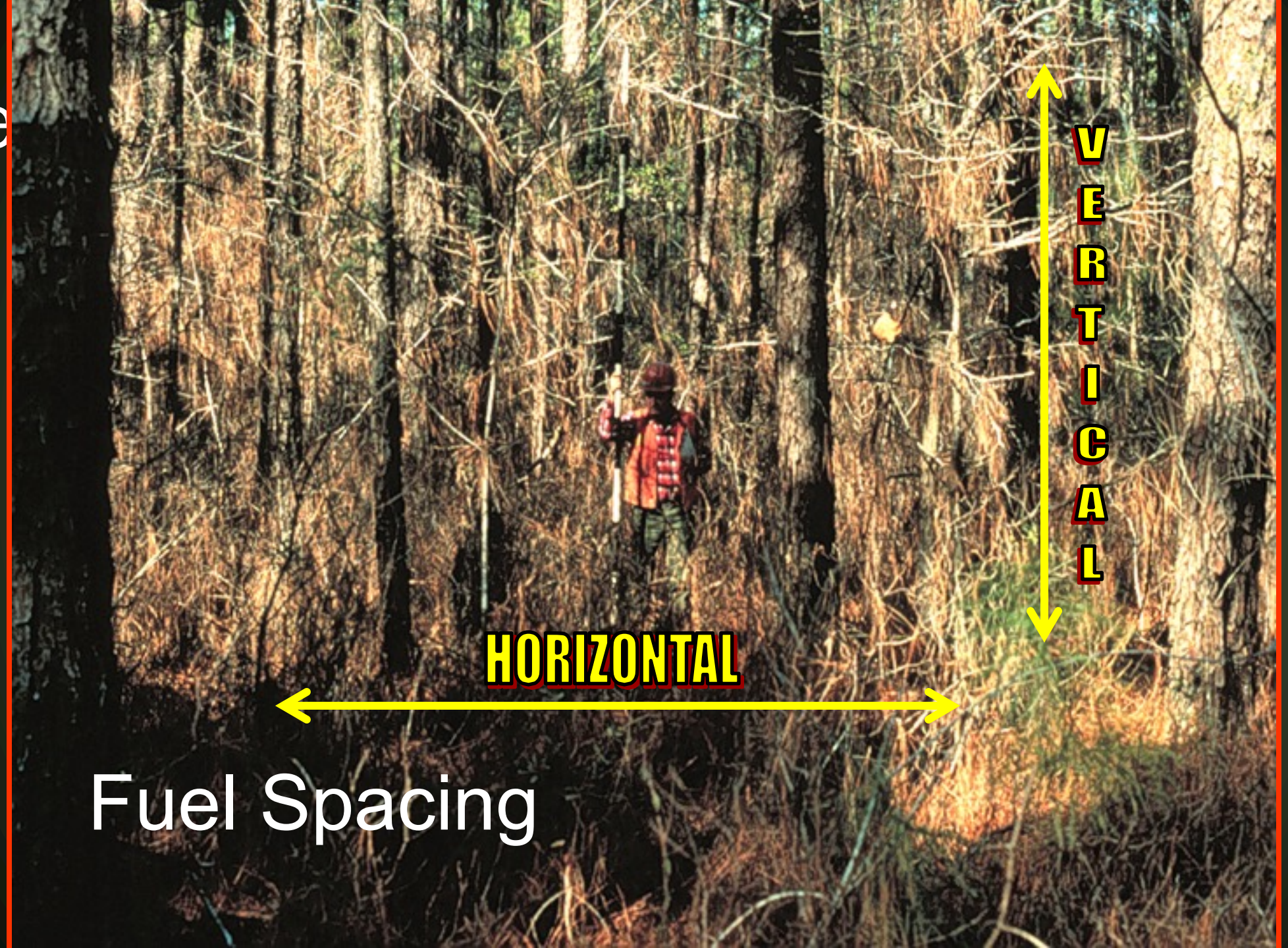
Horizontal Spacing

The spacing of the fuel, or the distance between burnable fuel as it lies on the ground

Vertical Spacing

When fuels are closely spaced vertically, fire will spread rapidly as convective heat preheats and ignites fuels above.

Fue



Fuel Spacing

Volume or Quantity of Fuel

How much fuel is burning or will burn is also important. The amount of fuel available to burn is usually referred to as volume or *quantity.*
The more fuel to burn the more intense the fire can be.

Weather Influences

One of the most important factors affecting the behavior of a fire is ***Weather*** .

In fire control, we usually break weather into three parts:

- Temperature
- Relative Humidity
- Wind

Weather Influences

Temperature:

The effects of temperature is important because fuels that are preheated by the sun burn more rapidly than cold fuels.

Air is also preheated raising up during the day, cooling at night and reversing direction

Weather Influences

RELATIVE HUMIDITY:

Is expressed in (%) .

It is the amount of moisture present in a parcel of air compared to the total amount the air could hold at that temperature

As air is heated the (RH) decreases

Weather Influences

Day

- Higher winds
- Lower humidity
- Higher temps
- Fire harder to suppress

Night

- Lower winds
- Higher humidity
- Lower temps
- Fire easier to suppress

Weather Influences

Wind:

Of all influences on a fire's behavior, ***wind*** has the greatest influence on both the rate and direction of spread. Wind generally blows upslope during the day and down slope at night. Up and down slope winds are sometimes overcome by the stronger prevailing winds.

video

WIND *has the greatest influence on both the rate and direction of fire spread…*

video

Weather Influences

Visible Wind Indicators

SMOKE- can show wind speed and wind direction .

THUNDERSTORMS- gusty winds usually flow out from the edge of a thunderstorm and can reach speeds up to 70 mph. Changing direction and rate of spread.

Topography Influences

Where the fire is burning, whether it be in steep mountainous terrain or on the coastal plain, the ***lay of the land*** is an important factor in the rate and direction of fire spread.

Topography Influences

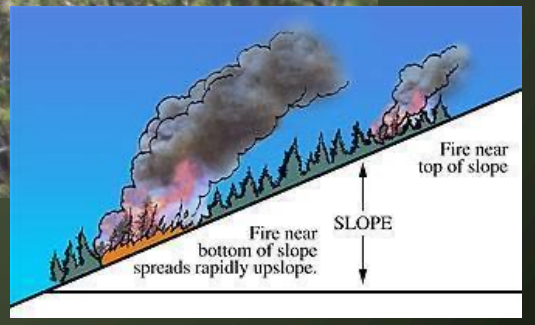
Topography is broken into (3) parts:

- **SLOPE**- how steep it is
- **ASPECT**- The direction it faces
- **TERRAIN**- The local features of the land.

Topography Influences

SLOPE - Greatest influences of fire spread

- Flames are closer to the fuels
- Wind currents are normally uphill
- Heat rises along the slope increasing Rate of Spread
- Burning embers can roll down hill, setting new fires



Topography Influences

- Aspect is the direction a slope is facing. North, South, East or West
- Southern aspects receive more direct radiation from the sun, drying both the soil and vegetation.

Topography Influences

Aspect Cont.

On south facing slopes, there will normally be:

- Higher temperatures
- Stronger winds
- Lower humidity's
- Lower fuel moistures.

Terrain

Terrain is special land features or obstructions.

Wind will take the path of least resistance.

Which can cause turbulence or eddies on the lea side of obstructions. Critical areas are chutes and steep “v”s .

Wildland Urban Interface

NFES FWC-602-03-DVD Part 1 Fire Behavior in the Wildland/Urban Interface

Wildland Urban Interface Watch-Outs

1. Unified Command not implemented
2. Poor access and narrow one-way roads. Bridge load limits
3. Chaotic suppression actions or panic during public evacuations
4. Extreme fire behavior, strong winds, drought conditions.
5. Inadequate water supply
6. Wood construction and shake roofing. Open soffits. Unscreened gable vents
7. Natural fuels <30 feet from structures
8. Poor access around structures because of accumulations of junk, etc.
9. Hazardous materials in path of fire, including unmarked barrels, dumps, etc.
10. Powerline situations, unsure of power status. Propane tanks near structures

Fire Prevention

Fire Danger

A state wide fire danger report has been implemented. An effort to alert citizens of a weekly fire danger rating is sent to the news media, showing a rating of low, moderate, high and extreme.

Adjective Rating	Implication to Firefighter
LOW	Fuels do not ignite readily although a intense heat source may start fires in duff or punky wood. Fires in open cured grasslands may burn freely but woods fires spread slowly by creeping or smoldering. There is little danger of spotting.
MODERATE	Fires can start from most causes but the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly and is of moderate intensity. Spotting is possible but not common. Fires are not likely to become serious and control is relatively easy.
HIGH	All fine dead fuels ignite readily and fires start easily from most causes. Fires spread rapidly and short distance spotting is common. Fires may become serious and their control difficult unless they are attacked successfully while small.
VERY HIGH	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long range spotting and fire whirls when they burn in heavy fuels.
EXTREME	Fires start quickly, spread furiously, and burn intensely. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires in heavy timber fuels may be unmanageable while extreme burning conditions last. The only effective control actions are on the flanks until the weather changes or fuel loading decreases.

Fire Prevention

Ready, Set Go!
http://wildlandfirersg.org/