TOPIC: Wildland Fire Behavior - Topography

TIME FRAME: 1 Hour

LEVEL OF INSTRUCTION:

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will list and describe the influences of key topographic features on fire behavior.

Standard: With a minimum of 70% accuracy

MATERIALS NEEDED:

- Appropriate visual aids
- Audio visual equipment

REFERENCES:

- IFSTA, Essentials of Fire Fighting, 2nd Edition, Chapter 14
- Wildland Firefighting, Clayton, Day and McFadden, Chapter 3
- Radiation & Wildland Fire, Countryman

PREPARATION: Topographic features have been a contributing factor in firefighter injuries and deaths. It is important for fire crews to recognize how topography can abruptly change fire behavior.

PRESENTATION	APPLICATION
I. INTRODUCTION	
A. Topography Has Important Indirect Effects on Fire Behavior	
1. Determining fuel type	
2. Elevation differences influencing fuel moisture and temperature	
3. Producing and modifying winds	
B. Topography Can Directly Affect Fire Behavior	
	Information sheet #1
1. Fire spreads faster up steeper slopes	
2. The transfer of heat from the fire front into new fuels is made more efficient by the relative nearness of fuels that lie upslope from the fire	
II. ASPECT AND ELEVATION	
A. Aspect is the Compass Direction that a Hillside Faces, the Direction You Would Travel in Going Straight Downhill	
B. The Intensity of Solar Radiation Together with Air Temperature Affects the Overall Moisture and Temperature of Soils and Plants	
1. South slopes receive the most intense sunlight; southwest slopes receive a bit less sun but are well heated during the hottest part of the day	
a. South and Southwest slopes have the lowest soil moisture content	
b. Vegetation on the South and Southwest slopes tends to be the most dry-and the most flammable	

PRESENTATION	APPLICATION

c. Higher fuel temperatures and lower dead fuel moisture on South and Southwest slopes contribute to greater fire occurrence and severity

2. North slopes receive the least solar heating; Northeast slopes receive as much sun as northwest slopes but during a cooler period

a. North and Northeast slopes have the highest soil moisture content

b. North and Northeast slopes tend to support shrubs and trees with a canopy separated from well shaded litter beneath it, generally less flammable

c. Lower fuel temperatures and higher fuel moisture on North and Northeast slopes contribute to the reduced fire occurrence and fire severity

C. The Trend for a Major Slope is that:

1. With increasing elevation average temperatures decline and average precipitation levels increase. (An exception discussed below is the "thermal belt")

2. It is typical for the water vapor content of the air (as measured by dew point) to be less with increasing elevation

a. As a result:

(1) Live fuels at higher elevations tend to lag behind those at lower elevations in drying their fuel moisture cycle

PRESENTATION	APPLICATION

(2) Dead fuels at higher elevations are generally less dry than corresponding fuels at lower levels, and they become very dry only under conditions of sustained sub-normal precipitation

D. Where Valleys or Canyons Confine Cool Night Air It Can Produce an "Inversion", Reversing the Normal Variation of Temperature with Elevation

1. Cool air developing at night can remain pooled in the lower zones of a confining valley or canyon, while air on the slopes above remains better mixed and therefore warmer

2. The result is a sandwich, a zone of warmer air at the mid-levels between the cool air in the canyon bottom and the cool air on the upper slopes - the "thermal belt". The "thermal belt" is normally the mid third of a slope

3. Average temperatures in the thermal belt are higher and average relative humidities are lower. Fires in the thermal belt can be more active at night than on the slopes above or below.

4. Fires at night and in the early morning in the cool air of the lower zone (below the inversion) can be reduced in intensity by higher humidity, lower fuel temperature, and sometimes lower wind spreads

III. TOPOGRAPHY AND WIND

A. Slope-Valley Wind System

1. Sunlit slopes warm the air causing it to rise and flow upslope

PRESENTATION	APPLICATION

a. Early in the day the winds are predominantly up slope

b. By mid-day winds blow up the major canyons

c. By afternoon winds blow up the larger valleys, often producing winds across the ridges that differ from those blowing up the canyons

2. As slopes become shaded in the evening and cool throughout the night air near the ground flows down slopes and drainages

a. Downslope flow is usually slower and smoother than the daytime up slope wind

b. Cool, denser air is strongly channeled by the terrain, flowing down-drainage

c. Strongest nighttime convective winds occur in the bottoms of major canyons

d. The higher ridges and peaks will be largely unaffected by the local slope winds

B. Topography and Other Obstacles Modify the Wind at the Ground

1. Wind deep in a drainage is strongly channeled, up or down canyon

2. Wind is often accelerated as it passes over long ridges or through saddles

3. Turbulence can cause gusty, erratic winds along canyon sides and on the lee side of ridges, or downwind of trees or buildings

4. A tree canopy will greatly reduce the velocity of surface winds

PRESENTATION	APPLICATION

IV. SLOPE AND SHAPE

A. The Steepness of the Slope

1. Directly affects the rate at which fire spreads and its intensity

2. Fires moving upslope will move faster the steeper the slope

3. The steeper the slope the more likely there will be rolling material that can ignite fire below the main fire

B. Two Slope-Change Situations, "Slope Reversals", Are of Special Importance

1. When fire reaches a ridge-top and begins to burn downslope on the other side it commonly suffers a significant reduction in rate of spread and intensity. That can present a good control opportunity.

2. When fire crosses a drainage and begins to run up the next slope it often increases greatly in spread rate and intensity. That can present a threat to firefighters or control lines.

C. Steep Drainages Can Contribute to Fire Spread and Intensity and to Control Problems

1. Where steep slopes face each other:

a. Radiant heat from fire on one side may preheat fuels on the other side

b. Firebrands may cross readily to the other slope

c. Both of those things contribute to the potential for "area ignition"

PRESENTATION	APPLICATION
2. In minor drainages that are cut into steep slopes fire can run up with greatly increased speed and intensity. Such drainages are often called "chimneys", and are notorious for the hazard they present to firefighters.	

SUMMARY:

Topography plays a key roll in how a fire burns. It affects the fuel moisture, fuel type, fuel density, and fire spread. Knowing the affects of topography on fire behavior you will make your Fire Control efforts more efficient and safe.

EVALUATION:

A written quiz.

ASSIGNMENT:

To be determined by instructor(s).