Fire behavior

Understanding how fire burns and how we can influence that

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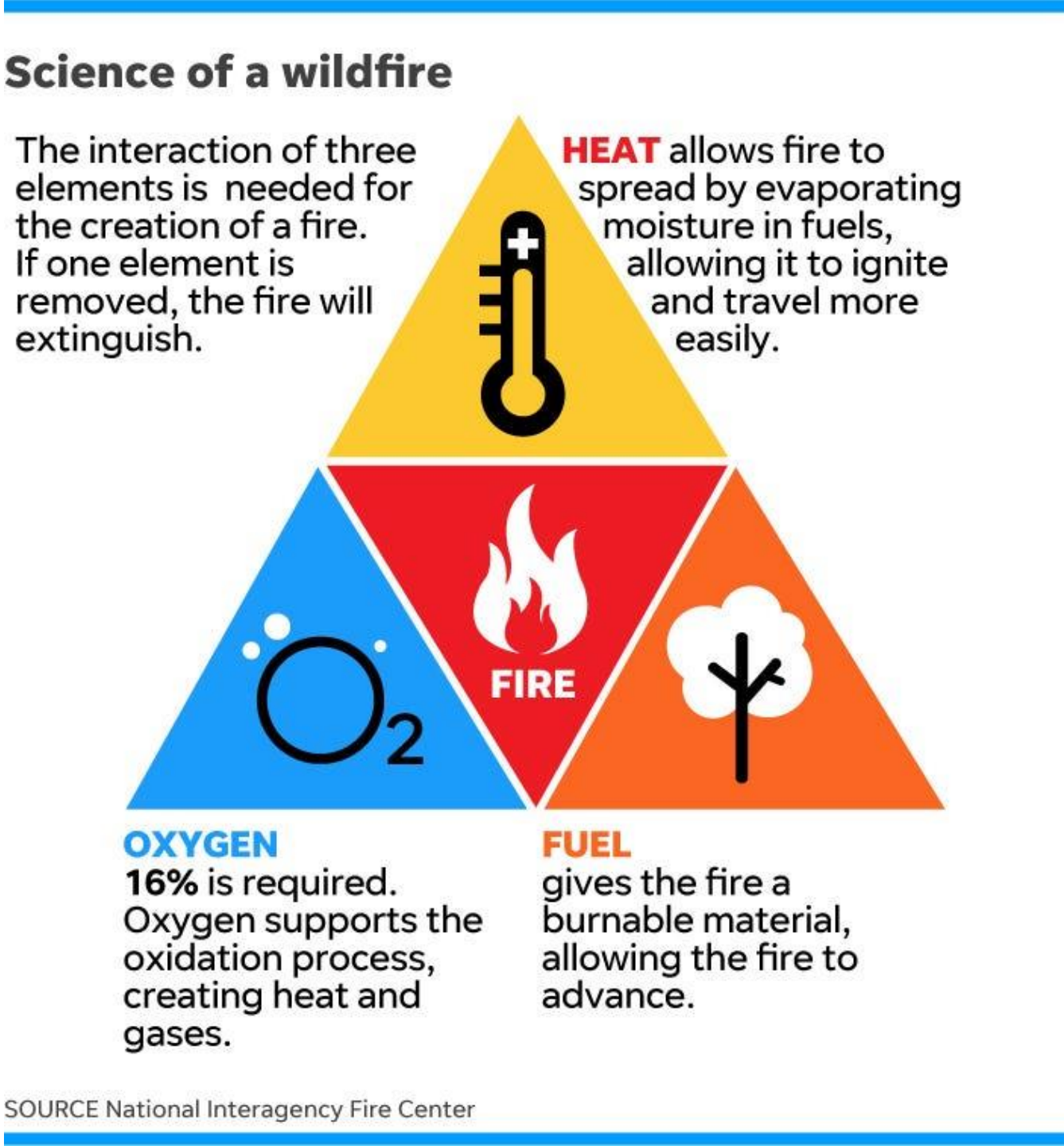
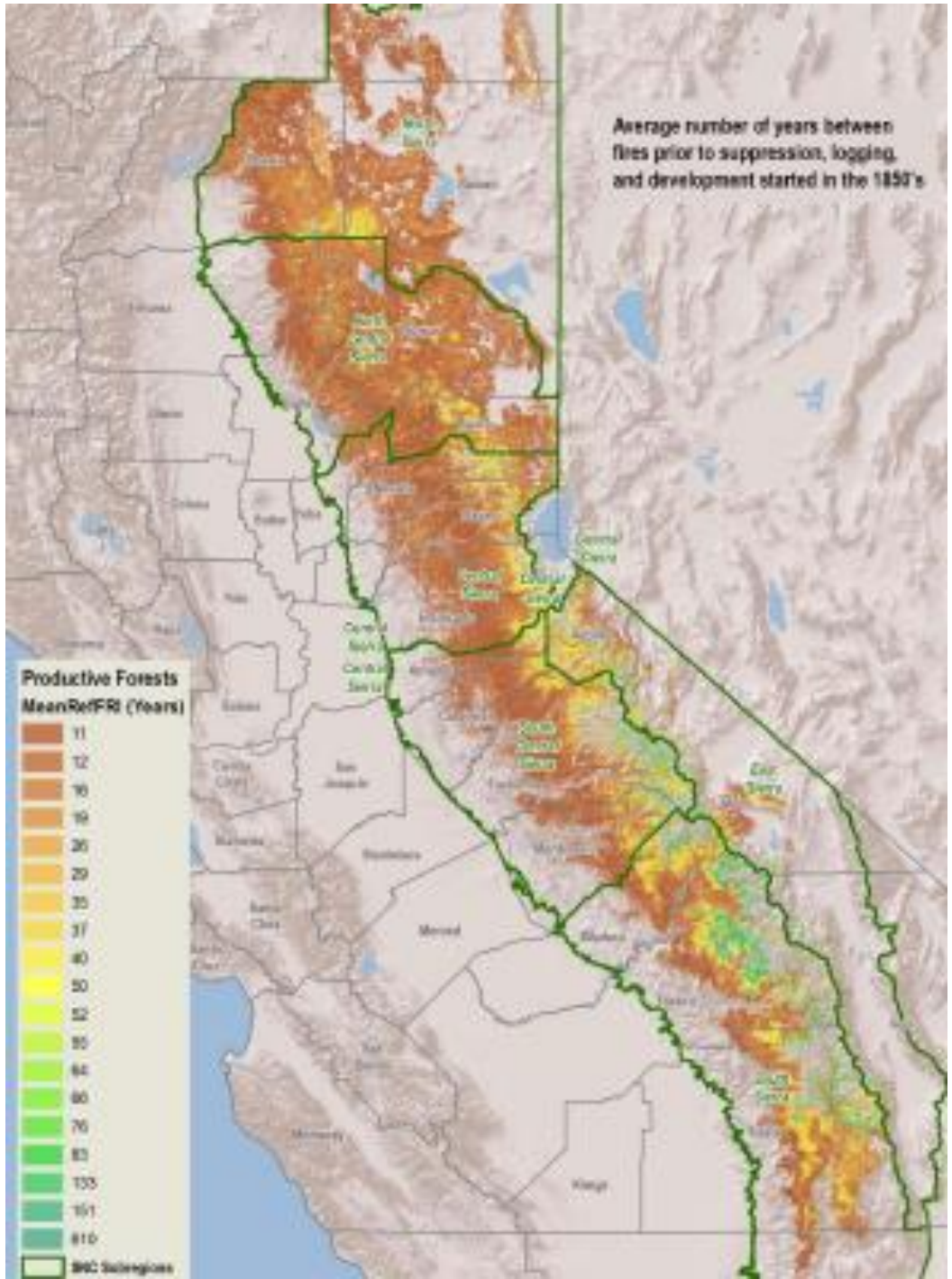
What is fire?

- Fire is a chemical reaction that occurs when fuel, oxygen, and heat interact.



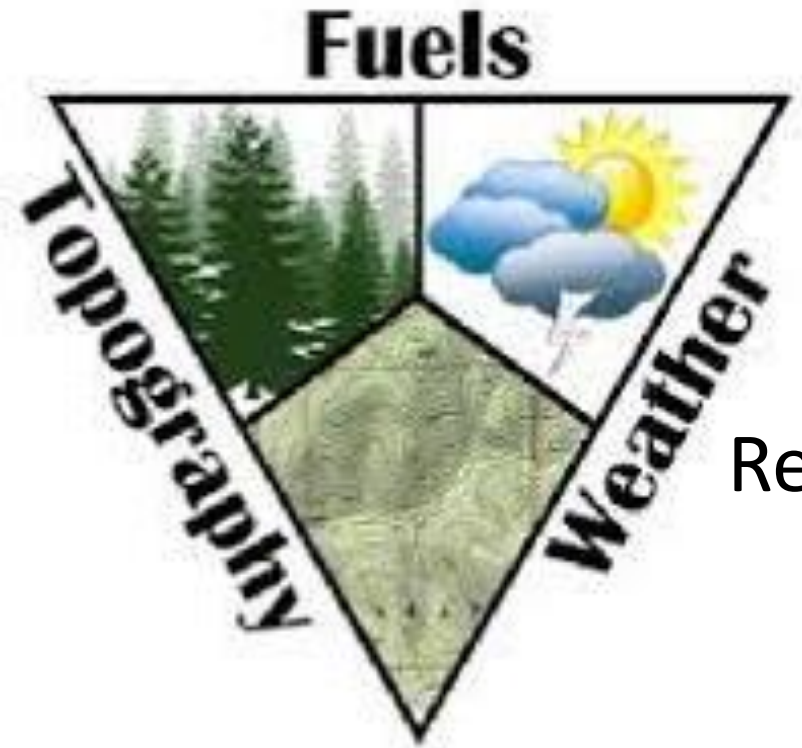


What is a fire regime?

- How frequently fires burns
  - Fire Return Interval – 15–30 years in much of Sierra
  - Sierra forests were frequent fire forest before suppression
- Fire size
  - Getting larger since fire suppression effective in mildest fire weather
- Energy release of the fire
  - Fire intensity
- How it alters vegetation
  - Fire severity – low medium, high.

What affects fire behavior?

Fine or heavy
Continuous/ heterogenous
Fuel moisture
Ladder fuel
Canopy cover / base height



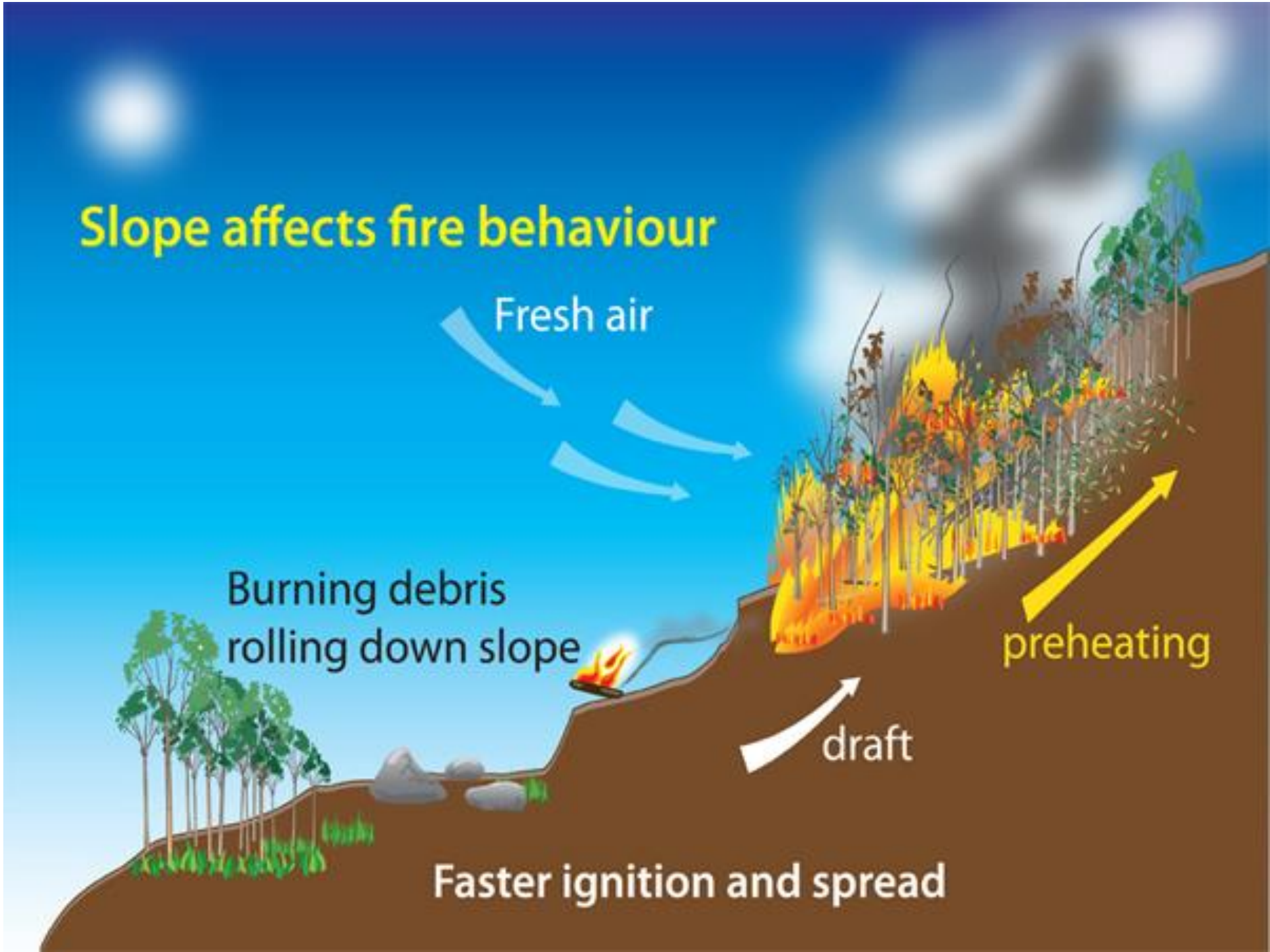
Flat or sloped
Aspect
Chutes/ canyons

Wind
Temperature
Relative humidity
Precipitation

Figure: USDA-NRCS, February 2016. Plant Materials Technical Note Report No. 66. Boise, ID

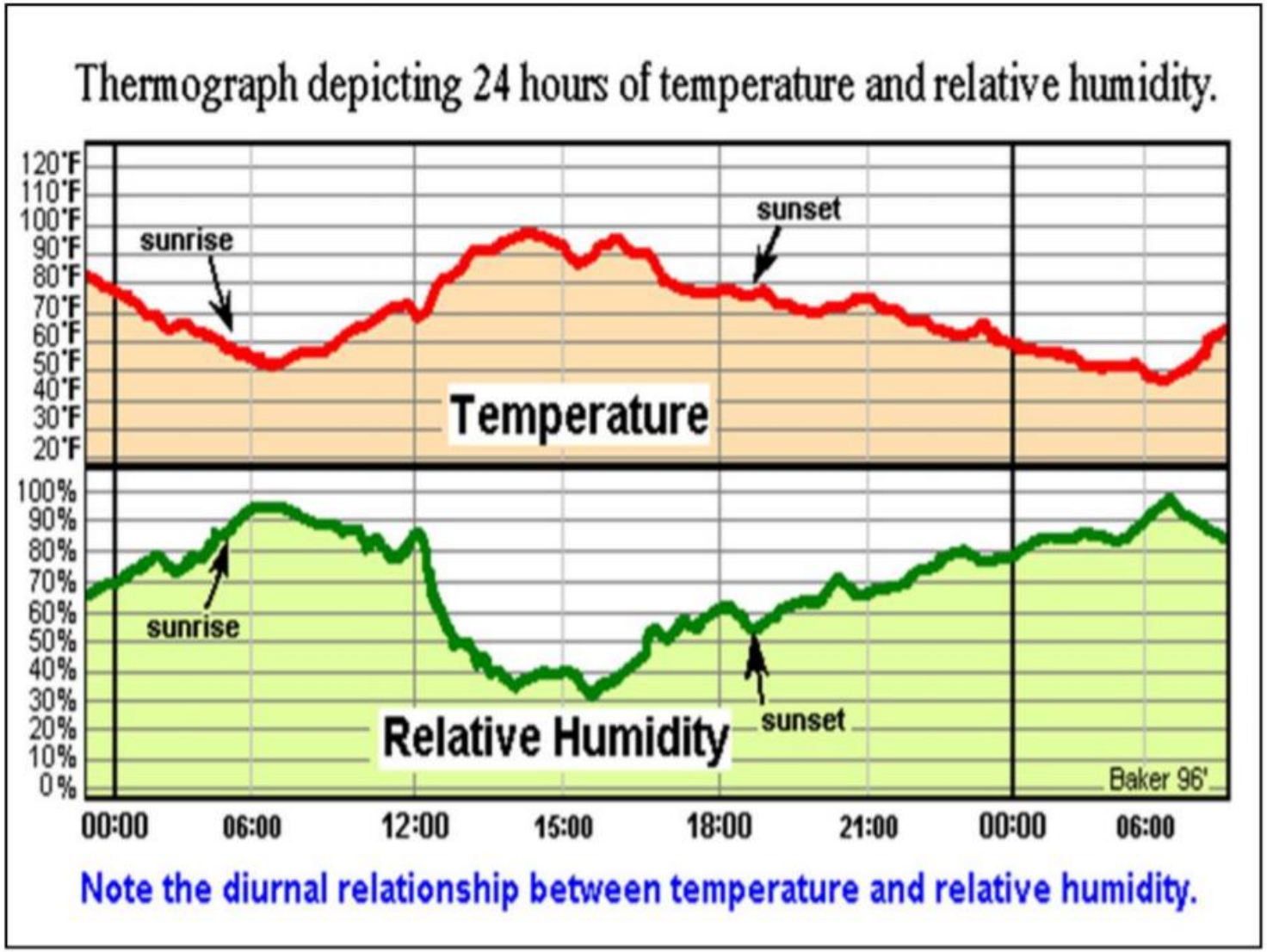
Topography

- Flat or sloped
- Aspect
- Chutes/ canyons



Weather

- Wind – Direction of fire spread and smoke transport mostly affected by wind
  - Hastens fuel drying, can send spots farther
- Temperature – Varies thru day
  - Warmer temp speeds burning
- Relative humidity – affects fuel moisture
  - Less RH increases burning – varies thru day
- Precipitation – increases fuel moisture and RH
  - Slows down burning



Fuel Characteristics

- Loading –More fuel leads to more heat
- Fuel size – smaller fuel burns faster/ dries faster
- Compactedness – compacted burns slower
- Continuity – fuels closer together spread faster
  - Ladder fuel carry fire from surface into tree crowns
- Fuel moisture – drier fuel burns faster
  - Temperature, rain, humidity and shade affect it
  - Size of fuel also affects fuel moisture
    - 1-hour **fuels**: <1/4 inch in diameter. - twigs, leaves, mulch and litter
    - 10-hour **fuels**: 1/4 inch to 1 inch - twigs
    - 100-hour **fuels**: 1 inch to 3 inches – twigs/ branches
    - 1000-hour **fuels**: 3 inches to 8 inches in diameter – branches/ logs

13 Anderson Fuel Models

Timber

Logging Slash

Anderson, H. E. 1982. Aids to determining fuel models for estimating fire behavior. Gen. Tech. Rep. INT- 122. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 22 p.

Fires can be described in terms of:

- flame height
- flame length
- rate of spread
- spotting distance
- fire intensity

OR

- By descriptions of behavior


SMOLDERING –
Burning without
blame and barely
spreading

CREEPING

Burning with low flames and spreading slowly

SURFACE FIRE

Low intensity fires that burn on the surface of the ground. The tree canopy may be scorched but does not burn to the extent that it will carry a fire

RUNNING

Rapid spread with a well defined head

Surface fire transitioning to single tree torching


SINGLE TREE TORCHING
Literally one tree burning up – not crowning

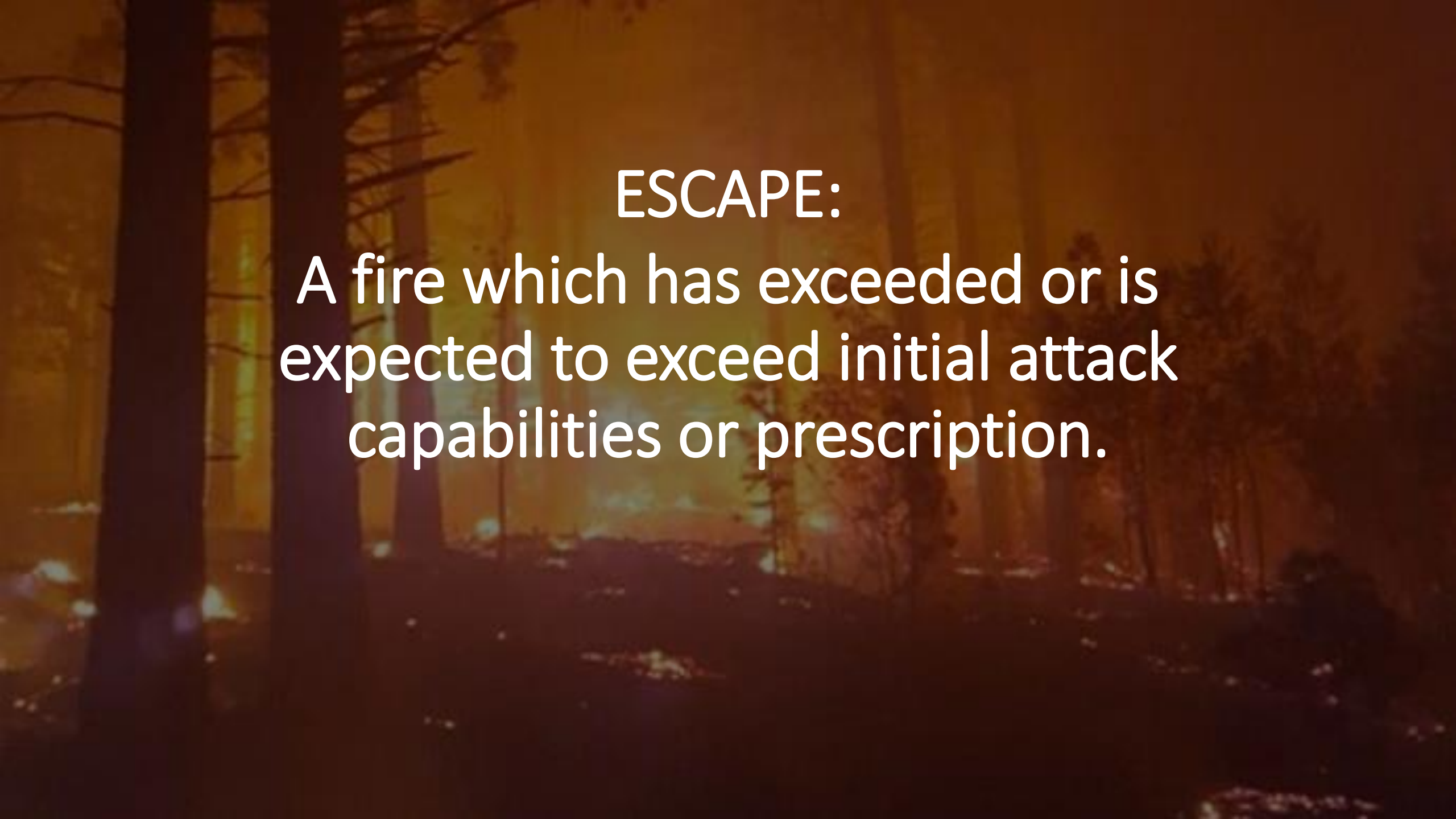
SPOT FIRE

A fire ignited outside the perimeter of the main fire by flying sparks or embers.

SLOP OVER:

A fire edge that crosses a control line or natural barrier intended to contain the fire.

Photo from Ben Jacobs.



ESCAPE:

A fire which has exceeded or is expected to exceed initial attack capabilities or prescription.

What are a fire's effects?

Fuel consumption – how much is left
Char height – how high stems are blackened
Crown scorch - percentage of needs scorched
Soil burn severity – areas made hydrophobic
Vegetation burn severity – percentage of trees killed