

Natural Disasters

Lecture 34 Topic 3: Wildfires

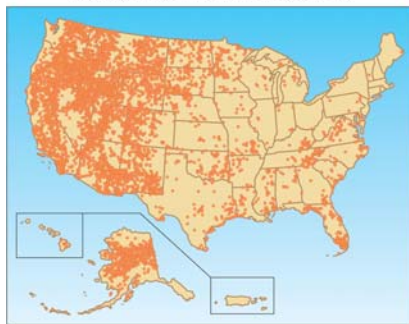
Text Source Today:
Chapter 15

Topic 3: Wildfires

● **Wildfire:** any **uncontrolled** fire in combustible vegetation that occurs in the countryside or a wilderness area.



◆ The four major natural causes of wildfires are: **lightning**, volcanic eruption, sparks from rockfalls, and spontaneous combustion. Many wildfires are attributed to human sources such as **arson, discarded cigarettes**, sparks from equipment and power line arcs.



USA Wildfires 1980-2003

● Wildfires occur on every continent, except **Antarctica**.

● Each year in the U.S., between 60,000 and 80,000 wildfires burn anywhere from **3 million to 10 million** acres of land.

● Fire is a **natural force** used by humans for purposes both good and bad. Controlled use of fire provides energy for industry and travel, lighting, heating and cooking, but fire also **kills and destroys**.

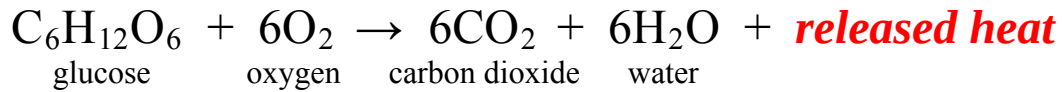
◆◆ From 1981-2005, fire caused a yearly average of 4,917 deaths (**82% in residences**) and over \$13 billion in property damage.

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TABLE 15.3	
Where People Died in US Fires in 1982	
Residences	82%
One- and two-family homes (66%)	
Apartments (14%)	
Hotels or motels (12.5%)	
Other (7.5%)	
Nonresidential buildings	4.3%
Highway vehicles	9.6%
Other vehicles	2%
Other	2.1%
Total	100%

Source: US Census Bureau, Statistical Abstract of the United States—1982.

♦ **What is fire?** It is the rapid combination of **oxygen** with carbon, hydrogen and other elements of **organic material** in a reaction that produces flame, **heat** and light:



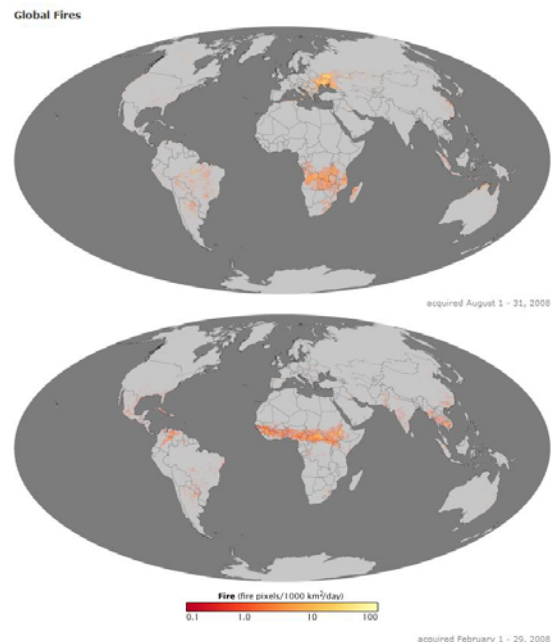
♦♦ In effect, fire is the **photosynthesis** reaction in reverse:

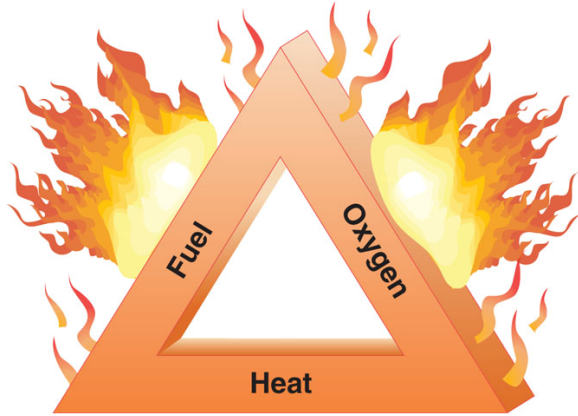


● **Photosynthesis** causes the buildup and storage of **chemical potential energy** in plants that is released during fires.

♦ **The Need for Fire:** In many environments, fire is needed to **recycle nutrients and regenerate plant** communities. Fire-dependent ecosystems include grasslands, seasonal tropical forests, some temperate-climate forests, and the **Mediterranean-climate** shrublands.

♦ Fire threats are greatest in areas with big contrasts between **wet seasons** (triggering voluminous plant growth) and **dry seasons** (dehydrating plants) → **Mediterranean climate**, also prominent in parts of the Californias, Australia, Chile and South Africa.



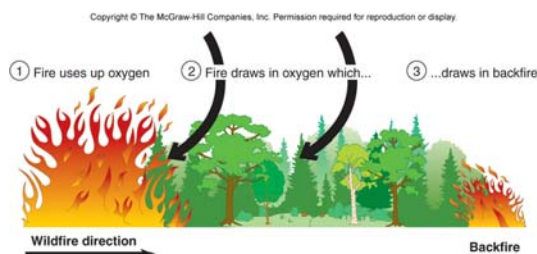


♦ **The *Fire Triangle*:** A fire may begin only when **fuel**, **oxygen and heat** are all present in the right combination.

- **Fuel** is any **combustible** material, which includes grasses, shrubs, trees, **slash** (organic debris left on ground after logging or windstorms), and **houses** as the human population spreads into wildlands.

♦ **Fighting Fires:** Take away any **one side** of the *Fire Triangle* and the fire collapses. *Examples:*

- Firefighters spray **water** on a fire to reduce its **heat**
- Air tankers drop **viscous fluids** in front of a fire to coat the unburned vegetation and block **oxygen** from contacting the plant
- Firefighters bulldoze and remove vegetation to eliminate **fuel**



→ Firefighters set **backfires** in front of the advancing wildfire; as the wildfire draws in oxygen, it also draws in the **backfire**, thus eliminating **fuel** in front of the advancing wildfire.

→ Firefighters can reduce **ladder fuels** by cutting and pruning vegetation to create vertical separations between layers



● **Mitigation:** Buildings can be constructed to withstand fire by: 1) eliminating **flammable vegetation and woodpiles** near the structure; 2) avoiding **wood-shingle roofs** and overhanging wood balconies or decks; 3) using **double-paned glass** in windows and doors; 4) using **spark arresters** on chimneys; 5) eliminating **vulnerable spots** where embers may enter and set it afire.

◆ The Stages of Fire:

I) A **preheating stage** in which **water** is expelled from woods, plants or fossil fuels by flames, drought or hot weather.

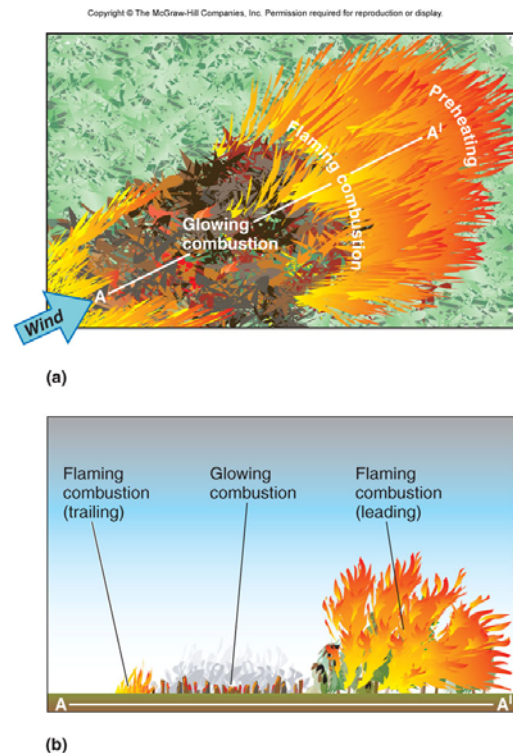
When temperatures exceed 300°C (615°F), wood breaks down and gives off flammable gases in the process of **pyrolysis**.

When oxygen is present, **pyrolyzed** gases can ignite and **combustion** begins.

II) In the **flaming combustion stage**, the pyrolyzing wood burns hot, as released heat keeps the wood surface hot through conduction, diffusion, radiation and convection.

III) A **glowing combustion stage** follows after the flames pass, during which fire slowly consumes the solid wood.

Note: all these stages are ongoing at once in different parts of the fire.



♦ Wildfires occur in three different styles.

- 1) They may move slowly along the ground, with **glowing combustion** playing a primary role;
- 2) They may advance as a **wall of fire** along a **flaming combustion front**; or,
- 3) They may race through the treetops as a **crown fire**.

♦ **Spread of Fire** depends on four factors:

- 1) **Fuel:** types of plants (or fuel) burned make a difference, as **eucalyptus and chaparral** ignite easily and burn intensely.
- 2) **Wind:** strong winds bring oxygen and push flames forward; strong winds also can carry **firebrands** (flaming debris and embers) to unburned areas, which can start new blazes.
- 3) **Topography:** can have numerous effects; fire will **race up a steep slope**, which acts like a chimney.
- 4) **Fire Behavior:** heated air rises buoyantly, creating its own winds, including **fire tornadoes** which can reach speeds over 150 mph and carry fiery debris miles away, starting new fires!

♦ **Fire Suppression:** During the 20th century, fire suppression tactics and equipment improved, resulting in **dramatic reductions** in the number of acres burned, transforming the forests. *Example: Bitterroot National Forest in Montana*



1909

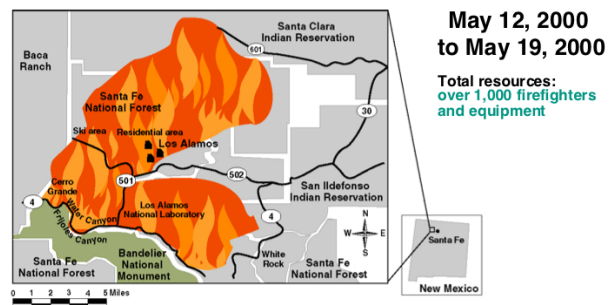
1948

1989

♦ **Prescribed Fires (Controlled Burn):** One solution to the problem of denser forests and shrublands is to deliberately set fires at times with forecast low wind speeds, low temperatures, good soil moisture, approaching rain, and other factors to **limit the size and power** of the fire. However, mistakes will happen!

● **Albany's Pine Bush, 27 April 1999:** The *Albany Pine Bush Preserve Commission* set a **small controlled burn** that got out of control, burning **65** acres of the Pine Bush. The fire was intense enough to jump the four lanes of the **NYS Thruway**, which had to be closed during rush hour, creating traffic jams all around the Capital District. No one was injured and no property was damaged.

● **Los Alamos, New Mexico, 4 May 2000:** The *National Park Service* set what they hoped would be a **controlled burn**, but the next day, strong winds whipped the fire into a wildfire that consumed **50,000** acres of national forest, as well as **235** houses in Los Alamos, displacing **25,000** people. The wildfire also damaged or destroyed **115** buildings in Los Alamos National Laboratory and came frightening close to the hazardous materials site at the nuclear research facility!



♦♦ **Fire cannot be prevented, only deferred.**
We pay a price for fire suppression. We must choose between lots of **little fires** or a few **monstrous, essentially unstoppable, blazes.**