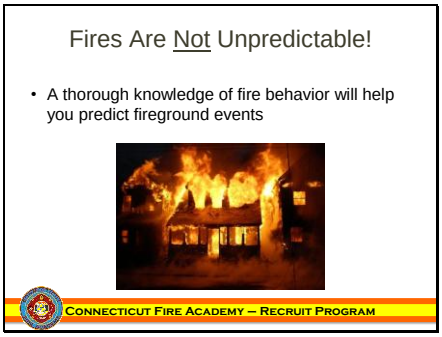
Slide 1

Slide 2

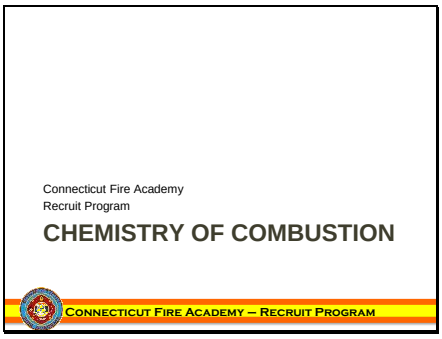
Slide 3



Some have said that fires in modern furnished homes are unpredictable

Nothing is unpredictable, firefighters just need to know what clues to look for

Slide 4



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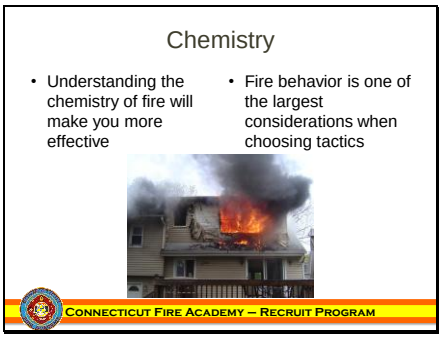
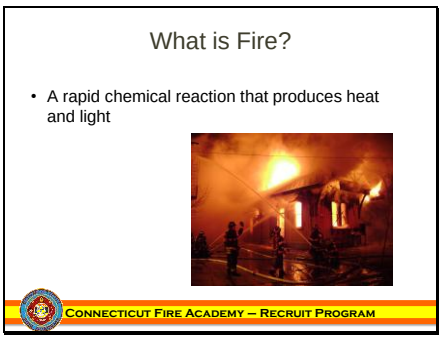


A basic understanding of how fire burns will give a firefighter the ability to choose the best means of extinguishment

Fire behavior and building construction are the basis for all of our actions on the fire ground

Slide 6



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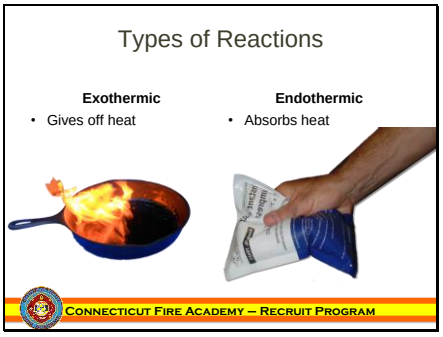

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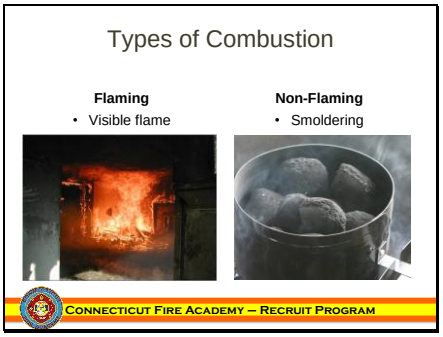
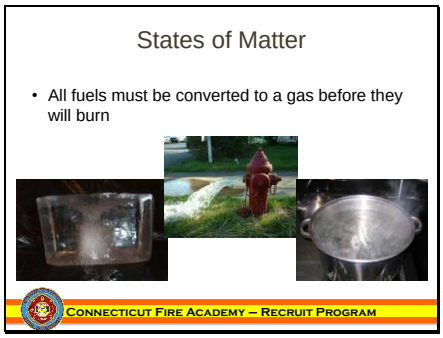


Non-flaming combustion can still damage structural components of a building

Non-flaming combustion produces the highest concentrations of toxic gases

Often found during backdraft or decaying fires

Slide 9

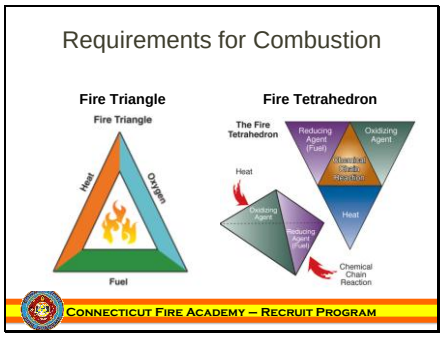


Water is a simple example of the 3 states of matter

Solids must be heated to the point where they begin to decompose and give off combustible vapors

Liquids must be at a minimum temperature to give off enough vapors to burn

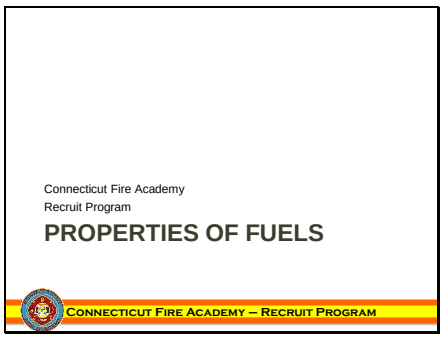
Slide 10



If any part of the tetrahedron is removed, the fire goes out

If any part of the tetrahedron is amplified, the fire intensifies

Slide 11



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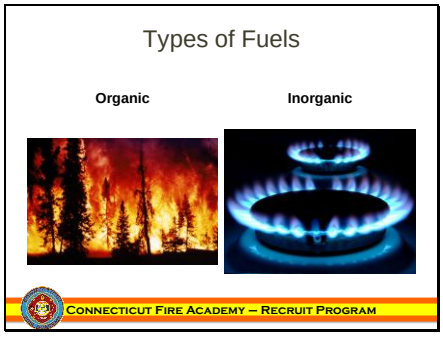


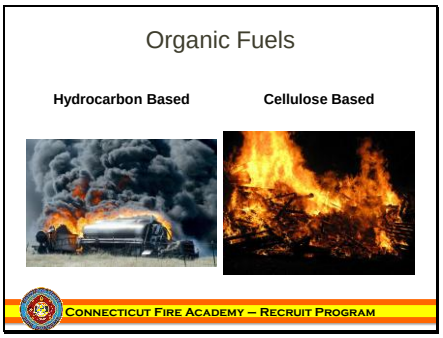
Inorganic fuels lack carbon and hydrogen atom bonds

Inorganic fuel example- methane, flammable metals

Organic Fuel- wood & natural fuels

Organic fuels came from something that was alive at one point

Slide 13



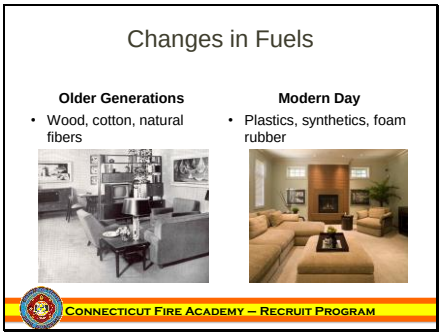
Hydrocarbon based fires are typically seen with large volumes of black smoke

Hydrocarbons include any fossil fuel, plastics, and synthetics that use any part of oil in their makeup

Cellulose based typically have a grey to brown smoke

Examples include wood, straw

Slide 14

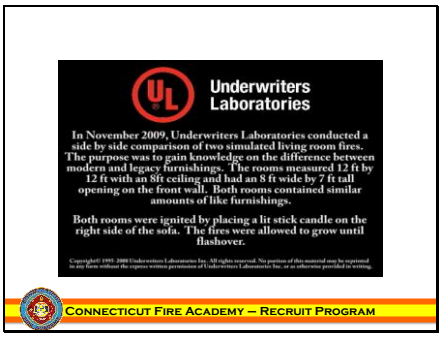


Rooms furnished with older, legacy type furnishings took much longer to reach flashover and didn't give off the volume of toxic smoke that modern furnishings do

Modern furnishings can cause a room to reach flashover in 5 minutes or less

The toxic smoke produced can kill in less than a few minutes

Slide 15



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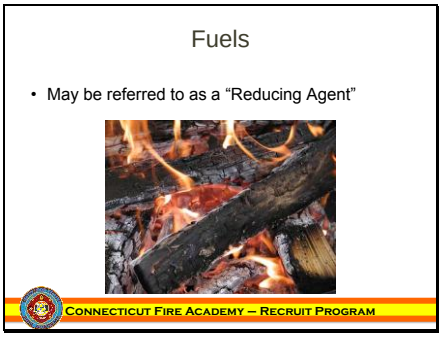
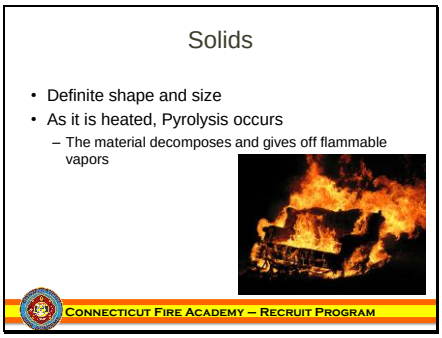


Some texts refer to a fuel as a reducing agent

Slide 17

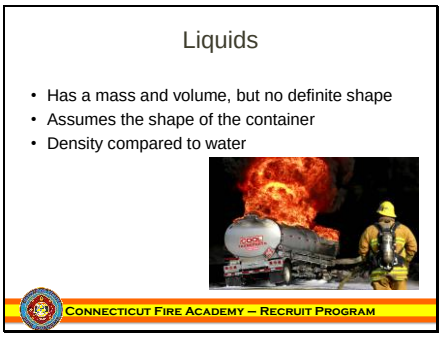


Fires involving solid fuels are the easiest to handle

The fuel must be heated and change state in order to burn

The fuel stays stationary

Slide 18



Fires involving flammable liquids are harder to control

The fuel can travel easily

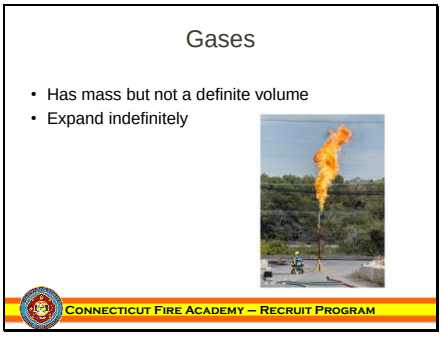
Many flammable liquids are already found at or near their flash point so they may be giving off enough vapors to burn

Example of diesel fuel vs. gasoline

Water alone typically does not work well to extinguish them

Foam is often needed

Slide 19



Gases are the hardest to handle

They are already in the required state to burn

As long as the concentration is right

They expand and travel indefinitely

Most gases are heavier than air so they collect in low areas and pool

They can pool enough to form an ignitable mixture

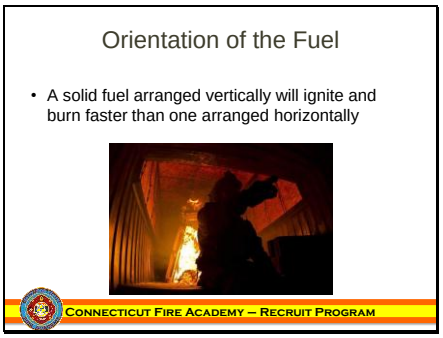
Lighter than air gases will dissipate shortly after escaping

Only 13 gases are lighter than air

Typically controlled by shutting off the fuel

They are typically allowed to burn

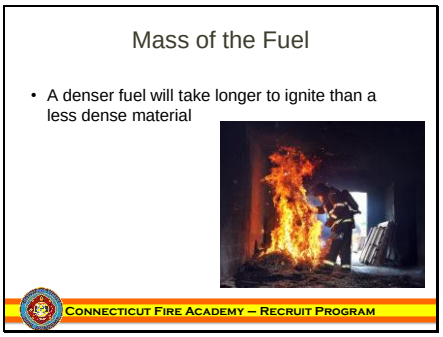
Slide 20



Wall coverings burn easily but floors are often minimally damaged

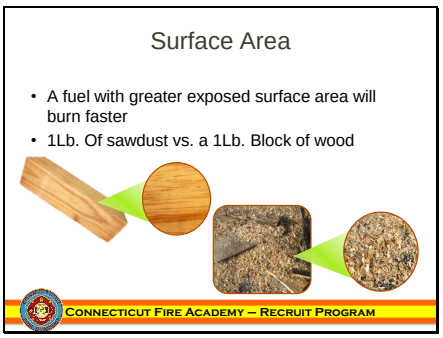
Sides of furniture will spread fire faster than horizontal surfaces

Slide 21

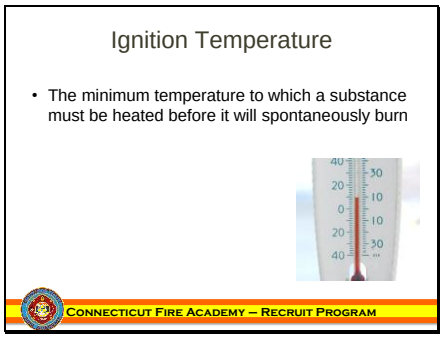


Hay vs. pallets

Slide 22

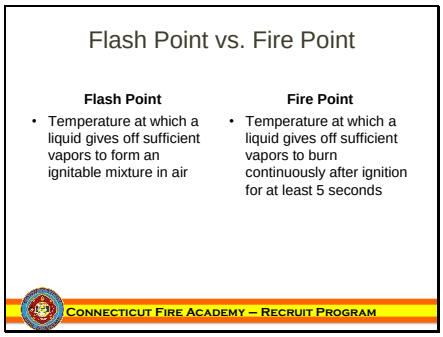


Slide 23



This occurs without an outside ignition source
- Wood 572°
- Gasoline- 536°
- Carbon Monoxide- 1128°

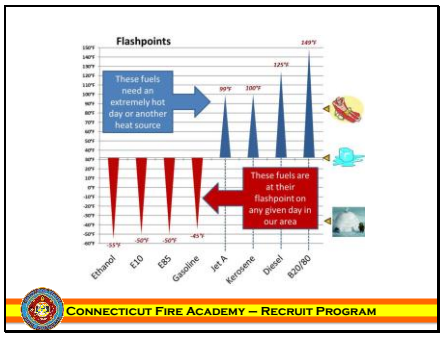
Slide 24



Examples on the next slide

These are typically very close in temperature

Slide 25



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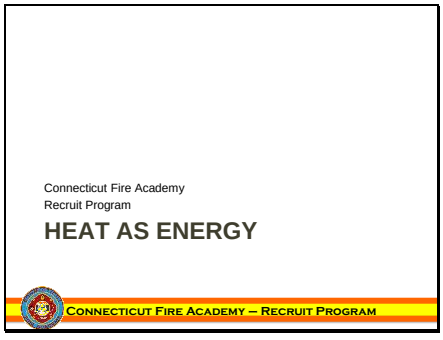

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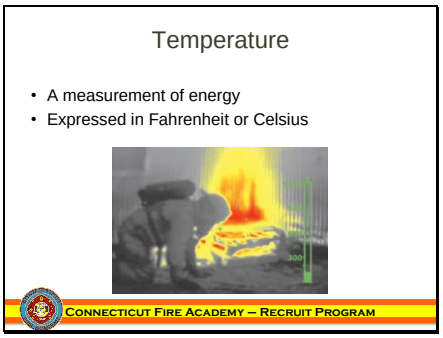
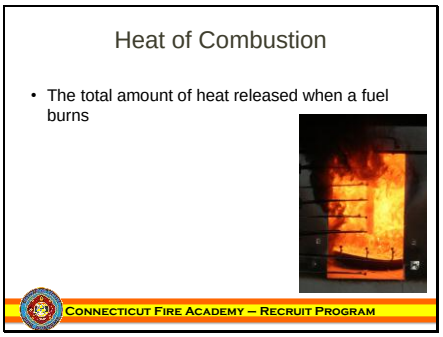
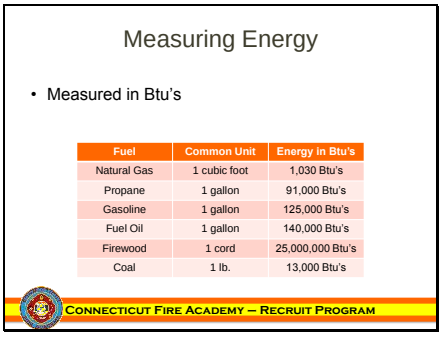


Slide 28



Examples on next slide

Slide 29



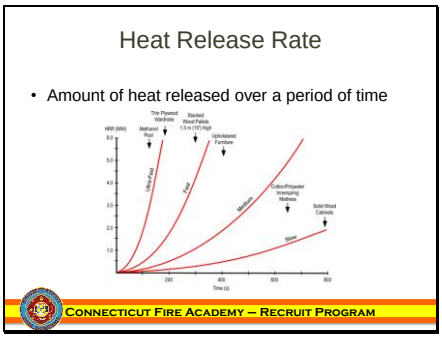
These numbers assume the complete combustion of each material

The rate at which they release this heat is dangerous

Heat release rate is discussed on next slide

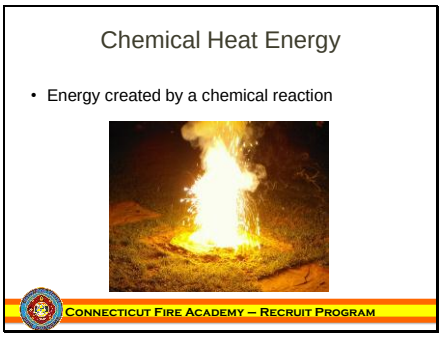
A Btu is the amount of energy needed to raise 1lb of water 1°F

Slide 30



We can see that a typical plywood wardrobe burns almost as fast as a pool of methanol

Slide 31

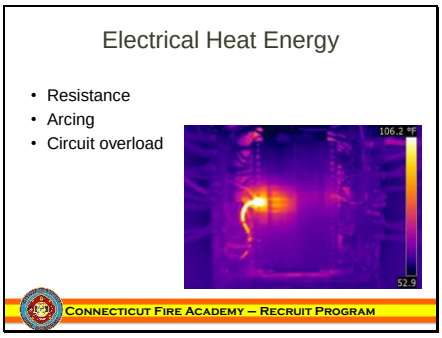


Example- sodium exposed to air

Slide 32

Example- compressing air into an SCBA cylinder or rubbing sticks together to make fire

Slide 33



Arc welding is an example of heat caused by arcing

Resistance example- a dimmer switch for lights

Energy not sent to the light bulb is dissipated as heat

A fuse is an example of a circuit overload

A small wire only allows a certain amount of current to pass through. Any excess will cause the wire to fail

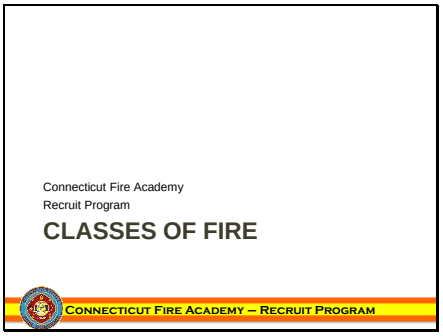
Multiple devices working off of one small circuit can cause heat to build up degrading the insulation of a wire. Eventually it will fail causing arcing and may start a fire

Slide 34

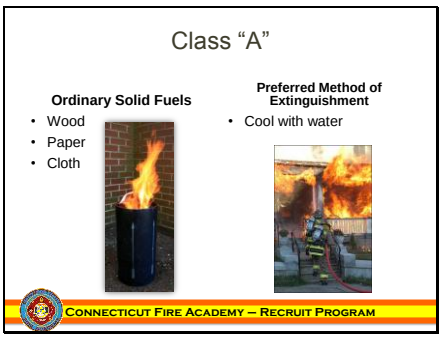
Fires in mulch piles are a good example

The mulch also acts as an insulating blanket keeping heat in

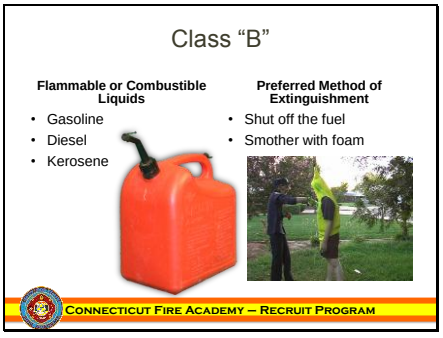
Slide 35



Slide 36

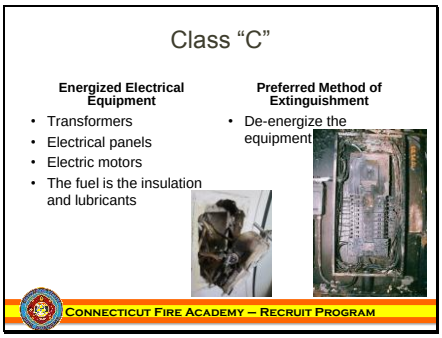


Slide 37



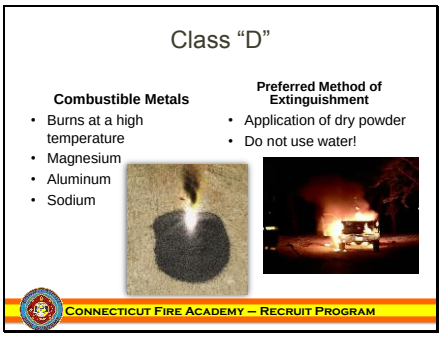
Video example shows a person doused with rubbing alcohol. They try to extinguish it with water but its ineffective

Slide 38



Once the equipment is de-energized, it can be treated as a class "A" fire

Slide 39



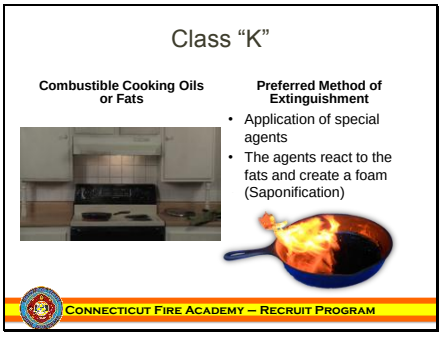
Flammable metals are often water reactive

The video shows a car fire when water is applied to magnesium

Magnesium is often found in vehicle construction

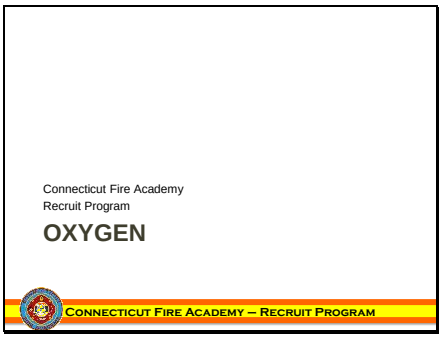
Reinforces the need to proper PPE at car fires

Slide 40

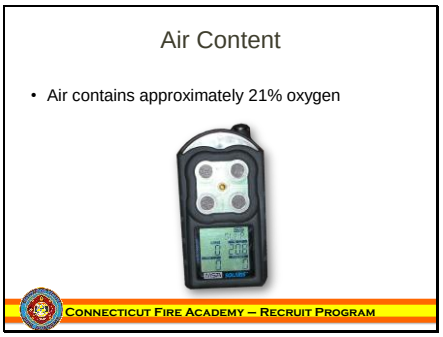


Video shows what happens when water is applied to a cooking fire (oil or grease)

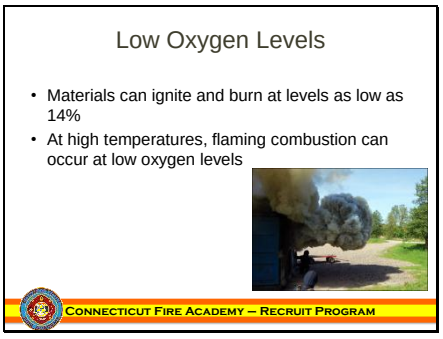
Slide 41



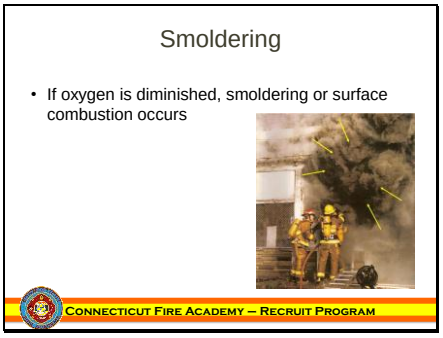
Slide 42



Slide 43

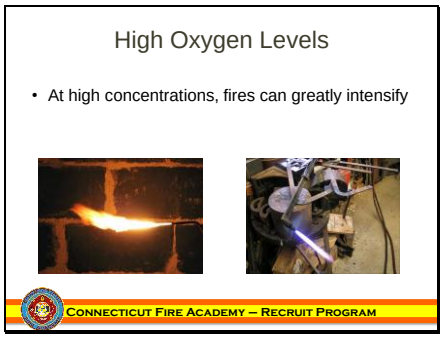


Slide 44



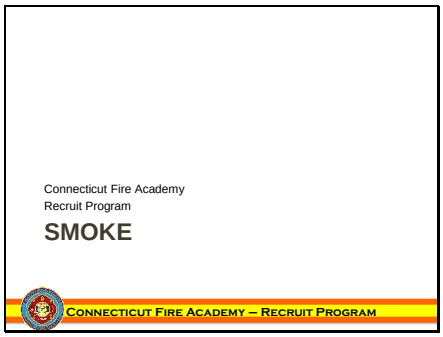
Smoldering fires produce the highest amounts of toxic and flammable smoke

Slide 45

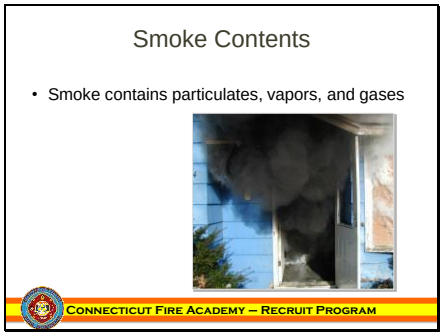


High oxygen levels can be expected in medical facilities, pool stores

Slide 46



Slide 47

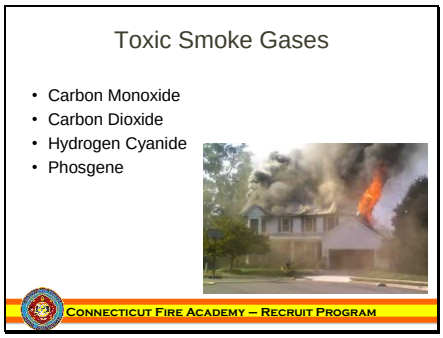


Smoke, in the right concentrations, can be considered fuel

Particulates are solid matter suspended in the atmosphere

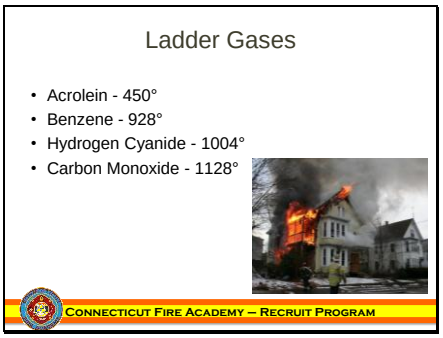
Vapors are liquids suspended in the atmosphere

Slide 48



Much of this is covered during the SCBA & PPE lecture, but is worth reviewing

Slide 49



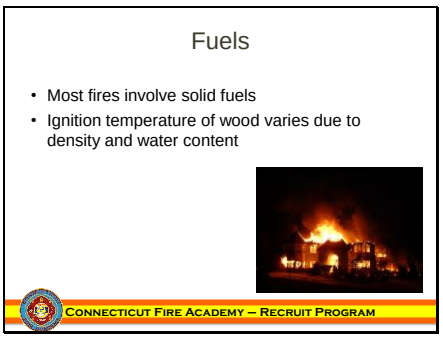
The "ladder" gases simply demonstrate why we see fingers of fire in smoke

The lower temperature gases light off faster

These gases burning also accelerates the heating of the other gases

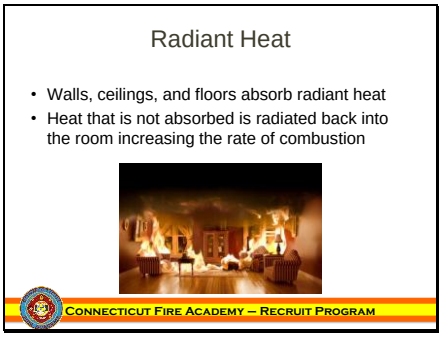
Slide 50

Slide 51



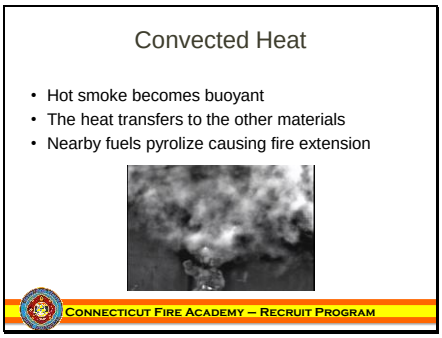
Older homes may have wood that has had time to dry longer

Slide 52



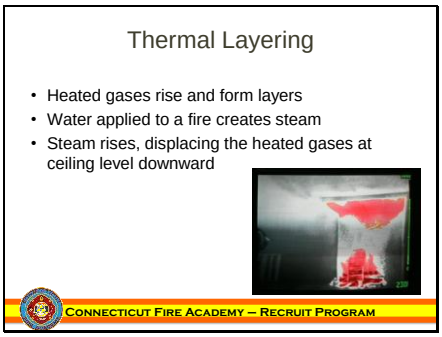
Radiant heat effects the compartment, but is also the biggest factor in exposures burning

Slide 53



This causes fires to travel from lower floors to upper floors even without direct flame contact

Slide 54

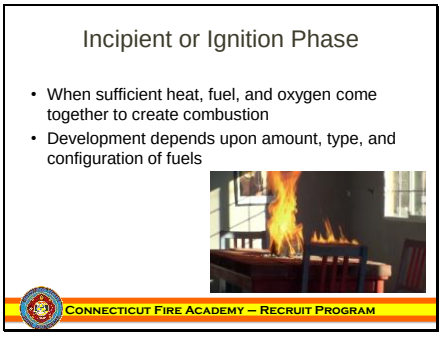


This is why we apply water at the ceiling level first

It cools the gases before they get driven down on top of advancing crews

Ventilation also prevents the gases from being driven down onto crews

Slide 55

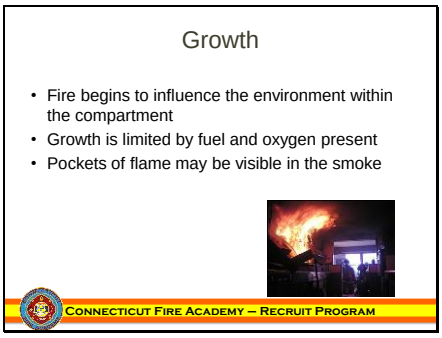


Very little heat in the room

Occupants can safely escape

Fire easily extinguished by a small portable fire extinguisher

Slide 56

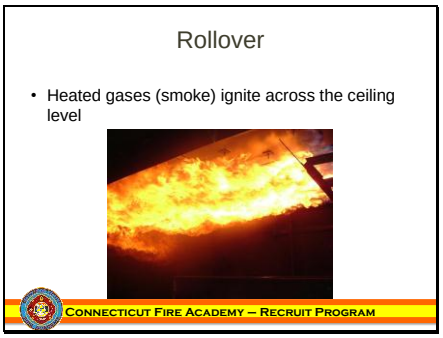


This is where a noticeable thermal layering begins

Occupants still have the ability to escape

Victims located within the room are still viable

Slide 57

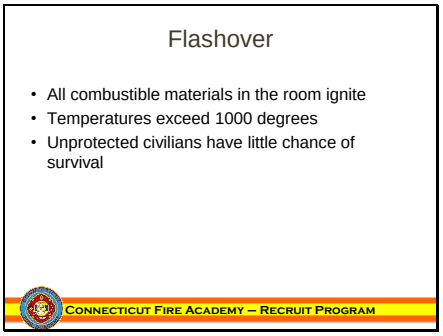


Rollover typically precedes flashover

It can be a warning sign to flashover, but thick, dark smoke can prevent it from being noticed by crews crawling on the floor

The heat then radiates into the room bringing everything up to its ignition temperature

Slide 58

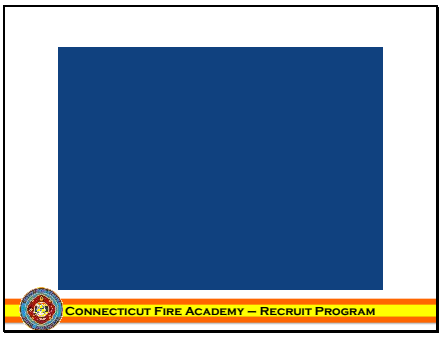


The fire will continue as long as fuel and oxygen remain

Firefighters have only seconds to escape without injury

Several videos to follow

Slide 59

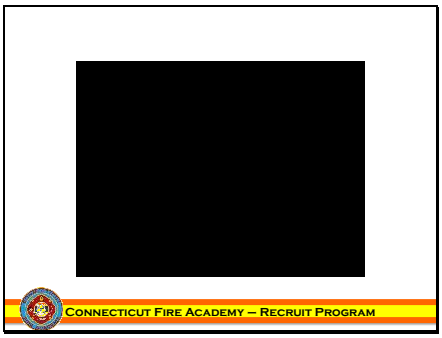


- NIST flashover video
- Small compartment fire development

Slide 60

- Fire from Huntsville, TX
- 2 story wood frame multiple dwelling
- Fire can be seen developing then flashing over
- Note the volume of fire present after flashover
    - Also note how rapidly the fire knocks down

Slide 61

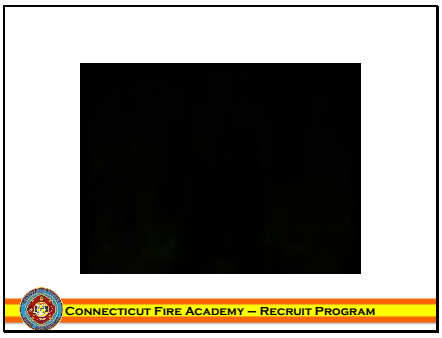


- Training fire
- Shows how flashover can be brought on by improper ventilation
- There is initially no ventilation
  - Opening the front door supplied oxygen and allowed the heated gases to escape
    - This is necessary and acceptable on the fireground because we have to get in somewhere!
  - Placing the PPV fan in the front door acted like a "bellows" on the fire, causing it to intensify and flash over
    - This is especially true with the lack of ventilation at any other part of the building
- PPV fans should never be used during fire attack, ESPECIALLY after crews have entered the house and with no adequate ventilation opposite the crews & fan

Slide 62

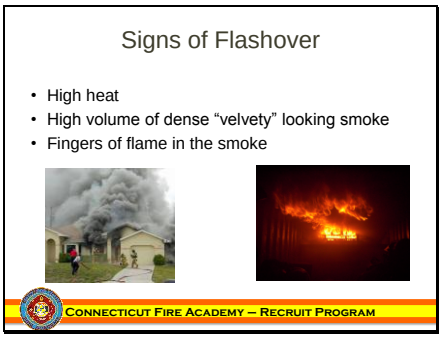
- Note the smoke conditions on the front porches
- Predict what was going to follow
- Fire is easily visible from a "B" side window, but it is more important to predict where the fire will spread

Slide 63



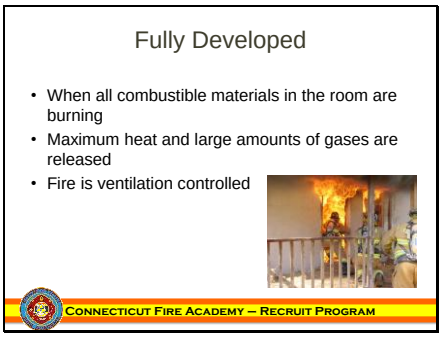
- Note that the smoke is venting quickly
  - This indicates a decent heat condition on the 2nd floor
- Venting in this manner may have to be delayed if there is no engine company on that floor of if they are delayed

Slide 64

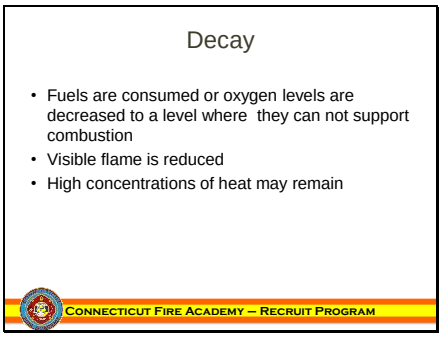


•Some visible signs may not be obvious while operating inside the building

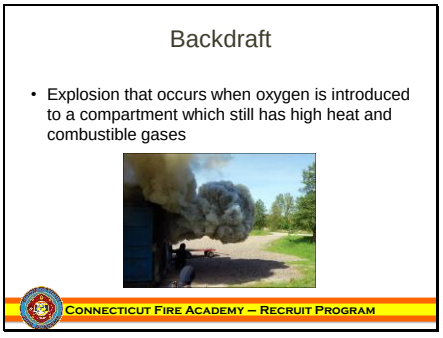
Slide 65



Slide 66

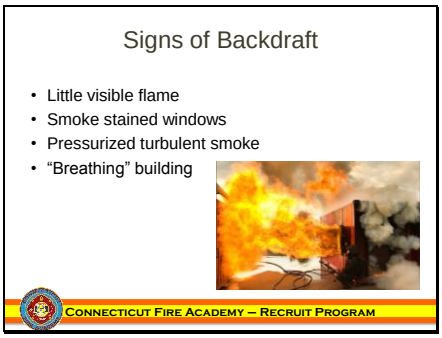


Slide 67



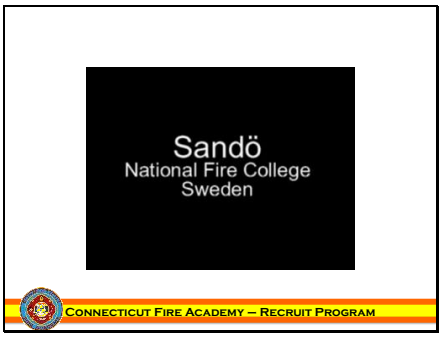
•Flashover and backdraft are often confused
- Backdraft occurs from oxygen being introduced into a room which is oxygen deprived
  - The result has a concussive, explosion type of effect
- Flashover is caused by heating of the contents
  - Not explosive in nature

Slide 68



•When confronted with suspected backdraft conditions, vertical ventilation is a priority

Slide 69

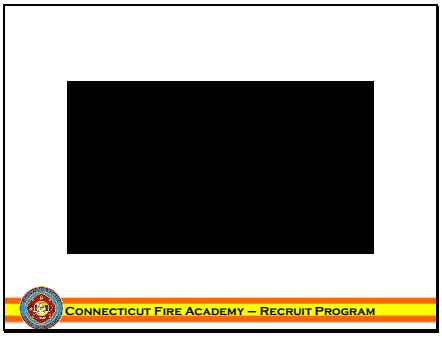


•Training fire showing the concussive nature of a backdraft
•The signs of backdraft are not visible in this video

Slide 70

•St. Johnsbury, VT
•3-4 story taxpayer
•Some signs of backdraft are visible around the 2nd floor area

Slide 71



•Battalion Chief being caught in backdraft
•Signs of backdraft are not really present

Slide 72

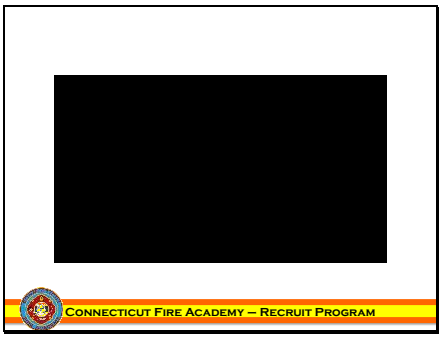
Slide 73

- Attic fire that backdrafted
  - A.k.a. "cockloft explosion"
    - Heat and pressure built up in the attic space because the ventilation is limited
    - Once something introduces oxygen (failed sheetrock, small vent opening, etc.) the attic backdrafts
      - This causes the ceiling in the upper floor to collapse on crews underneath
        - Note that it was powerful enough to cause the chimney to separate from the house
        - These are NOT common on peaked roof buildings
          - They typically have better ventilation
          - These typically occur on flat roof buildings

Slide 74

- Minor backdraft occurs at a private dwelling
- Wind can hide the signs of impending backdraft

Slide 75



•No signs of backdraft visible

Slide 76

•Texas fire in private dwelling

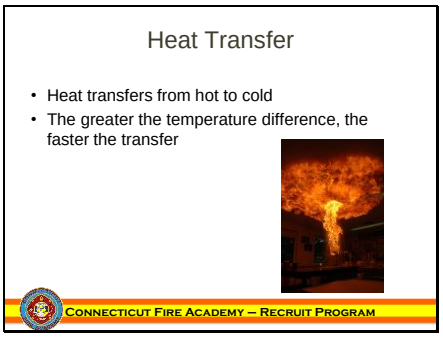
Slide 77

•Harrison, NJ
•Signs of backdraft present quickly followed by explosion

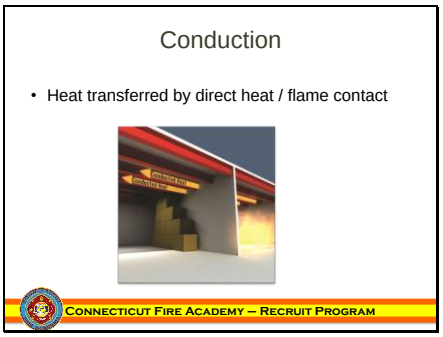
Slide 78

Slide 79

Slide 80

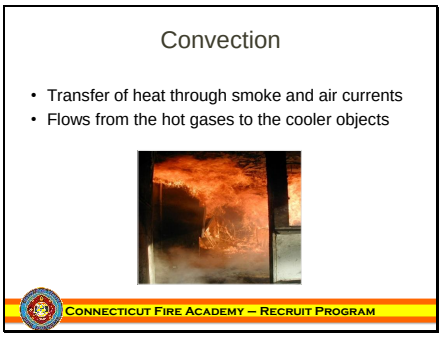


Slide 81



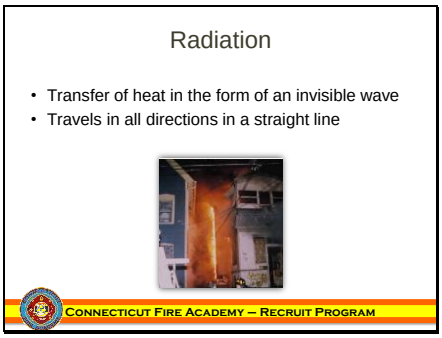
•Direct flame contact to an object or a heated object transferring heat to another

Slide 82



•Typically how fires travel from lower floors to higher ones

Slide 83

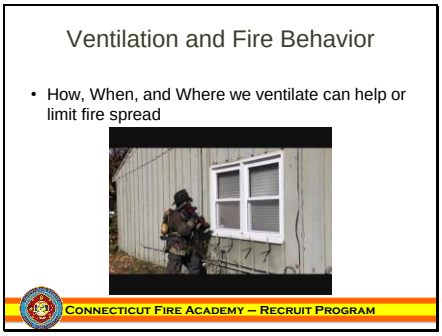


•Typically the biggest concern with exposures

Slide 84

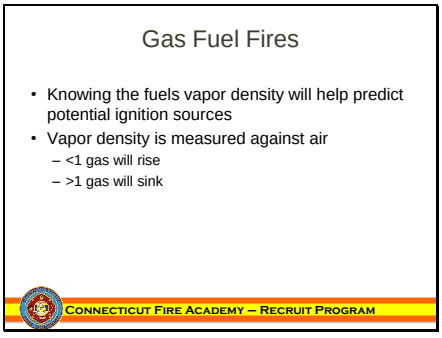
•Obviously fires of equal size would behave differently in the two occupancies shown

Slide 85

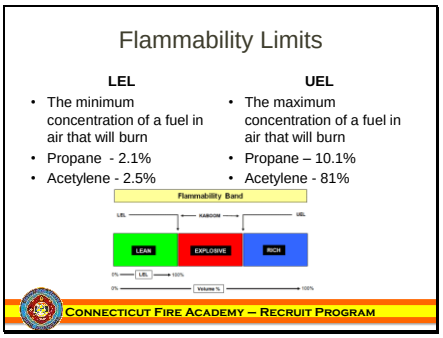


•As much as proper ventilation can help fire attack, improper ventilation can hamper it

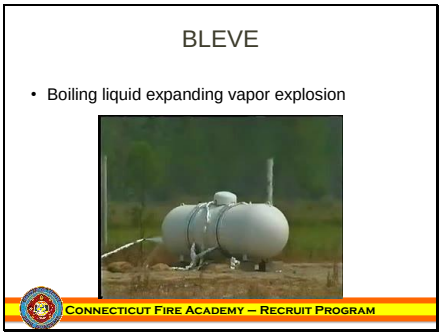
Slide 86



Slide 87

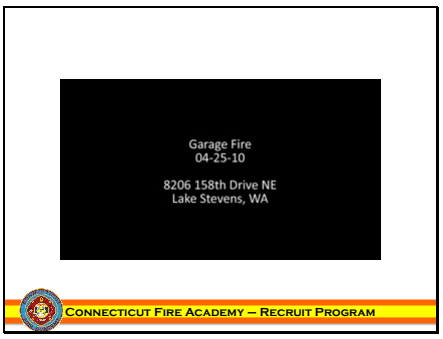


Slide 88



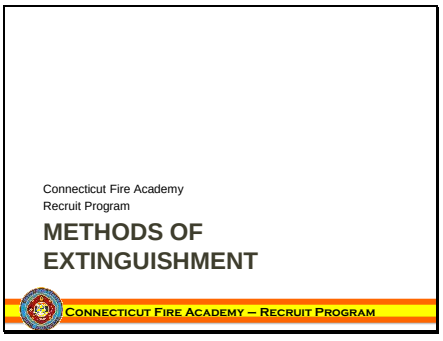
•BLEVE video

Slide 89

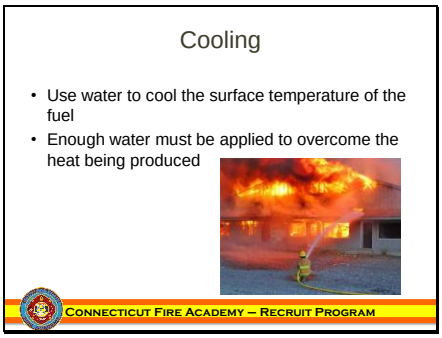


•20lb LP tank explosion at a garage fire

Slide 90

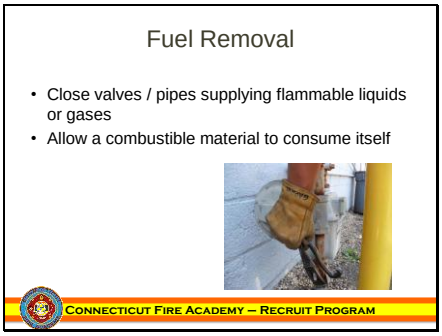


Slide 91



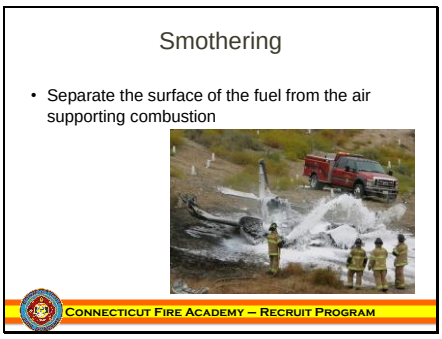
•Typically the best for class "A" fires

Slide 92



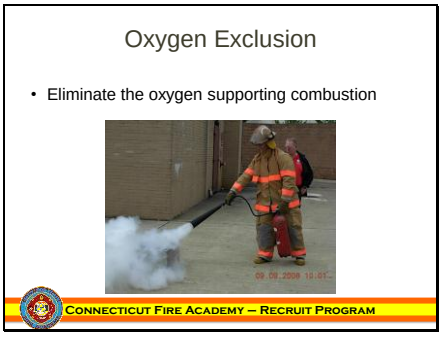
•Typically the best means for flammable gas fires

Slide 93



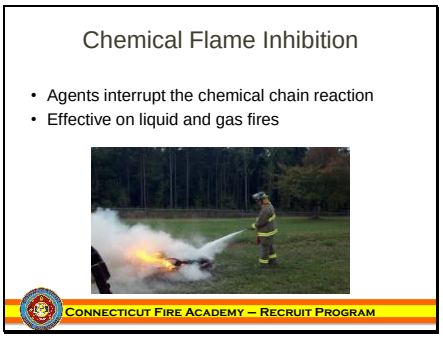
•Typical for combustible liquid fires

Slide 94



•Must be applied until the fuel is shut off or it has cooled enough to prevent re-ignition

Slide 95



•Fires typically won't flare back up after dry-chem is applied

Slide 96