Fire Behavior

Module 2

Chapter 5

ALABAMA FIRE COLLEGE

IFSTA
INTERNATIONAL FIRE SERVICE TRAINING ASSOCIATION

LEARNING OBJECTIVES

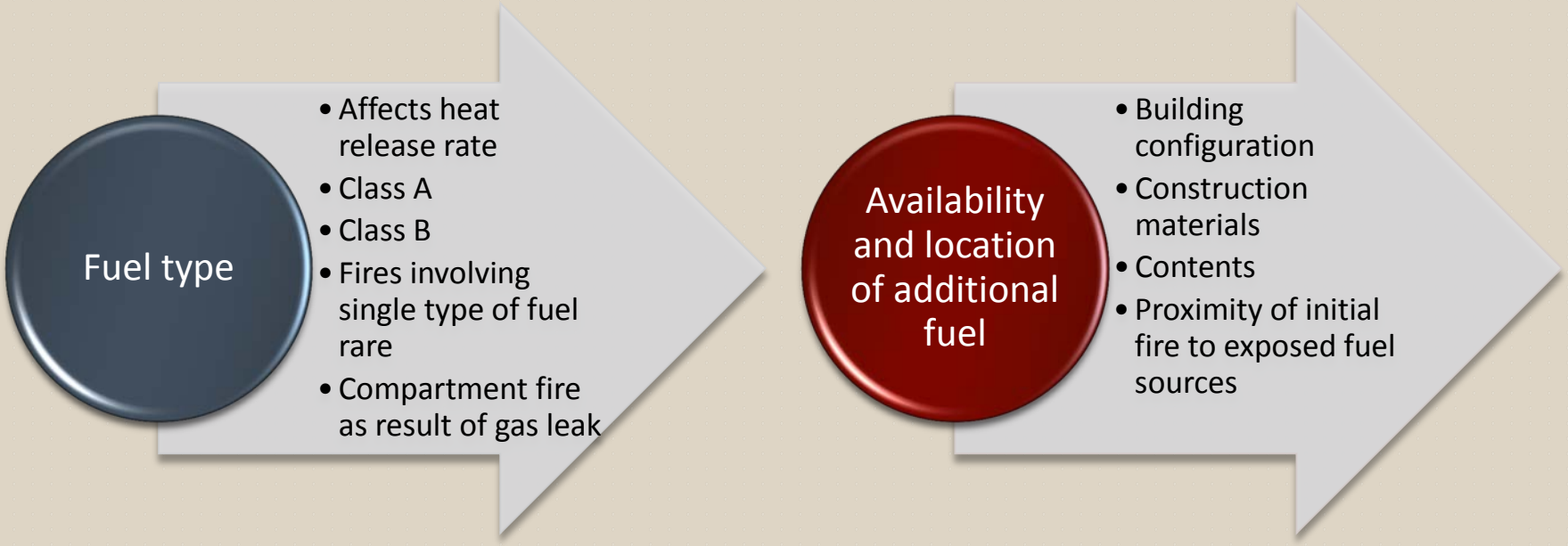
Explain the factors that affect fire development.

Describe the stages of fire development.

Recognize signs, causes, and effects of rapid fire development.

Describe the methods through which fire fighting operations can influence fire behavior.

THERE ARE SEVERAL FACTORS THAT WILL AFFECT FIRE DEVELOPMENT.



THERE ARE SEVERAL FACTORS THAT WILL AFFECT FIRE DEVELOPMENT.

Compartment volume and ceiling height

- Large vs. small compartment
- High ceiling can make determining extent difficult

Ventilation

- All buildings exchange air from inside to outside
- Influences
- Can be increased or assisted
- Two forms of compartment fires
- Changes
- HRR decreases/increases

THERE ARE SEVERAL FACTORS THAT WILL AFFECT FIRE DEVELOPMENT.

Thermal properties of compartment

- Insulation
- Heat reflectivity
- Retention

Ambient conditions

- High humidity, cold temperatures
- Strong winds
- If window fails, door opens on windward side
- Wind direction, velocity
- Cold temperatures
- Atmospheric air pressure

THERE ARE SEVERAL FACTORS THAT WILL AFFECT FIRE DEVELOPMENT.

Fuel load

- On scene only estimate
- Knowledge of building construction, occupancy types essential

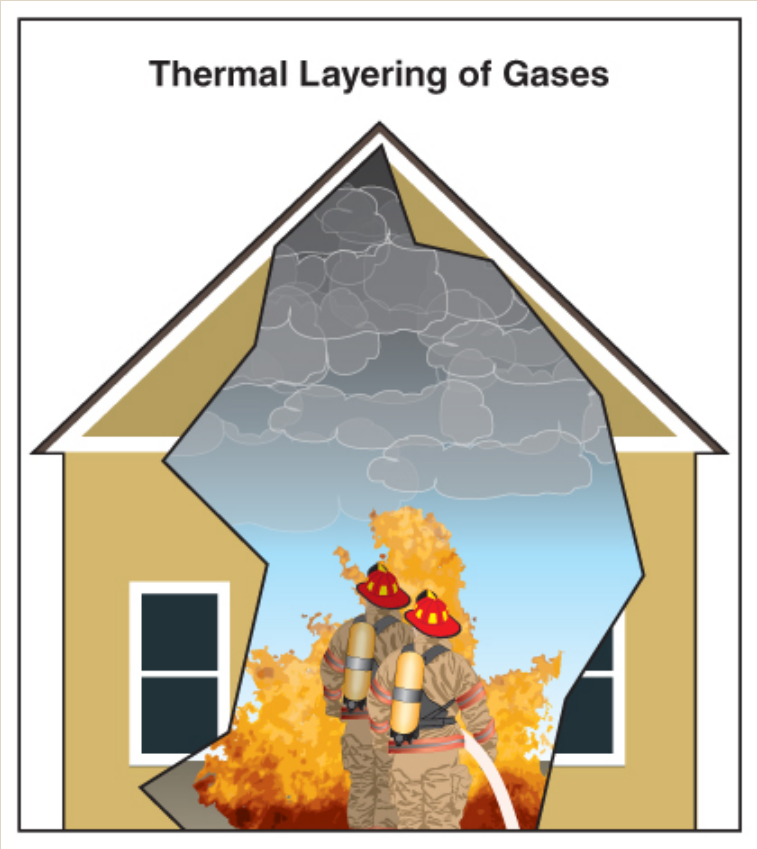
THE INCIPIENT STAGE STARTS WHEN THE ELEMENTS OF THE FIRE TRIANGLE COME TOGETHER AND COMBUSTION BEGINS.

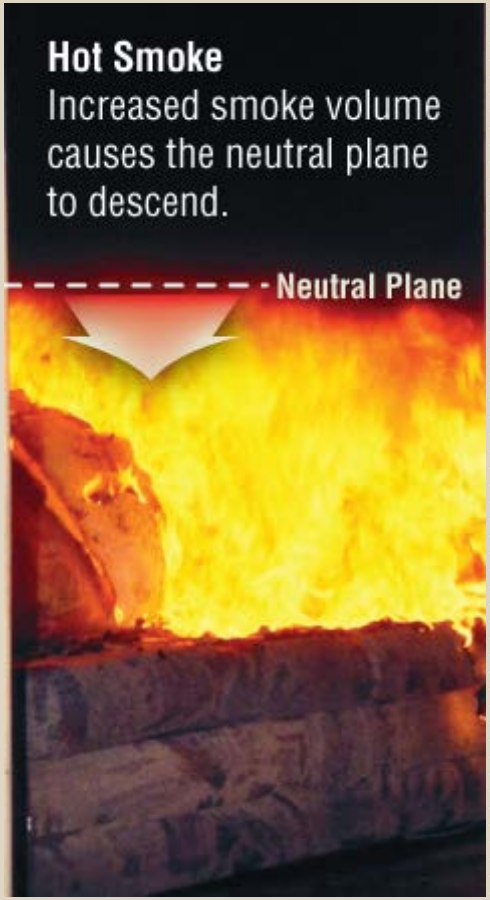
Courtesy of Dan Madrzykowski, NIST

THE GROWTH STAGE OCCURS AS THE FIRE TRANSITIONS AND IS INFLUENCED BY AIR IN THE COMPARTMENT.

Courtesy of Dan Madrzykowski, NIST

THERMAL LAYERING CAN ALSO OCCUR DURING THE GROWTH STAGE.





ISOLATED FLAMES AND RAPID TRANSITIONS MAY ALSO BE A PART OF THE GROWTH STAGE.

Courtesy of Dan Madrzykowski, NIST

THE FULLY DEVELOPED STAGE OCCURS WHEN ALL COMBUSTIBLE MATERIALS ARE BURNING.

Courtesy of Dan Madrzykowski, NIST

THE DECAY STAGE BRINGS COMBUSTION TO A COMPLETE STOP THROUGH TWO MEANS.

Courtesy of Dan Madrzykowski, NIST

RAPID FIRE DEVELOPMENT IS RESPONSIBLE FOR NUMEROUS DEATHS AND INJURIES.

Protect yourself and your crew

- Recognize indicators
- Know conditions created by
- Determine best action to take before

FLASHOVER OCCURS WHEN COMBUSTIBLE MATERIALS IN A COMPARTMENT IGNITE ALMOST SIMULTANEOUSLY.

Typically occurs during growth stage – May occur during fully developed stage

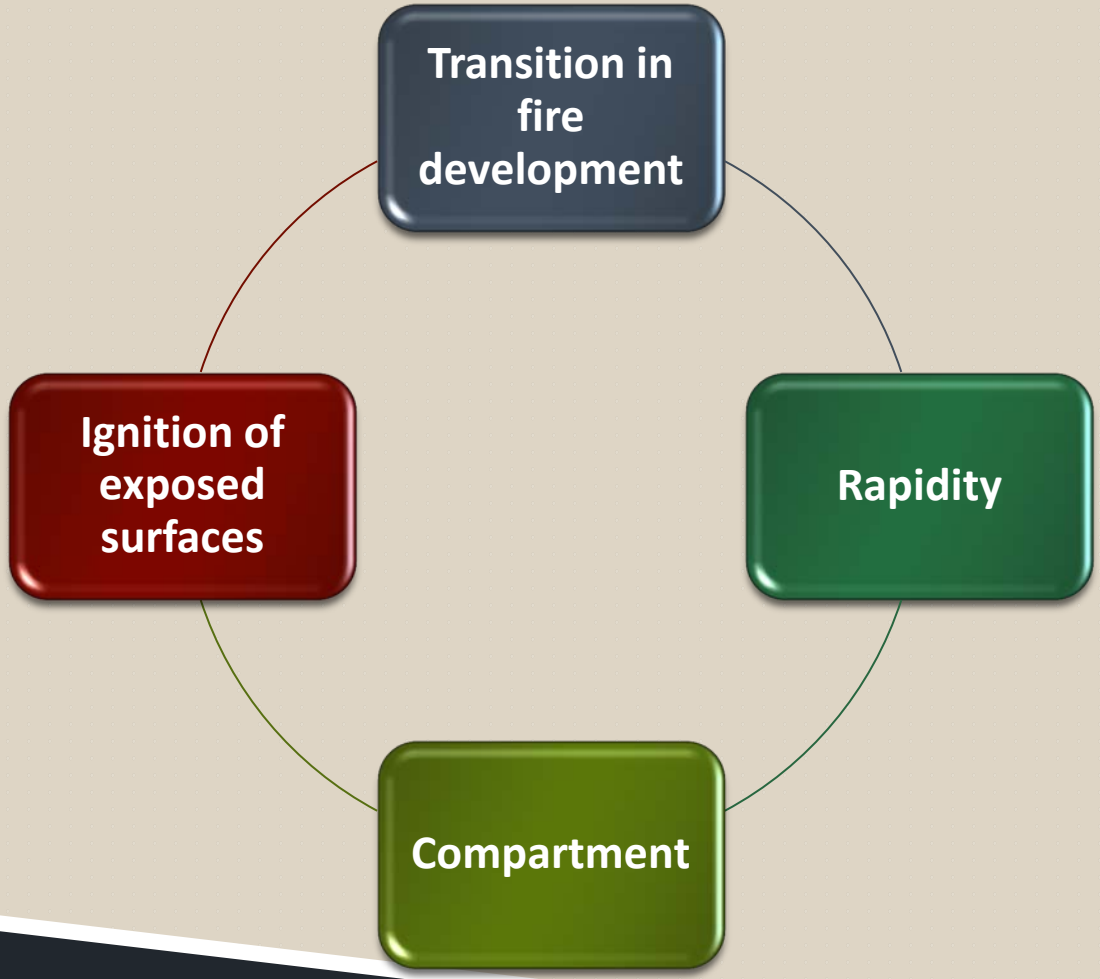
Environment of room changes from two-layer condition to single well mixed, untenable hot gas condition

Transition between pre-flashover to post-flashover can occur rapidly

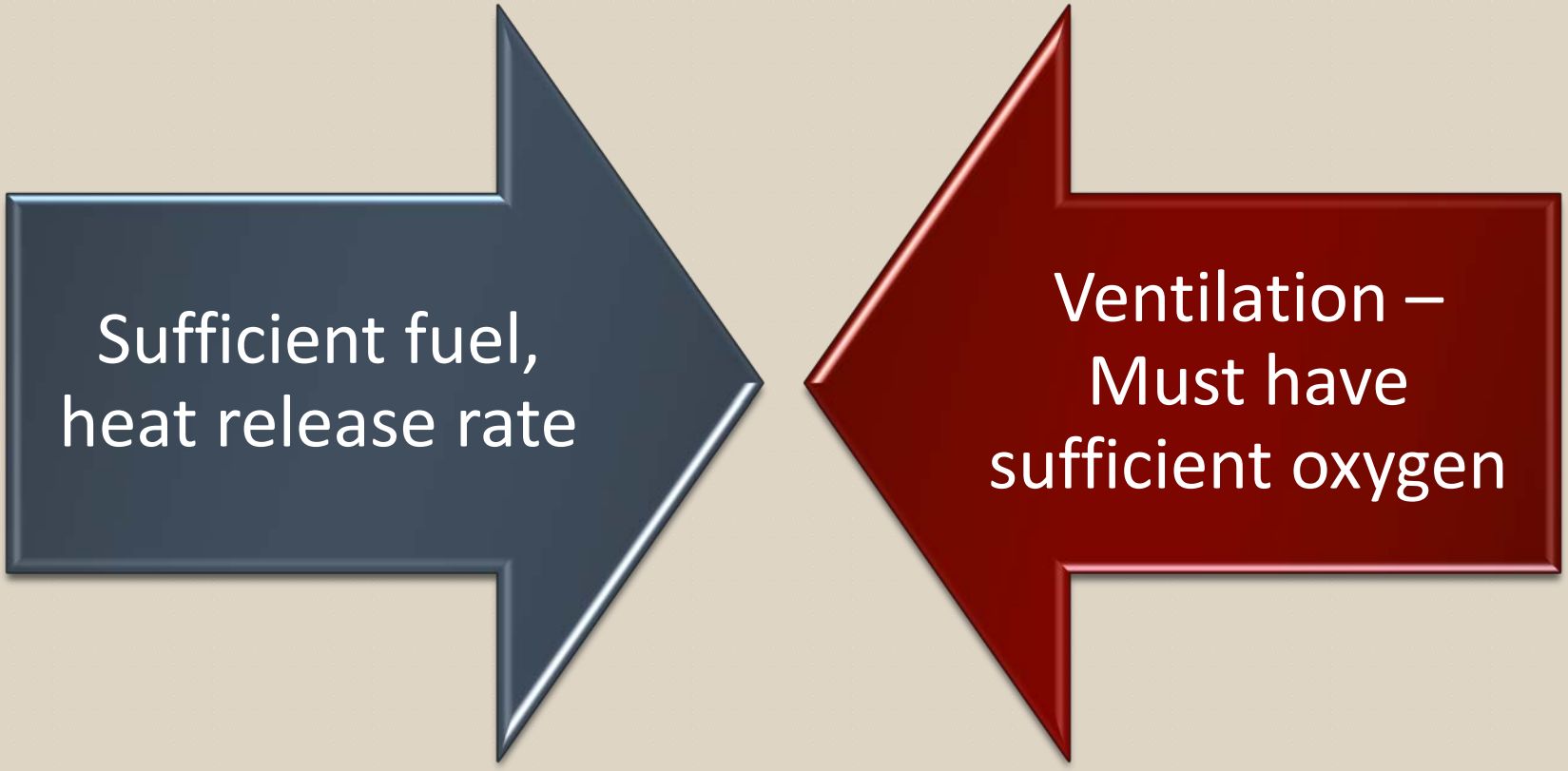
Conditions during

- Volume of fire can increase to fill entire room
- Burning gases push out of openings

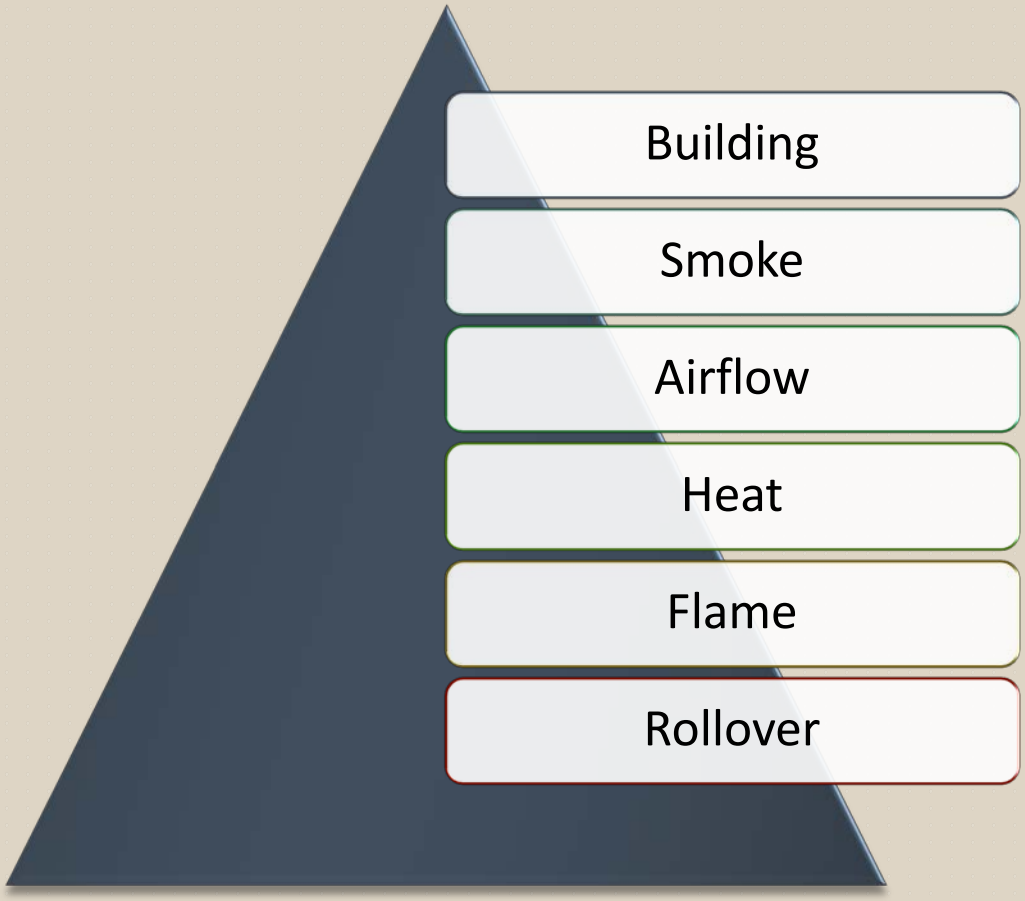
THERE ARE SEVERAL COMMON ELEMENTS IN FLASHOVER TO BE AWARE OF.



PROGRESSION TO A FLASHOVER IS DETERMINED BY TWO FACTORS.



FIREFIGHTERS SHOULD BE AWARE OF SEVERAL FLASHOVER INDICATORS.



BACKDRAFT IS A CHANGE IN VENTILATION THAT RESULTS IN EXPLOSIVELY RAPID COMBUSTION OF FLAMMABLE GASES.

Courtesy of Bob Esposito

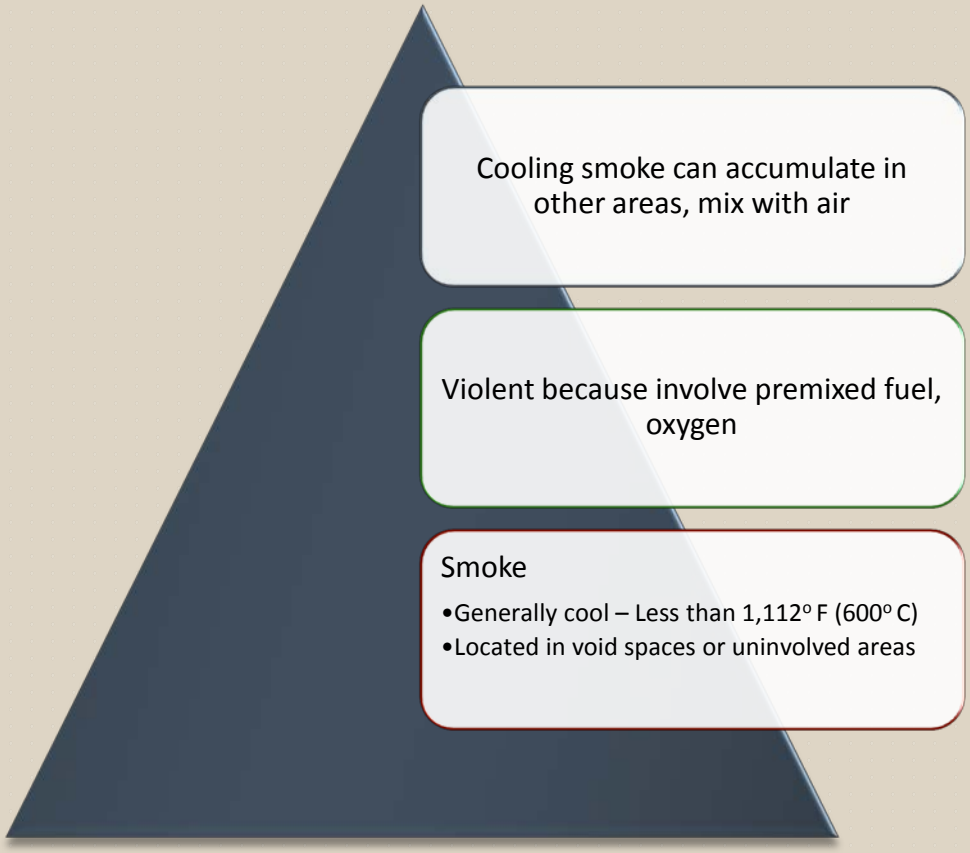
FIREFIGHTERS SHOULD KNOW ABOUT SEVERAL BACKDRAFT INDICATORS AS WELL.

- Building
- Smoke
- Airflow
- Heat
- Flame

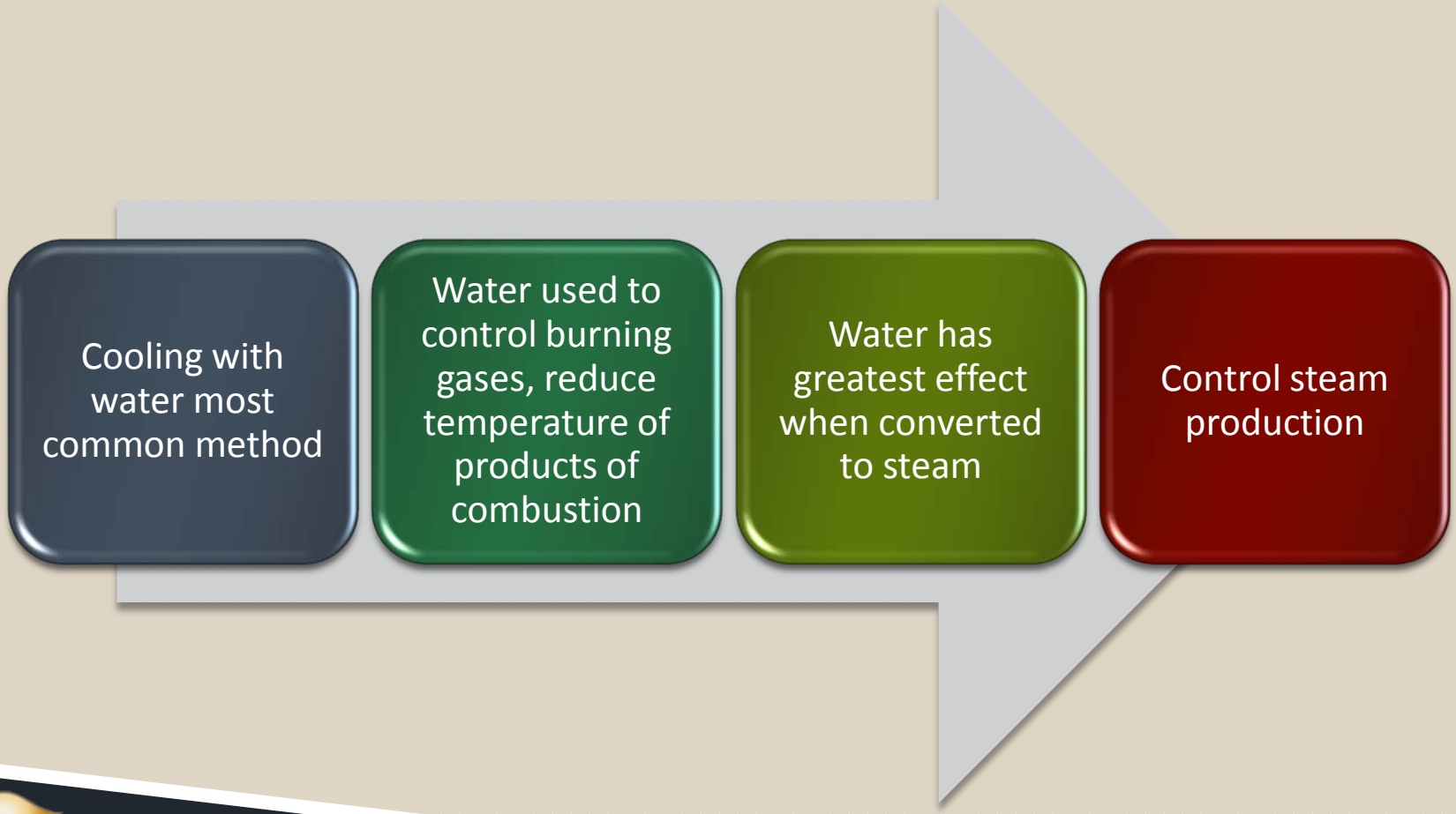
BACKDRAFT EFFECTS VARY DEPENDING ON SEVERAL FACTORS AND WILL NOT ALWAYS OCCUR IMMEDIATELY AFTER THE OPENING IS MADE.

Factors	Not always occur immediately	Violence depends on
• Volume of smoke • Degree of confinement • Pressure • Speed with which fuel and air are mixed • Location where ignition occurs	• If mix of hot flammable products, air is slow – Unlikely to occur • May not occur until air is fully introduced	• Extent of confinement • More confined – More violent

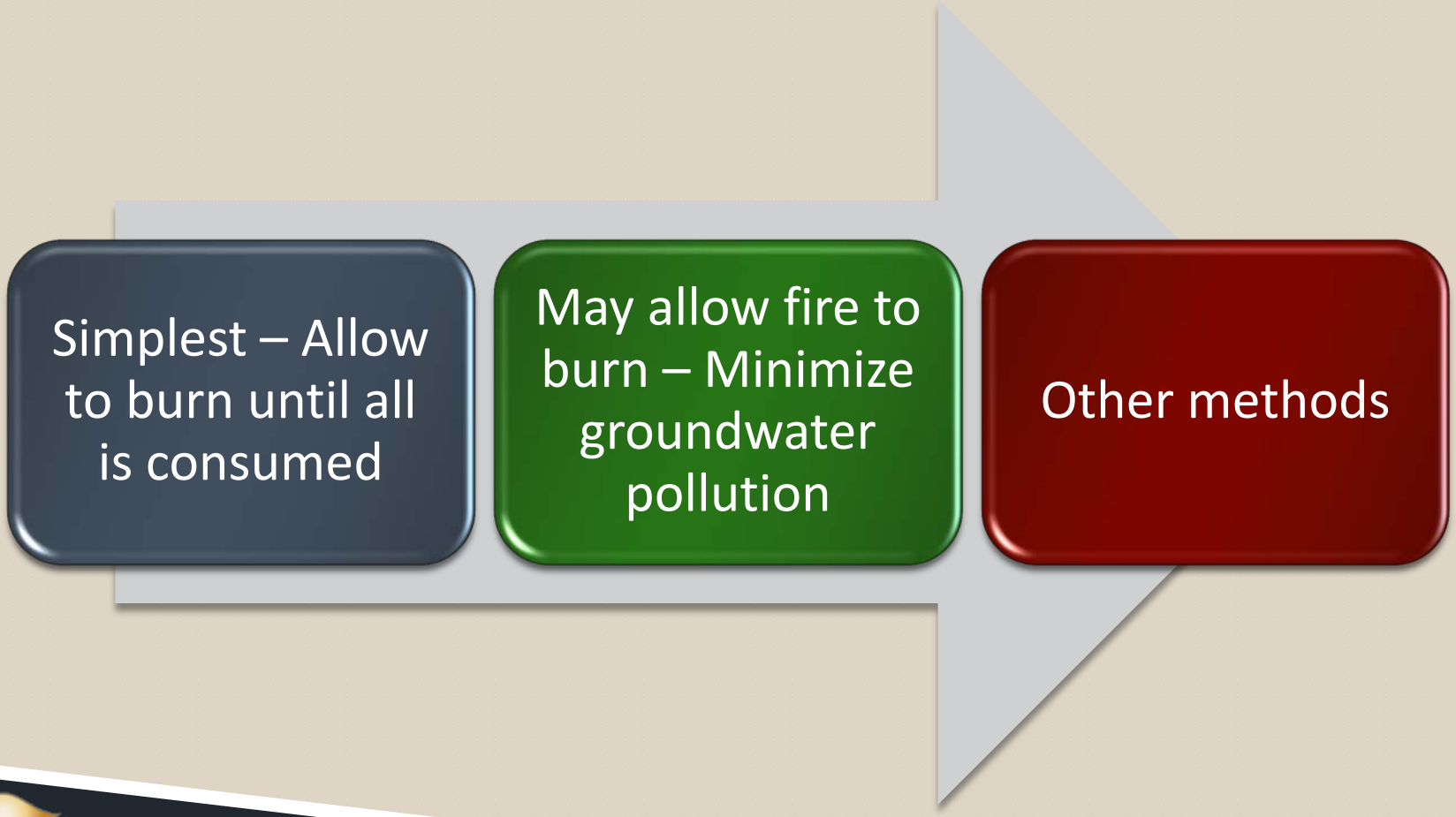
A SMOKE EXPLOSION MAY OCCUR BEFORE OR AFTER THE DECAY STAGE AS UNBURNED FUEL GASES CONTACT AN IGNITION SOURCE.



FIREFIGHTERS CAN INFLUENCE FIRE BEHAVIOR THROUGH TEMPERATURE REDUCTION.



FIREFIGHTERS CAN INFLUENCE FIRE BEHAVIOR THROUGH FUEL REMOVAL.

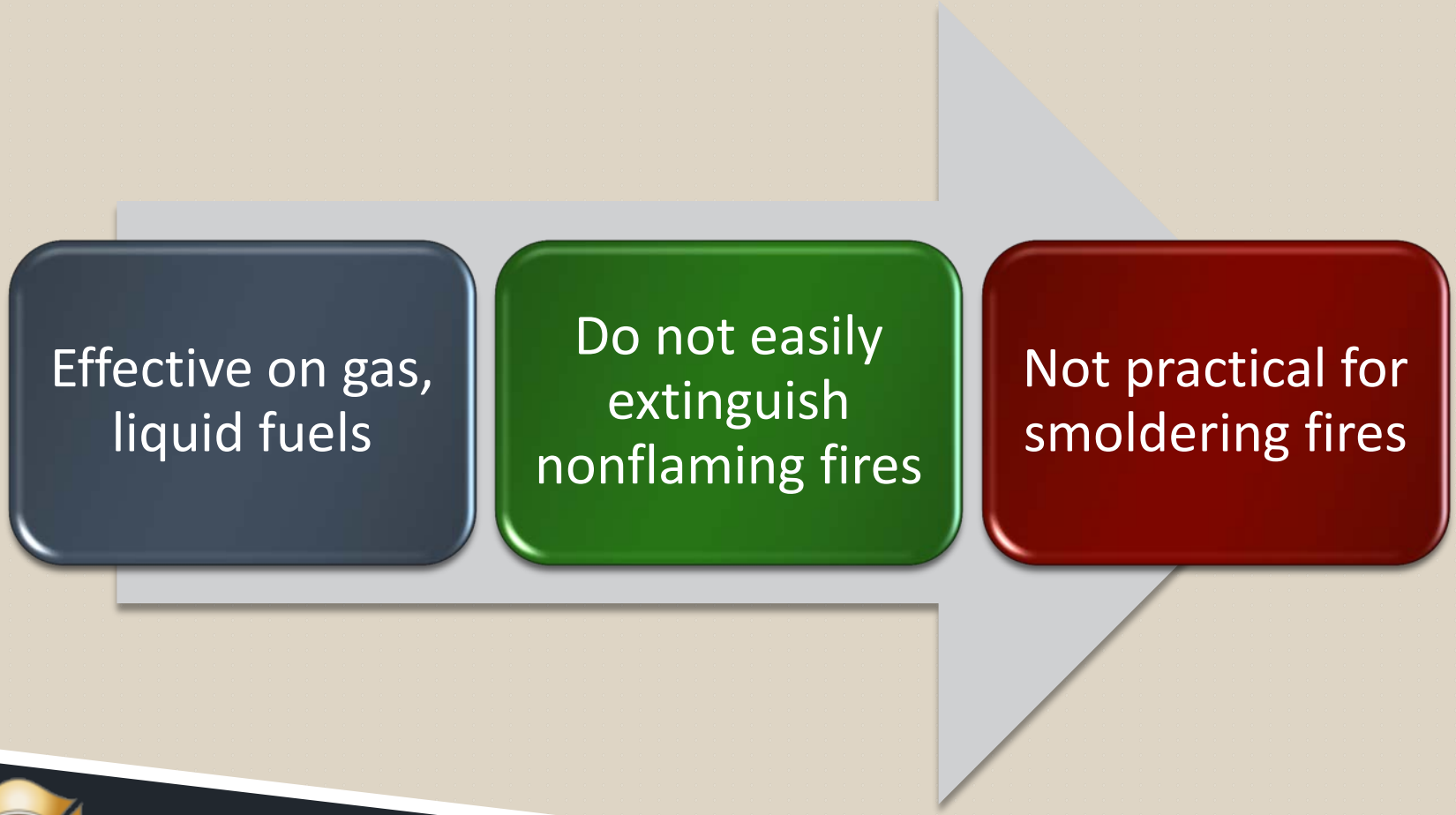


OXYGEN EXCLUSION REDUCES A FIRE'S GROWTH AND MAY EXTINGUISH IT OVER TIME.

Methods – Will not work if fuel is self-oxidizing

Closing doors can limit air supply, help prevent flashover

CHEMICAL FLAME INHIBITION USES AGENTS TO INTERRUPT THE COMBUSTION REACTION.



UNPLANNED VENTILATION MAY OCCUR BEFORE OR AFTER SUPPRESSION OPERATIONS START.

Can be result of wind outside structure

- Increase pressure inside structure
- Drive smoke, flames into unburned portions
- Upset tactical ventilation

WARNING

Wind-driven conditions can occur in any type of structure. Wind speeds as low as 10 mph (16 kph) can create wind-driven conditions.

UNPLANNED VENTILATION MAY OCCUR BEFORE OR AFTER SUPPRESSION OPERATIONS START.

May be result of

- Occupant action
- Fire effects on building
- Action outside of planned ventilation

TACTICAL VENTILATION IS PLANNED, SYSTEMATIC, AND COORDINATED.

Must be coordinated with suppression operations

Influence behavior based on

- HHR increased when ventilation increased
- Can be simple or complex

Increase in combustion rate when controlled

WARNING

Even coordinated tactical ventilation increases the combustion rate in ventilation controlled fires.

SUMMARY

Understanding fire behavior can help you recognize developing fire conditions and respond safely to mitigate hazards present in the fire environment.