

FIRE



A chemical process in which a substance reacts with oxygen to give out heat is called Combustion.

# Types of Combustion

- **Slow combustion**
- **Spontaneous combustion**
- **Rapid combustion**
- **Flashing and explosion**

Increasing severity

Rapid combustion



Spontaneous combustion



Explosion



**There are several different types of explosions that can happen;**

**Natural Explosions:** These are explosions that occur in nature such as volcanic eruptions, and explosions during forest fires from igniting of oils in the tree tops.



**Chemical Explosions:** These are the most common types of explosions that occur, mostly in areas that use it during the job operation such as ammunition testing areas. This type includes such explosions like Gunpower, TNT, and dynamite.



**There are several different types of explosions that can happen;**

**Nuclear Explosions:** These are explosions derived from the fission or fusion in a nuclear reaction, even the smallest nuclear weapon is powerful enough to destroy an entire city, making them a deadly hazard.



**Electrical Explosions:** excessive magnetic pressure within an ultra-strong electromagnet can cause a magnetic explosion. A lightning bolt is another form of electrical explosion.

**There are several different types of explosions that can happen;**

**Astronomical Explosions:** Even though being the biggest type of explosion are also the least possible to occur in normal circumstances.



**Mechanical Explosions:** ,These are completely physical, mechanical explosions occur when a tightly sealed container under pressure encounters a break, at which point it releases its gases or liquids rapidly causing an explosion.

A FULL FUEL TANK?  
AN EMPTY FUEL TANK?  
WHICH ONE WOULD YOU PREFER?



*Which is more dangerous when exposed to flames, an empty fuel tank or a full fuel tank?*

# Flame colors in fuel fires



The full tank burns with black smoke and **red flame**.



As the tank is emptied, the smoke color changes to **brown** and the flame color changes to **yellow**.



As the tank gets less fuel, the more explosive gases increase, the smoke turns into a mixture of **yellow & purple** colors, and the flame turns to **blue**.



The **blue** color is the sign that the tank on fire is **about to explode**.

# The spreading of fire

## CONDUCTION

- Transfer of heat by means of solid objects

## CONVECTION

- Transfer of heat by air circulation

## RADIATION

- Beam transfer

### Conduction, Convection, and Radiation

#### Conduction

Energy is transferred by direct contact.



#### Convection

Energy is transferred by the mass motion of molecules.



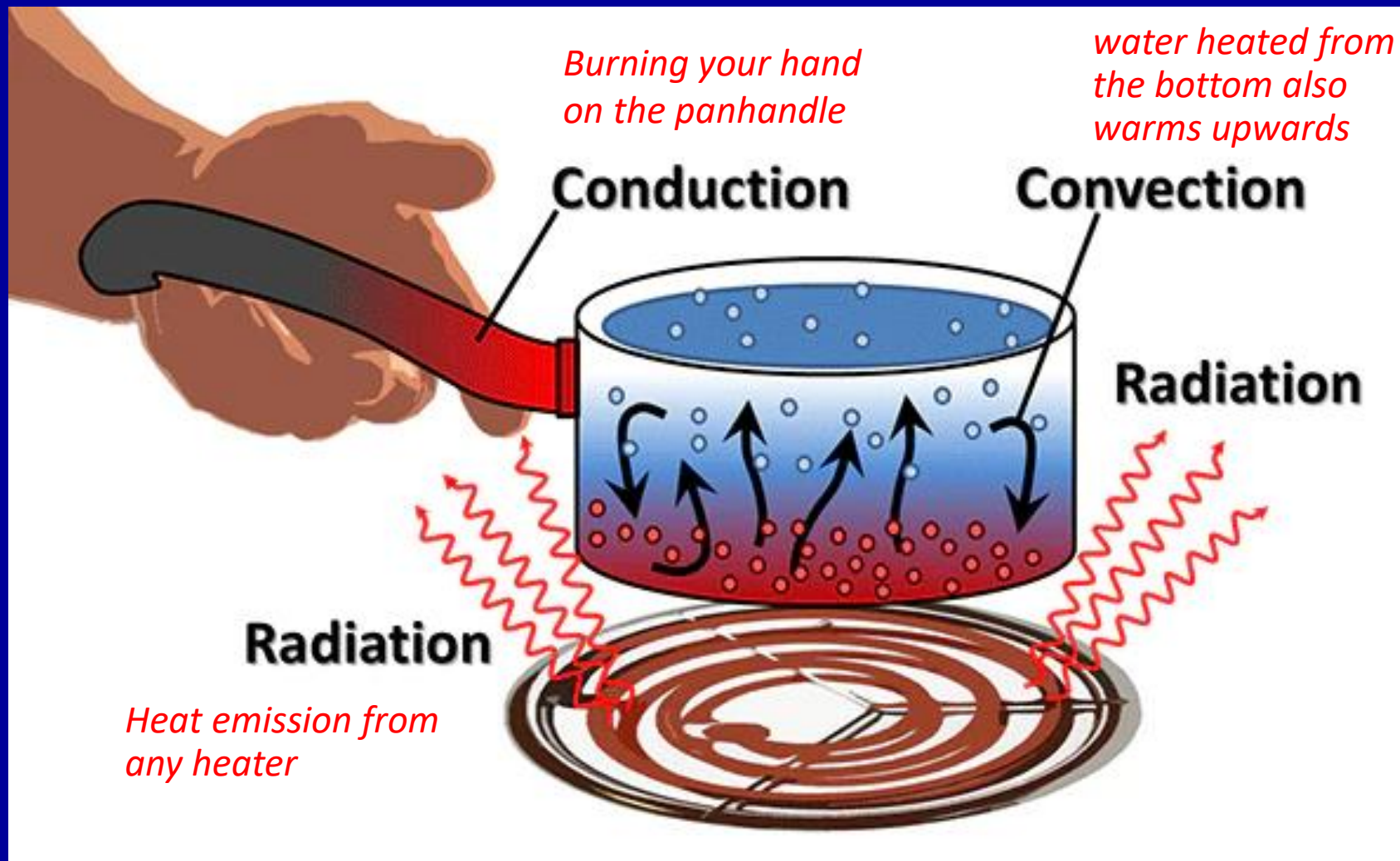
#### Radiation

Energy is transferred by electromagnetic radiation.



water heated from the bottom also warms upwards





*Burning your hand on the panhandle*

*water heated from the bottom also warms upwards*

**Conduction**

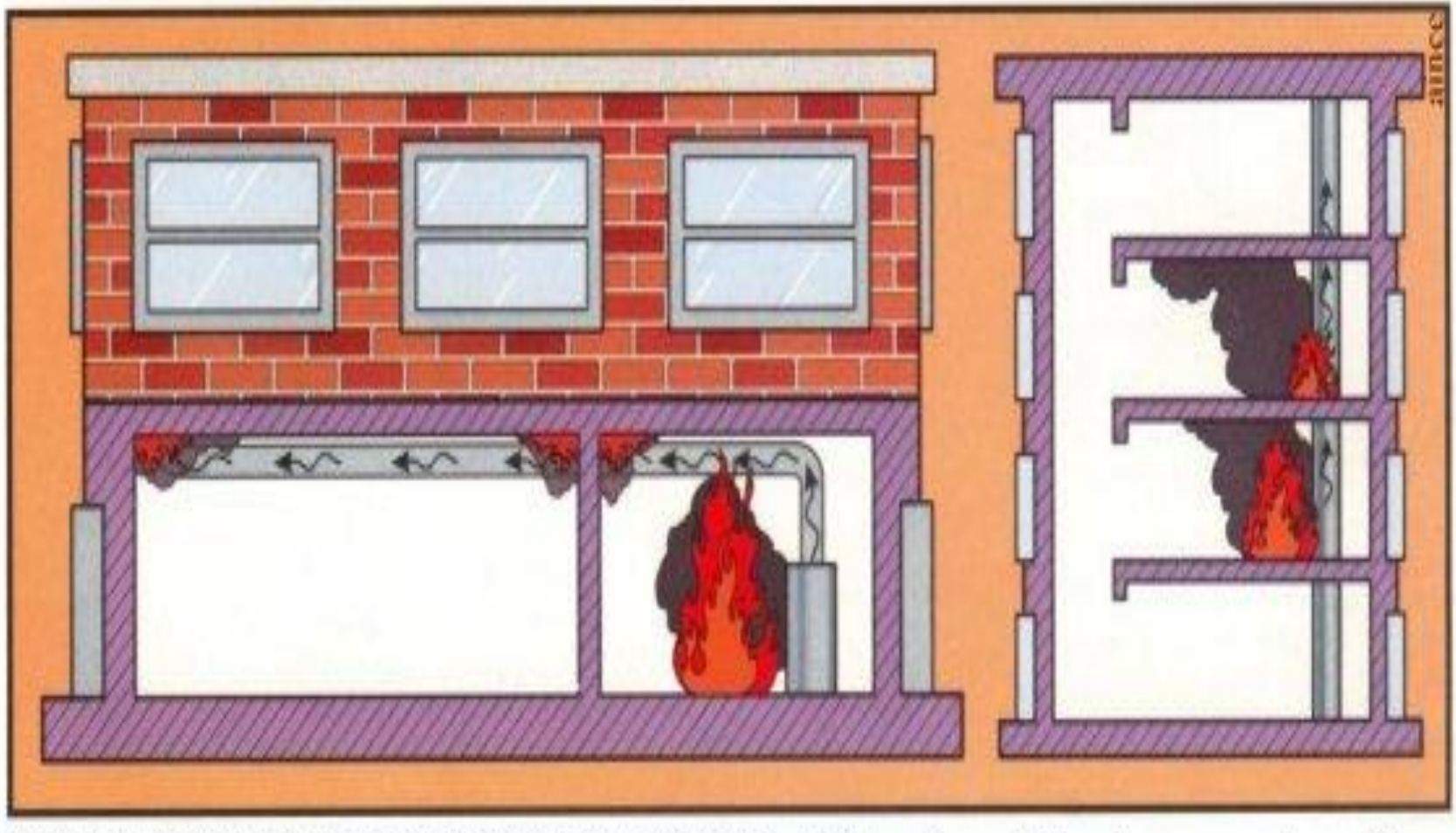
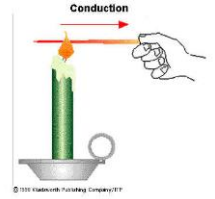
**Convection**

**Radiation**

**Radiation**

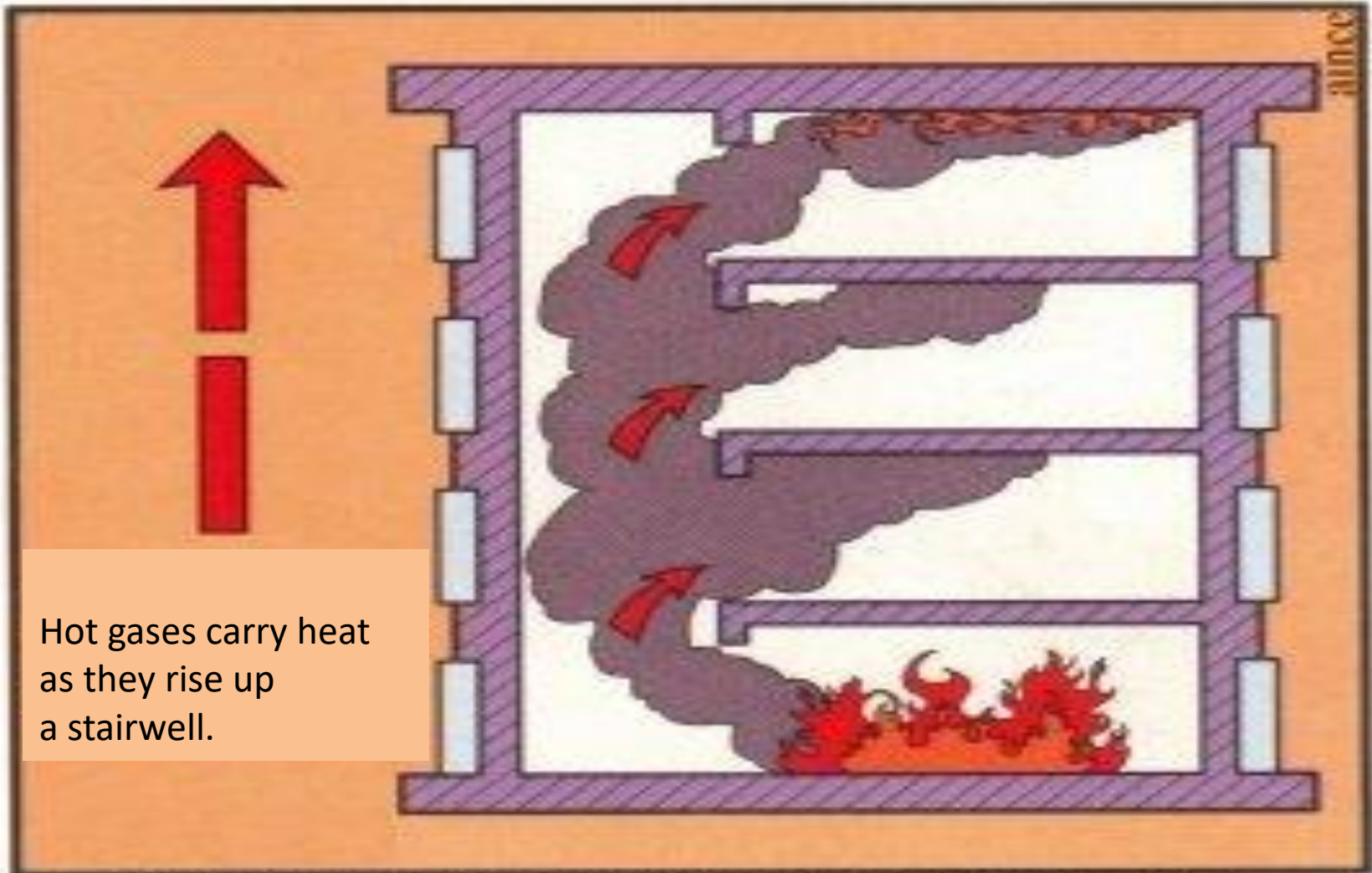
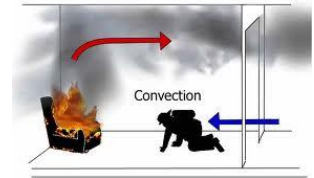
*Heat emission from any heater*

# Spreading of fire



**CONDUCTION**: Metal pipes, which are thermally conductive, transfer heat to long distances, raising the temperature of the flammable materials around them to the ignition point and causing them to burn.

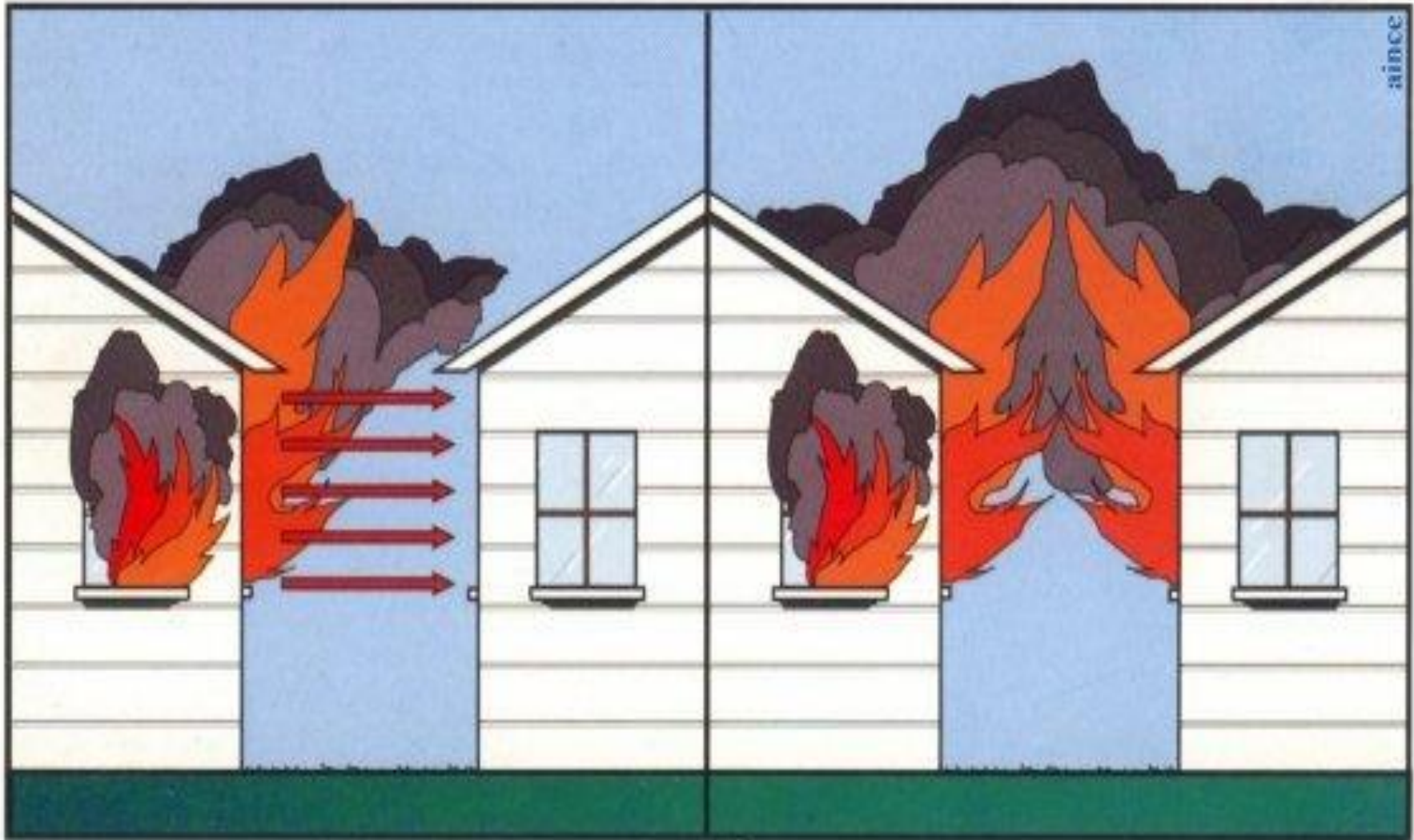
# Spreading of fire



Hot gases carry heat as they rise up a stairwell.

**CONVECTION**

# Spreading of fire



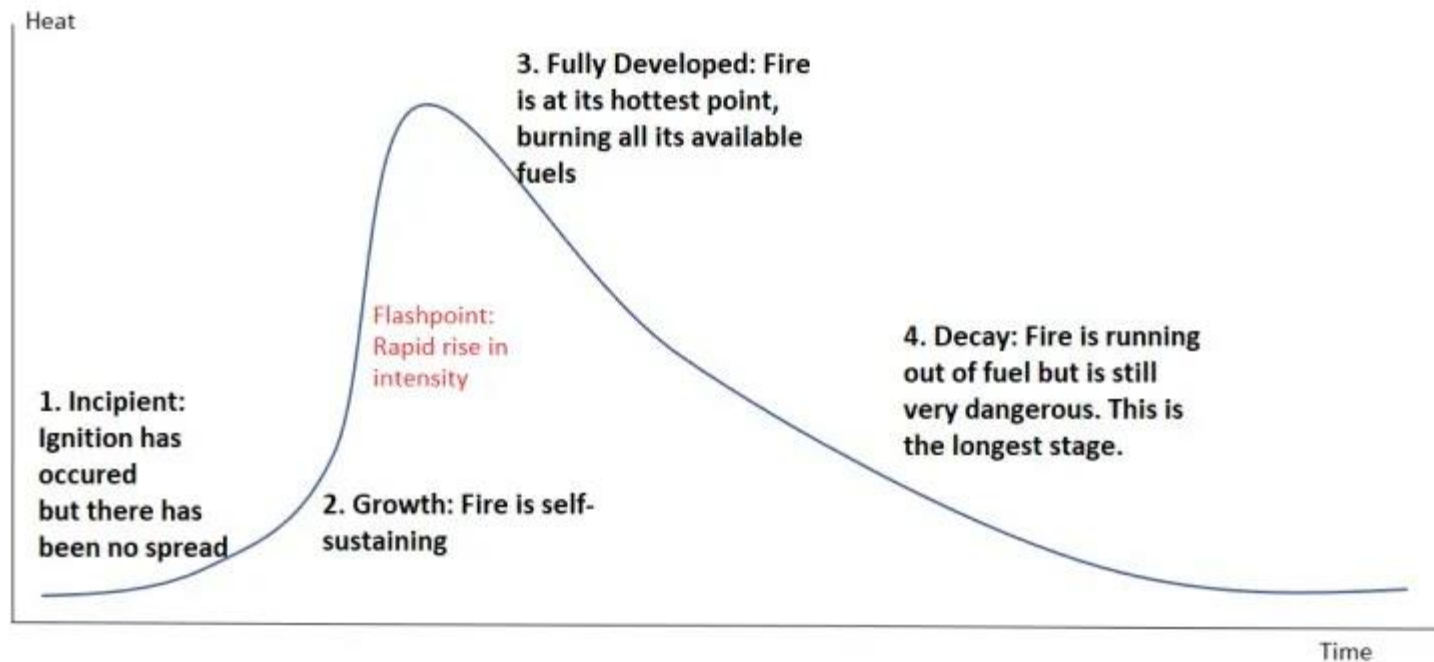
**RADIATION** :

**Electromagnetic Waves Traveling Through Space Until They Reach a Solid Object**



# FIRE STAGES

## The 4 Stages of a Fire



# INCIPIENT



A candle that has just tipped over and flames have just started to trickle onto a sofa.



A cigarette has dropped onto the couch.



A stove catches fire due to an electrical fault



A wild fire ember has drifted ahead of the fire front and landed in a backyard, lighting a few leaves where it landed.

## GROWTH

The growth stage occurs when the fire has established itself and is burning self-sufficiently. At this point, the fire is generating enough of its own heat to cause a positive heat feedback loop.



The growth stage occurs as the fire transitions and is influenced by air in the compartment.



The growth stage is the shortest stage of the fire, where the flames spread exponentially. It is incredibly dangerous and people need to be well and truly evacuated from the building.



## The 4 Stages of a Fire



The growth stage often ends when a ‘flashover’ occurs. A flashover is a moment in a fire’s life where it has generated so much heat (usually around 1150 degrees fahrenheit) that the fuels in the fire’s vicinity catch fire spontaneously.

During a flashover, you will often see a ‘flash’ where the fire spreads extraordinarily quickly, engulfing an entire room almost instantly.

The flashover is incredibly dangerous and can trap and burn people and firefighters in the home.



*A flashover is the near-simultaneous ignition of most of the directly exposed combustible material in an enclosed area.*

# FLASHOVER

2-18



PRE-FLASHOVER CONDITION

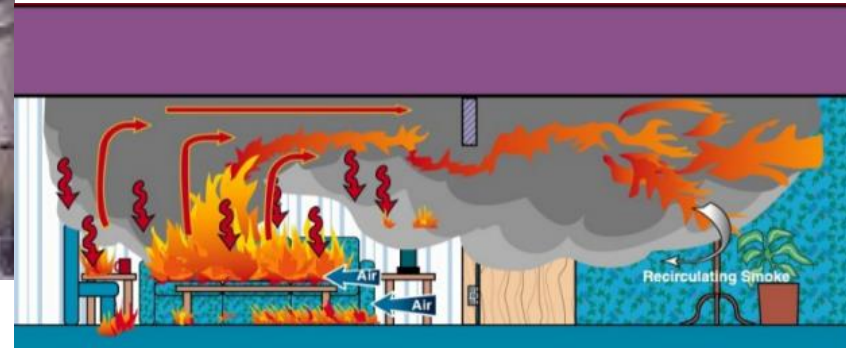


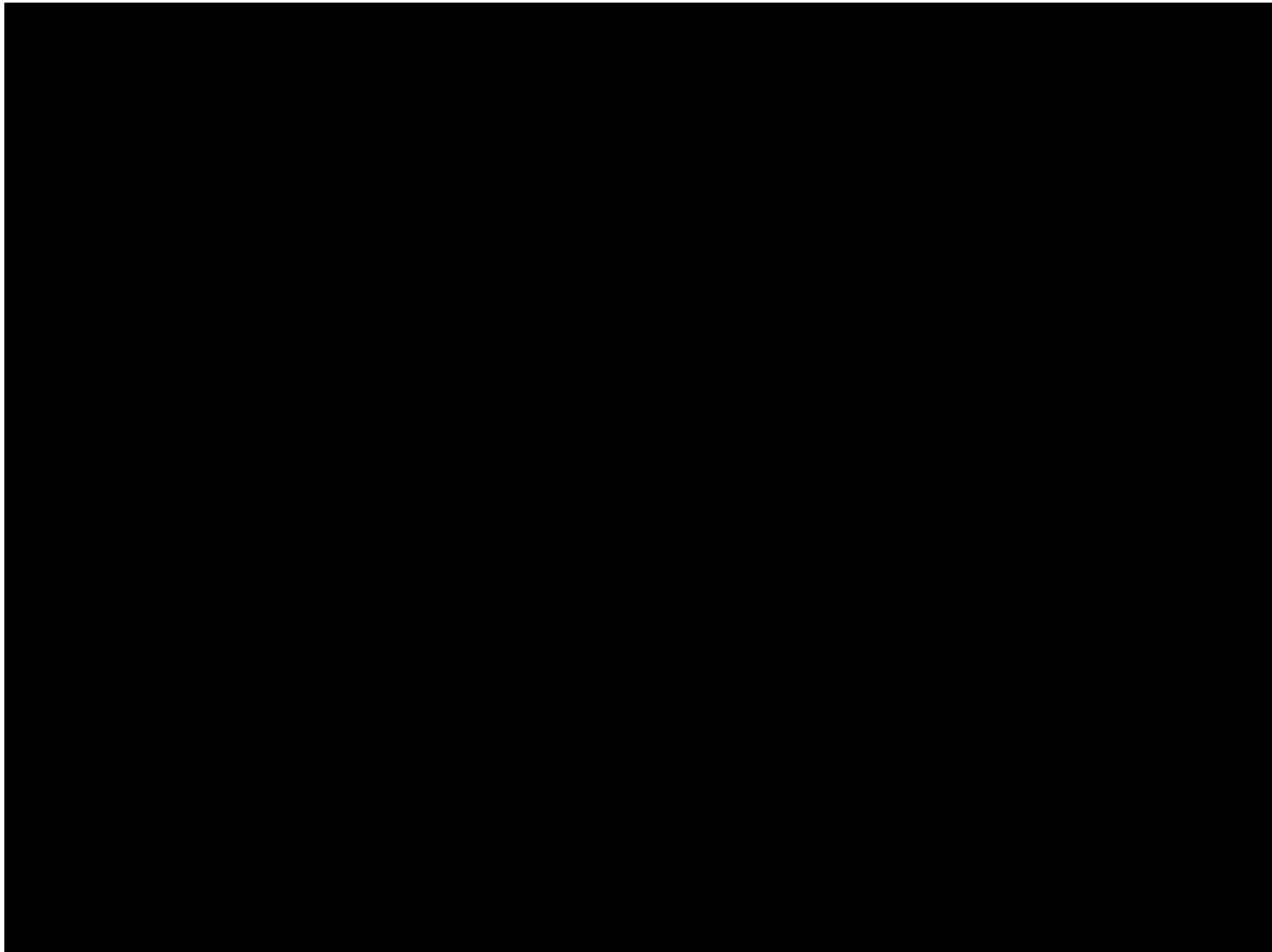
FLASHOVER

# FULLY DEVELOPED

A fire is considered fully developed when it is at its hottest point and is engulfing all of its available fuel sources.

## The 4 Stages of a Fire

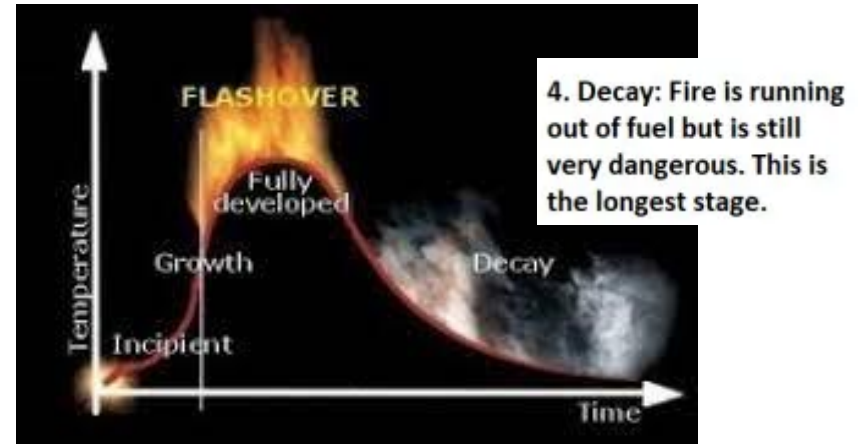




# DECAY

A fire will enter its decay stage when the fire runs out of oxygen or fuel for it to sustain itself. This is the longest stage and can take weeks for larger fires such as wild fires.

Another danger of the decay stage is the potential for new oxygen or fuels to be introduced to the fire. A sudden wind updraft or a falling tree branch may cause the fire to reignite.



After a fire has finished, care must be taken to ensure the fire does not reignite.

## DECAY

- Fire has run out of fuel *or* oxygen
- In a sealed environment
  - When oxygen is below 15%, combustion is slowed
  - Pyrolysis continues to occur
  - Room is superheated and charged with smoke and combustible gases
  - If oxygen is introduced, backdraft can occur



**BACKDRAFT ?**

*occurs because oxygen is not enough*

# BACKDRAFT

2-22b

- Low oxygen
- High heat
- Smoldering fire
- High fuel vapor concentrations



PRE-BACKDRAFT

- Introduction of oxygen causes fire of explosive force



BACKDRAFT

- Combustible fire gases are prevalent in atmosphere
- Gases are at or above their ignition temperature
- Oxygen content is too low for ignition (too rich to burn)
- Oxygen is introduced
- Gases ignite with explosive force

**A backdraft** is a rapid or explosive burning of superheated gasses in a fire, caused when oxygen rapidly enters an oxygen-depleted environment.

For example, when a window or door to an enclosed space is opened or broken.

Backdrafts present a serious threat to firefighters.

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