



UNIVERSITY OF  
**MARYLAND**  
Department of Fire Protection Engineering



# Flames

A. JAMES CLARK SCHOOL of ENGINEERING • UNIVERSITY of MARYLAND

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## What is Fire?



- Fire is a **chemical chain reaction** of a **fuel** and **oxidizer** releasing **heat**

Solid Fuels: Wood, Plastic  
Liquid Fuels: Gasoline  
Gaseous Fuels: Hydrogen, Natural Gas (Methane)

12

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## A flame seems *SIMPLE*, why study it?



- Several processes involved:
  - Chemical Kinetics
  - Fluid Dynamics
  - Heat Transfer
  - Thermodynamics



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**Buoyancy in the Candle Flame**

The diagram shows a candle flame with three red arrows pointing upwards from the flame, labeled "HOT PRODUCT GASES RISE". Two blue arrows point downwards from the base of the flame, labeled "COOLER AIR SINK".

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14

**Buoyancy in the Candle Flame**

The image shows a candle flame in two states: on the left, a normal flame in air; on the right, a blue, spherical flame in a microgravity environment. The NASA logo and "C-38-488" are visible in the top left corner.

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National Aeronautics and Space Administration  
Lunar Research Center
15

**Lets look "inside" a flame!**

• What is inside?  
– Fire? Air? Fuel? Nothing?

The image shows two photographs: on the left, a candle flame; on the right, a candle flame in a laboratory setting with various equipment.

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### The Interior of a Flame



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### "Cut the Flame"



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### Summary

- Ignition of fires need heat, fuel, air and chain reaction
- Suppression can be done by removing one of those four entities
- Flames behave according to physical and chemical mechanisms

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