

# **BASICS OF ROCKETRY AND PARACHUTE DEPLOYMENT**





# BASIC PRINCIPLES

01

## NEWTON'S FIRST LAW

At rest: forces are balanced. The force of gravity on the rocket balances with that of the launch pad.

In motion: thrust from the rocket unbalances the forces as a result it travels upward.

02

## NEWTON'S SECOND LAW

Force equals mass times acceleration: The pressure created inside the rocket acts across the area of the rocket exhaust it produces force. Here mass represents the total mass of rocket including its fuel

03

## NEWTON'S THIRD LAW

Action and reaction: a rocket takes off only when it expels gas

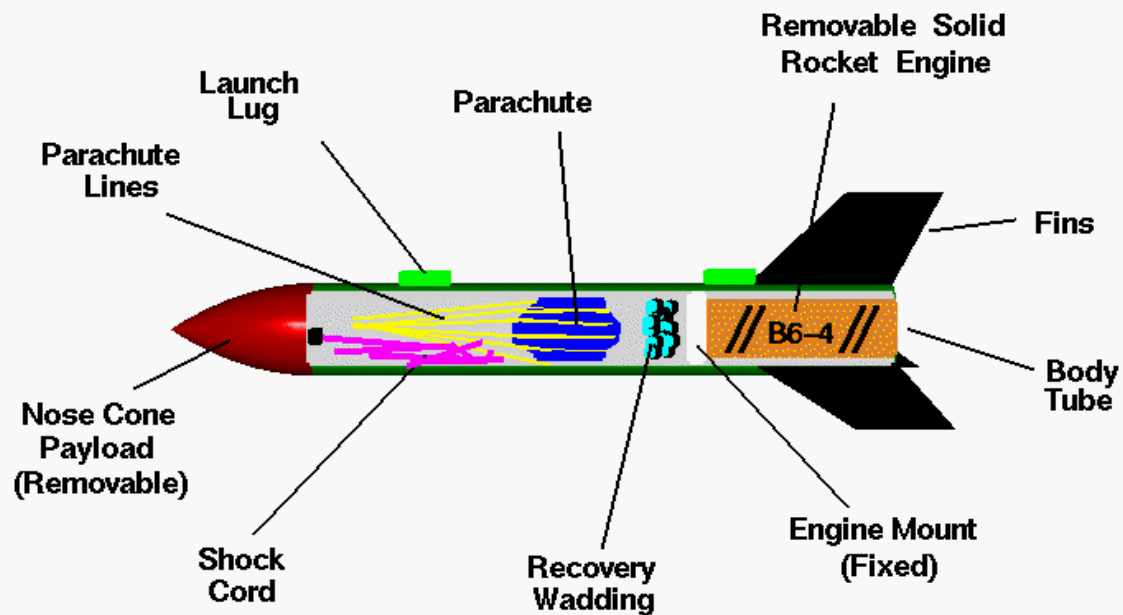
Action: the rocket pushes the gas out of the engine.

Reaction: the gas pushes off the rocket

# PARTS OF ROCKET



## *Model Rockets*

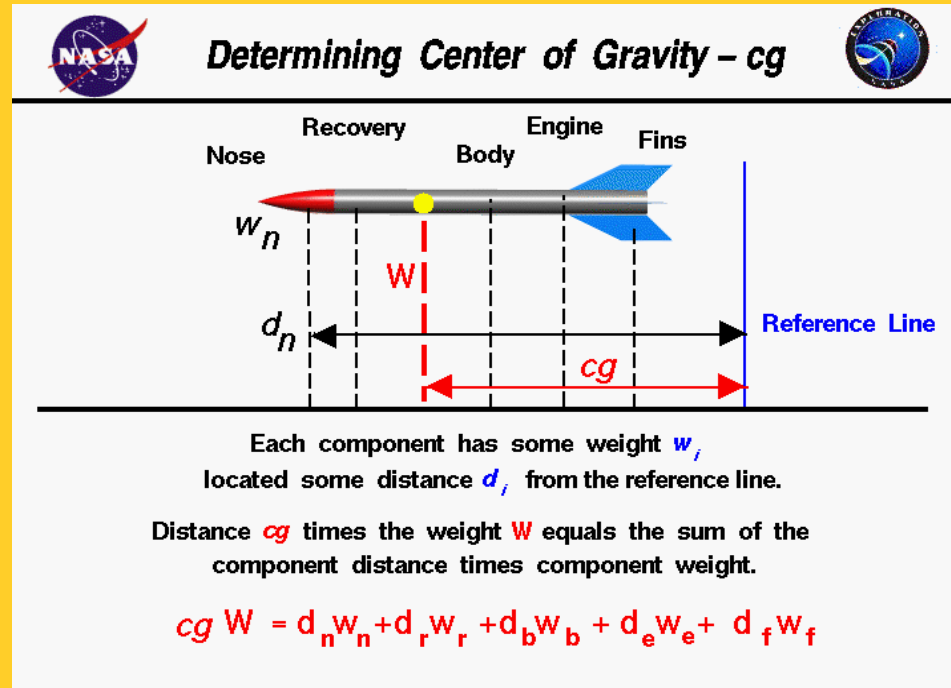


# BASIC TERMS RELATED TO ROCKETRY



## CENTER OF GRAVITY:

It is the point where the weight of all the rocket components seem to be concentrated.



# BASIC TERMS RELATED TO ROCKETRY

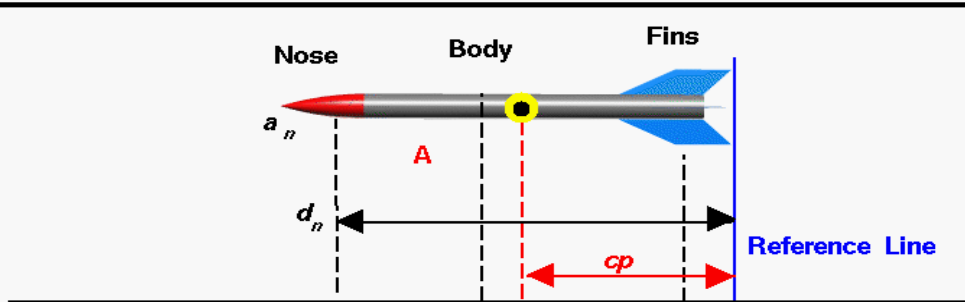


## CENTER OF PRESSURE:

It is the point where where the aerodynamic forces seem to be concentrated.



### *Determining Center of Pressure – $cp$ (simplified)*



Each component has some area  $a_i$   
located some distance  $d_i$  from reference line.

Distance  $cp$  times the area  $A$  equals the sum of the  
component distance times area.

$$cp \ A = d_n a_n + d_b a_b + d_f a_f$$

# BARROWMAN EQUATIONS



## Conical Transition Terms

$$(C_N)_T = 2 \left[ \left( \frac{d_R}{d} \right)^2 - \left( \frac{d_F}{d} \right)^2 \right]$$

$$X_T = X_P + \frac{L_T}{3} \left[ 1 + \frac{1 - \frac{d_F}{d_R}}{1 - \left( \frac{d_F}{d_R} \right)^2} \right]$$

## Fin Terms

$$(C_N)_F = \left[ 1 + \frac{R}{S+R} \right] \left[ \frac{4N \left( \frac{S}{d} \right)^2}{1 + \sqrt{1 + \left( \frac{2L_F}{C_R + C_T} \right)^2}} \right]$$

$$X_F = X_B + \frac{X_R}{3} \frac{(C_R + 2C_T)}{(C_R + C_T)} + \frac{1}{6} \left[ (C_R + C_T) - \frac{(C_R C_T)}{(C_R + C_T)} \right]$$

## Finding the Center of Pressure

Sum up coefficients:  $(C_N)_R = (C_N)_N + (C_N)_T + (C_N)_F$

Find CP Distance from Nose Tip:

$$\bar{X} = \frac{(C_N)_N X_N + (C_N)_T X_T + (C_N)_F X_F}{(C_N)_R}$$

# BASIC TERMS RELATED TO ROCKETRY



## DRAG:

Drag is defined as the aerodynamic resistance to motion of the rocket through air. Drag directly depends on the shape and size of rocket.



## *The Drag Equation*



$$D = C_d \frac{\rho V^2 A}{2}$$

Drag = coefficient x density x velocity squared x reference area  
two

Coefficient **C<sub>d</sub>** contains all the complex dependencies and is usually determined experimentally.

Choice of reference area **A** affects the value of **C<sub>d</sub>**.

# BASIC TERMS RELATED TO ROCKETRY



**LIFT:** Lift of a rocket is a side force used to stabilize and control the direction of flight.



## *The Lift Equation*



$$L = C_l \frac{\rho V^2}{2} A$$

Lift = coefficient x density x velocity squared x wing area  
two

Coefficient **C<sub>l</sub>** contains all the complex dependencies and is usually determined experimentally.

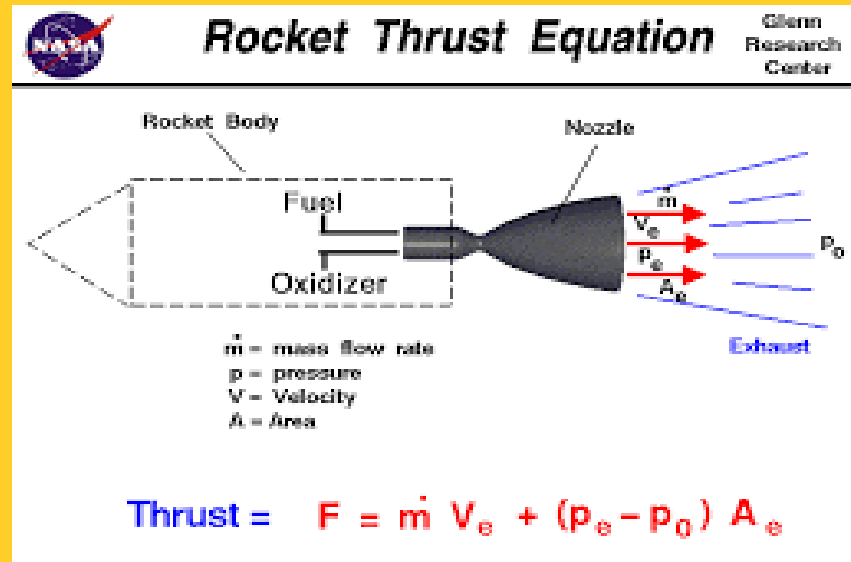


# BASIC TERMS RELATED TO ROCKETRY



## THRUST :

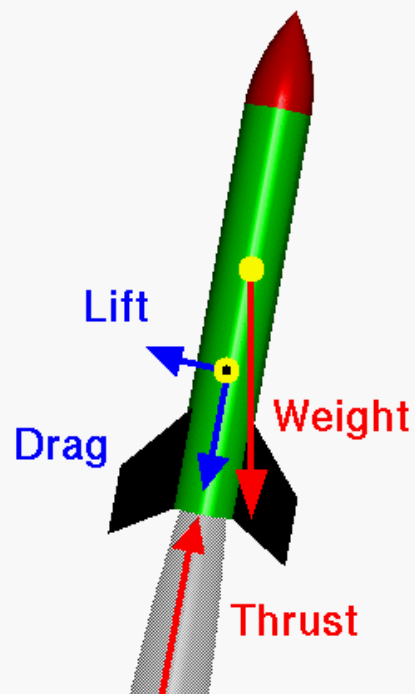
**Thrust** is the force which moves the rocket through the air, and through space. Thrust is generated by the propulsion system of the rocket through the application of Newton's third law of motion



# FORCES ACTING ON ROCKET



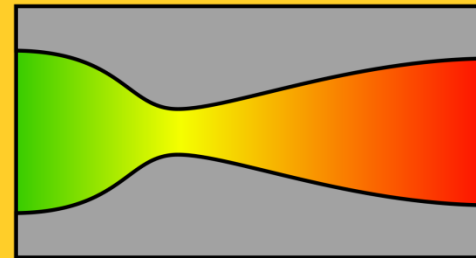
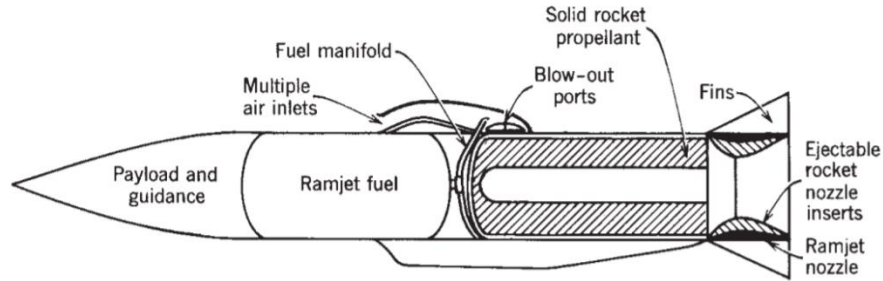
## *Forces on a Rocket*



# PROPULSION

Rocket **propulsion** is the process that uses force to move a rocket off the ground and into the atmosphere.

## 10 CLASSIFICATION



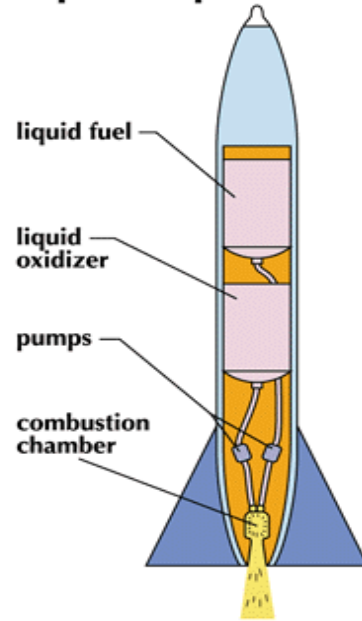
Flow →

# PROPULSION

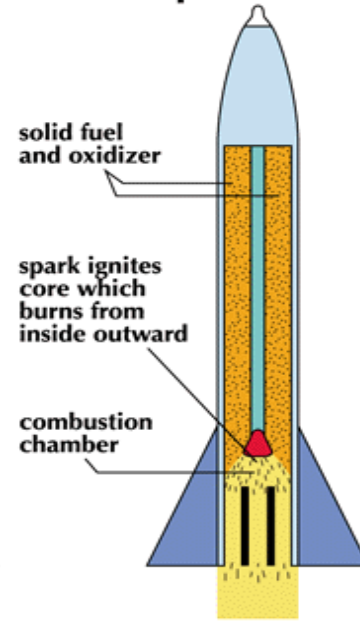


## TYPES OF PROPULSION

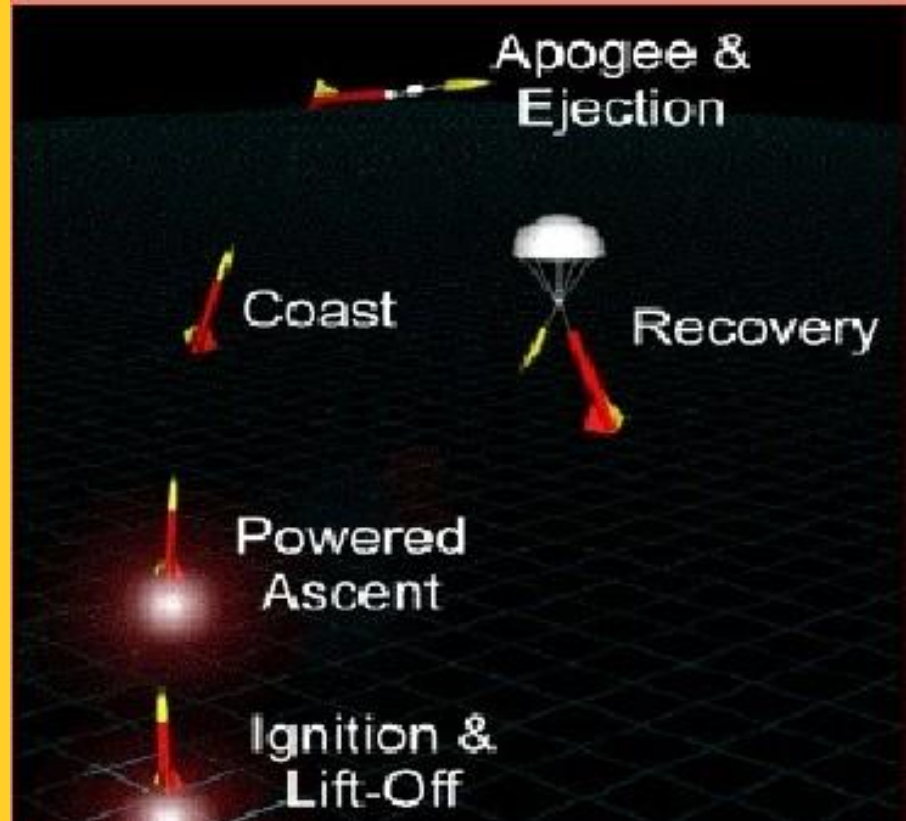
### Liquid Propellant



### Solid Propellant



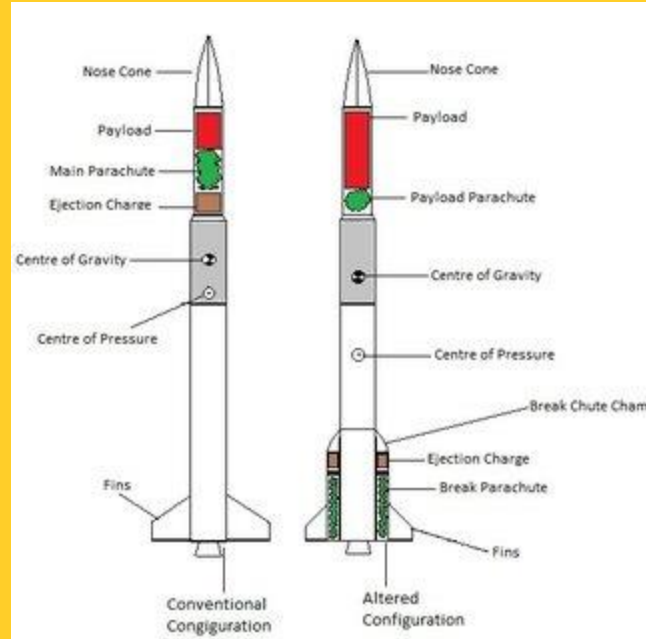
# STAGES OF ROCKET FLIGHT



# PARACHUTE DEPLOYMENT



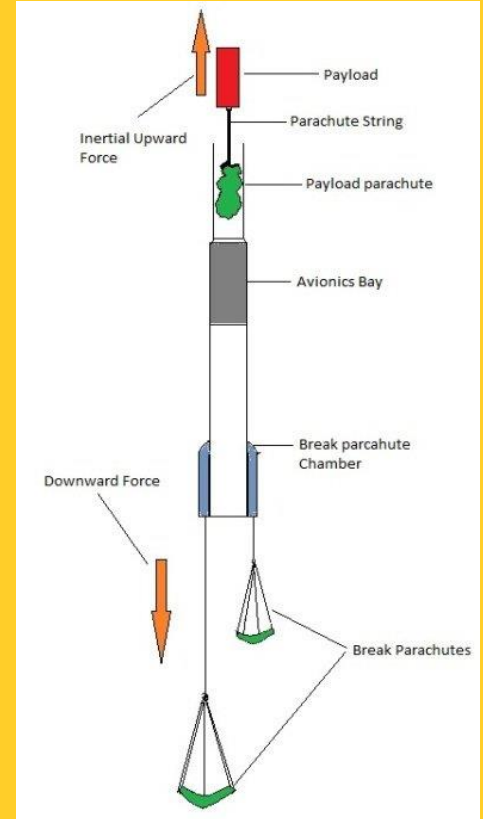
Parachutes have been conventionally used for recovery of rockets. Although it was done to recover flight data but now full rocket recovery is also possible. To recover the rocket it is important to deploy parachutes in a controlled manner.

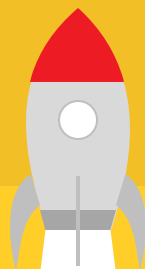


# PARACHUTE DEPLOYMENT

## OPERATING PRINCIPLE:

The new design and system uses inertial force for the deployment of payload parachute and relies on break parachutes for the recovery of the rocket body





**Thank you**