



WHITE EAGLE  
AEROSPACE



# Basic Rocket Science

MAKE YOUR CAREER SOAR



# Course Description

**The Basic Rocket Science (BRS) short course is intended for those seeking a solid technical familiarization and grounding in the discipline of sub-orbital rocket flight.**

This short course provides participants with a sound understanding of the various phases of rocket flight including launch, boost, coast, and recovery. Course members also become familiar with the kinematic performance characteristics of both single and multiple stage rocket-powered vehicles. The influences of atmospheric properties on vehicle performance is stressed as well.

The principles of solid rocket propulsion are presented and representative solid rocket motor characteristics reviewed. Flight simulation based on the round Earth equations of motion is a significant topic of instruction. Important aerodynamics data such as vehicle zero-lift drag characteristics and aerodynamic force and moment derivatives are discussed as well. The vital significance of accurate propulsion, aerodynamics, and mass properties data in the flight simulation process are highlighted in addition.

Course members also learn about the static and dynamic stability requirements for each stage of a rocket-powered vehicle. Aerodynamic heating effects are discussed from the standpoints of thermal design, evaluation, and survivability. Range safety dispersion footprints as required for flight clearance are an important topic of discussion as well.

## Key Course Topics

- Atmospheric Properties
- Solid Rocket Motor Propulsion
- Single Stage
- Multiple Stage
- Static Stability
- Dynamic Stability
- Aerodynamic Heating
- Mass Properties
- Stabilizing Fins
- Tangent Ogive
- Zero-Lift Drag Characteristics
- Aerodynamic Derivatives
- Launch Lugs
- Altimeters
- Trajectories
- Equations of Motion
- Atmospheric Models
- Parachutes
- Dispersion Footprints
- FAA Clearance
- Flight Simulation
- Range Safety
- Data Uncertainties
- Aero Prediction
- Onboard Video





# Course Outline

**Basic Rocket Science (BRS) is a top-level treatment of sub-orbital rocket-powered vehicle flight systems. The knowledge obtained is applicable to rocket flight at any scale including model rocketry, high-power rocketry, amateur rocketry, and commercial rocketry.**

## Basic Rocket Science Module Overview

Day	Module	Lecture Title	Key Topics
1	1	Rocket Flight Operations	Launch, Boost, Coast, and Recovery. Range facilities and flight support personnel. Altimeters. Record keeping. Photo and video support.
	2	The Earth's Atmosphere	Atmospheric pressure, density, temperature, and wind variations with altitude. Atmospheric models.
	3	Airframe Design	Single and multiple stage configurations. Static and dynamic stability considerations. Nose external shapes. Stabilizing fin geometries and sizing.
2	4	Trajectories	Round earth equations of motion. Rocket vehicle flight simulation. Single and multiple stage flight performance.
	5	Propulsion	Solid rocket motor operation Total impulse categories. Thrust-time curve data. Specific Impulse. Data uncertainties.
	6	Aerodynamics	Aerodynamic zero-lift drag characteristics. Aerodynamic force and moment derivatives. Data uncertainties.
3	7	Mass Properties	Stage weight, center-of-gravity, and moment of inertia characteristics. Data uncertainties.
	8	Aerodynamic Heating	Causes of aerodynamic heating. Vehicle stagnation point and acreage heating estimation. Maximum surface temperature and airframe thermal design.
	9	Dispersion Patterns	Impact/landing dispersion estimation. Range safety. Flight clearance and altitude limitations. Effects of winds, thrust misalignments, and vehicle imperfections.

