

StellarXplorers National Finals

During the National Finals, the academic quiz is taken closed book/notes and individually, by each competitor. The individual scores are then averaged together to calculate the team's final quiz score. Teams can earn up to 10 points based on their completion of the academic quiz. The quiz is 10 questions (multiple choice, true/false, and/or matching) and each correct answer is worth 1 point. All questions are based on topics covered in Nova Space's *StellarXplorers Space Foundations* course.

Rocket Science and Space Launch Foundational Module

Physics Primer

- Four Forces of Flight
- Bernoulli's Principle
- Functions of rocket systems
- Newton's Laws of Motion
- Momentum Equation
- Conservation of Linear Momentum
- Total Energy and the Conservation of Energy Principle
- Thermodynamics and fluid dynamics
- Ideal gas law
- Venturi Effect
- Specific Enthalpy
- Mass Flow Rate

Rocket Science

- Thrust
- Payload
- Orbiting
- Deceleration
- Acceleration
- Simply Put
- Conservation of Momentum
- Rocket Equation

Basic Rocket Design

- Combustion chamber
- Nozzle design and function
- Pressure
- Efficiency

Propulsion Systems

- Types of propulsion systems
- Propulsion basics
- Thermodynamic Rockets
- Electric Rockets

Launch Vehicles

- Launch Vehicle Subsystems
- Launch Vehicle Staging

Satellite Launch

- Vernal Equinox
- Solar Day
- Sidereal Day
- Orbital Plane
- Launch Windows
- Launch Equation
- Geographic Considerations

Space Systems Engineering Foundational Module

Systems Engineering Overview

- Integrated Systems
- Verification and Validation
- Close to Flawless Design
- Major Subprocesses
- V Diagram

Space Systems

- Payload
- Spacecraft Bus and Subsystems
- Spacecraft Design Process

Payloads

- Remote Sensing
- Communications
- Position, Navigation, Timing Payloads
- Science and exploration
- Defense Industry
- Futures

Subsystems

- Structure and mechanisms
- Spacecraft Design
- Launch Environment
- Mechanisms

Specific Subsystems

- Command and Data Handling Subsystems
- Electrical Power Subsystems
- Thermal Control Subsystems
- Attitude Determination and Control Subsystems
- Telemetry, Tracking & Control Subsystems
- Environmental Control and Life Support Subsystems
- Propulsion

Space Environment and EMR Theory Module

EMR Theory and Sources

- Introduction: EMR theory and sources
- Maxwell's Equations
- Characters of electromagnetic waves
- EM energy and propagation

Space Mission Areas and Capabilities Module

Remote Sensing

- Telescope and imager parameters
- Ground Sample Distances
- Types of passive sensors
- Active Sensors

Communications

- SATCOM overview
- Uplink, downlink, and bent-pipe comms
- Antennas
- SATCOM performance and orbit selection
- Signals and link budget
- SATCOM spectrum
- EMI and Jamming

PNT

- Principles of PNT
- GPS Constellation and ground architecture
- GPS architecture
- Other PNT systems