Fairfax Collegiate
2026 Summer Program
Aerospace Engineering Course Syllabus
Rising Grades 7-9

Course Description

Design and build planes and rockets.

Learn Newton's First Law and build paper helicopters. Like the Wright brothers, build a wind tunnel and test airfoils. Build gliders and a model propeller plane.

Learn Newton's Third Law and design a jet engine. Design and build a rocket. Learn about the International Space Station. Build a model solar sail.

Students participate in engineering challenges, problem solving, and exploration of how aircraft and spacecraft are designed. A combination of traditional lessons and project-based exploration guides students throughout the session, encouraging curiosity, creativity, and iterative thinking. A logical sequence of activities helps students connect key physics ideas to real aerospace systems.

Throughout the course, students investigate how forces like lift, thrust, drag, and gravity shape flight and learn how engineers refine ideas through testing and iteration. Students experiment with simple rocketry, build a functioning wind tunnel, and use computer-assisted design tools to create their own jet concepts. They also explore satellites, space missions, and current aerospace innovations. Fairfax Collegiate provides all necessary materials, and students collaborate in pairs or small groups for many activities.

At the end of the course, instructors upload a collection of photos and videos showcasing student work for families to access. Students leave with a stronger understanding of aerospace engineering and the confidence to tackle more advanced engineering, physics, or design projects.

Learning Objectives

Course Goals	**Engineering Design:** Students build a variety of aerospace engineering projects and use the engineering design process as a framework to reflect on their designs to improve performance. **Creativity & Problem Solving:** Students gain experience working in teams as they collaborate to

	build and test their projects. **Physics Concepts:** Students are introduced to Newton's 1st and 3rd Laws and learn how they describe the 4 primary forces acting on aircraft: thrust, lift, drag and weight. **Connection With History:** Students learn about the history of aerospace engineering as a series of keys developments from air balloons to satellites. **Computer Assisted Design:** Students use computer assisted design technology to design their own modern aircraft.
Course Topics	**Newton's First Law:** Students design helicopters and discuss Newton's First Law, gravity, lift, thrust, and drag. **Balloons:** Students learn about aerostatic buoyancy and the physics of balloons. **Airfoil Testing:** Students build a wind tunnel and test airfoils. **Gliders:** Students create, test, and iterate on the design of gliders made with household supplies. **Propeller Planes:** Students learn how propellers generate thrust and design a propeller plane. **Jets:** Students learn how jets produce thrust through Newton's 3rd Law and then design jets using Tinkercad. **Propulsion:** Students build, test, and analyze the performance of a sugar-based rocket propulsion mix. **Rockets and Gravity:** Students learn how rockets fly, how to get involved in rocketry, materials selection, and fundamental principles of gravity. **Satellites:** Students learn about satellite applications, satellite history, space junk, and the international space station. **Space Exploration.docx:** Students learn about space exploration by designing solar sails with household supplies and researching novel missions around our solar system.

Course Schedule

Class Meeting 1	**Relationship Building:** Students build community with each other through get-to-know activities that familiarize them with the 4 primary forces acting on something in flight. **Designing Helicopters:** Students explore the concept of gravity and lift by designing paper helicopters. **Helicopters Lesson:** Students learn about helicopters and how they rise up, fly, hover, and generate lift. **Newton's First Law:** Students learn about Newton's First Law within the context of gravity, lift, thrust, and drag. **Course Outline:** Students learn what they will see and do in the course.

Class Meeting 2	**Layers of the Atmosphere:** Students learn about layers of the atmosphere and why scientists want to know information about each layer. **Balloons:** Students learn about the two types of large balloons used by humans: hot air balloons and weather balloons. **Engineering Design Process:** Students learn about the engineering design process. **Buoyancy and Lift:** Students learn about the differences between buoyancy (aerostatic lift) and (aerodynamic) lift, and their contributions to flight. **Balancing Balloon Challenge:** Students (in pairs) utilize their knowledge of buoyancy and the engineering design process to solve a strange phenomenon involving air-filled balloons. **Hot Air Balloons:** Students (in pairs) use household supplies to build their own hot air balloons and fly them in the classroom.
Class Meeting 3	**The Wright Brothers and Wind Tunnels:** Students learn about the scientific process the Wright Brothers used to solve the power, control, and lift problems they encountered. **Building a Wind Tunnel:** Students build a wind tunnel to test airfoils. **Airfoils Lesson:** Students learn about the details of airfoils. **Building Airfoils:** Students build airfoils to test in the wind tunnel.
Class Meeting 4	**Testing Airfoils:** Students test their airfoils in the wind tunnel and record data. **Reflecting on Airfoil Testing:** Students reflect on their airfoil designs and prepare presentations about results, limitations, errors made, and ideas for improving airfoil design and testing methods. **Presenting Data From Airfoil Testing:** Students present their findings from the airfoil design. **Aerospace Engineering Challenge:** Students act as aerospace engineers and compete to design an airfoil that maximizes the lift-to-weight ratio.
Class Meeting 5	**Glider Lesson:** Students learn about the different types of gliders, how they fly, and how it is possible for an engineless aircraft to gain altitude. **Build and Test Gliders:** Students apply their knowledge of airfoils to build and test gliders using household supplies. **Propeller Plane Lesson:** Students learn about propellers planes and apply their new knowledge to predicting how restricted wind flow affects flight. **Propeller Plane Construction:** Students create their own propeller plane and test the effect of different propeller blades on flight.
Class Meeting 6	**Newton's 3rd Law and Jet Engines:** Students learn about Newton's 3rd Law and apply it to learning about jet engines. **Tinkercad Introduction:** Students learn the basics of 3D Design software in preparation for designing a jet. **Commercial Versus Military Jets:** Students research similarities and differences between military

	jets and commercial jets to prepare to create their own jet in Autocad. **Jet Engines and 3D Design:** Students design their own jets using 3D Autocad design software.
Class Meeting 7	**Sugar Rockets:** Students build and test solid-state rocket motors from household products in groups of 2-3 and are introduced to fuel and propulsion. **Sugar Rockets:** Students build and test solid-state rocket motors from household products in groups of 2-3 and are introduced to fuel and propulsion.
Class Meeting 8	**Rockets Lesson:** Students learn how a rocket works. **Rocket Stability:** Students learn about rocket stability and perform tests to determine if rockets are stable. **Newton's Law of Universal Gravitation:** Students learn about Newton's Law of Universal Gravitation and apply it to planetary and satellite motion. This is an alternate activity because it's most applicable to planetary motion as opposed to Aerospace Engineering. Nevertheless, the formula for gravitational attraction between two objects stems from Newton's Laws and thus can be linked the concepts in this course. This is lesson is more "plug and chug" than other lessons. Students are given a formula and told to apply the formula to understanding planets and satellites. This can be used anytime after the 1st day. It is best used as an emergency in case your materials for an activity do not arrive in time. **Gravity Well Demo:** Students works together to assemble a visual demonstration of gravity wells and is introduced to Einstein's general theory of relativity. **Rocketry Opportunities:** Students learn about current opportunities and progress in student-focused rocketry programs, including Project Caelus (TJHSST) and TARC (Team America Rocketry Challenge). **Aerospace Materials Selection:** Students learn the importance of materials selection in aerospace engineering through cost analysis and case studies.
Class Meeting 9	**Intro to Satellites:** Students learn about satellite history, applications, and current research. **What Satellites Orbit Earth?:** Students explore a website with a list of every (known) satellite around earth, research one of them, and prepare a presentation on it. **International Space Station:** Students learn about the history and parts of the international space station. They also track the international space station in real-time. **Space Junk!:** Students learn about the danger space junk poses to satellites. **Launching a Satellite:** Students learn what goes into launching a satellite and maintaining its orbit. **Space Exploration:** Students learn about long-range space missions that send satellites far from earth.
Class	**Solar Sails:** Students learn about solar sails and create their own model solar sail.

Meeting 10	**Current Space Tech:** Students learn about the current progress in space technologies, including the Perseverance Rover and JWST (James Webb Space Telescope). **Mission to Mars:** Students watch videos on a mission to Mars and discuss how life on Mars could be sustained as a wrap-up to the course.