Goddard Level
Synopsis

Prerequisite: Oberth Level

Goals: Application of the student's knowledge base, developed over the first three years, especially the Tsiolkovsky and Oberth Levels; addition of knowledge; and the expanded development of life and work skills, cognitive reasoning, critical thinking, problem solving, design and development, testing and analysis, documentation, and teamwork and leadership; and the design, development and testing of a high-altitude vehicle.

The first semester begins by encapsulating the "early" design aspects of the vehicle's payload, performance and configuration. The students, or project team, will develop a flight profile using Excel. The profile will predict all flight dynamics, determine propulsion performance and stresses that will be applied to the vehicle during testing. By the end of the semester, the students have concluded a strong configuration of the vehicle and will travel to NASA – Johnson Space Center Houston - to present the profile to flight engineers. Flight profile undergo critique and additional work as needed. Flight profile and design must be approved prior to fabrication of vehicle.

After a review of the industry approved Research Design and Development Loop (RD&D Loop), students begin to design and build a vehicle to take a scientific payload 80K to 100K ft. These vehicles are launched with support of the U.S. Army at White Sands Missile Range (WSMR) in New Mexico.

The students, as a project team, develop the overall vehicle design using computer modeling - the design incorporates all the content mastered in the past 3 years concerning rocket flight. After being selected to component teams (propulsion, air frame and fins, recovery, etc.), students are instructed about timeline management, critical decision-making and project management. Specific component teams develop a timeline for production of their component, then begin the research phase concerning the problem aspects of their component. Problem aspects include function, mass envelope, simplicity etc. A final design is developed, usually in the form of mathematical calculations, that allow the team to move forward in the design process. The mathematical calculations are reviewed by a professional in aerospace industry offering criticism of the calculations but no insight into how it may be approved. The mathematical design is then converted to a working drawing representing the design of the component. The team begins extensively researching materials and developing decision matrices based on component function. Material variables include safety, cost, application viability, acquisition time etc. The team then presents a Critical Design Review (CDR) to the overall project team. If a "thumbs-up" is received from the overall project team, it is time to move forward to the development of the component. If not, redesign is needed until it is accepted. All components are manufactured entirely from scratch – nosecone, oxidizer tank, injection, fuel grain, nozzle, etc. After individual components are complete, all systems (components) must the integrated to complete the class project. Students must also submit must DATCOM files detailing the design of the vehicle to engineers at NASA. These files are then converted to GEMDECK files and sent to WSMR Range Safety for approval. The vehicle must also pass the *SystemsGo* Flight Safety Review (FSR), prior to launch, to ensure adherence to all safety guidelines. Students must then adhere to Standard Operating Procedures (SOP) of WSMR for vehicle testing. After vehicle has been tested students enter the final phase of the project by evaluating vehicle performance.

SYSTEMSGO

Goddard Level
Scope and Sequence

First Six Weeks:	**History of Space Travel**
Week 1	Review RD&D Loop
Week 2	Fundamentals of Hybrid Motors
Week 3	Fundamentals of Hybrid Motors
Week 4	Fundamentals of Hybrid Motors
Week 5	Fundamentals of Hybrid Motors
Week 6	PE = KE = Instantaneous Velocity
Second Six Weeks:	**Flight Profile**
Week 7	Excel Spreadsheets
Week 8	Delta V
Week 9	Drag and the Atmospheric Model
Week 10	Newtonian Physics Applied
Week 11	Mass Properties
Week 12	Overall Vehicle Configuration, 1st Iteration, Prelim Component Concepts
Third Six Weeks:	**Components' Designs**
Week 13	NASA Flight Profile Review
Week 14	Component Problem Statement Research
Week 15	Component Problem Statement Research
Week 16	Technical Calculations
Week 17	Technical Calculations
Week 18	Mechanical Drafting
Fourth Six Weeks:	**Components' Designs**
Week 19	Working Drawings
Week 20	Prototyping
Week 21	Testing and Analysis
Week 22	Testing and Analysis
Week 23	CDR - Critical Design Review
Week 24	Purchase Orders and Material Acquisition
Fifth Six Weeks:	**Component Acquisition and Fabrication**
Week 25	Machining Principles
Week 26	Standard American Engineering (SAE)
Week 27	Tolerances
Week 28	Component Fabrication
Week 29	Component Fabrication
Week 30	Component Fabrication
Sixth Six Weeks:	**Test Prep**
Week 31	SOP - Standard Operating Procedures
Week 32	SOP/SHA - Safety Hazard Analysis
Week 33	FRR - Flight Readiness Review / Vehicle Test
Week 34	PMA - Post Mission Analysis
Week 35	PMA
Week 36	PMA