SYSTEMSGO

Scientific Research and Design
Tsiolkovsky Level
Synopsis

Prerequisite: Student must be concurrently enrolled in or have successfully completed Algebra 2.

Goals: Application of the student's knowledge base, addition of knowledge, and the development of life and work skills - cognitive reasoning, critical thinking, problem-solving, design and development, testing and analysis, documentation, and teamwork, collaboration, and leadership.

First Semester
The first semester is designed to ignite the student's desire to learn and enhance 21st Century Learning skills through hands-on projects in 15 modules supported by teacher-friendly PowerPoints and discussions. Lectures, labs and projects are designed to teach problem-solving skills and foundational knowledge within the four main energy systems: mechanical, fluid, electrical and thermal. As the semester advances and in-depth learning increases, students are required to design and build three small-scale rockets, each with increasingly more difficult criteria.

Second Semester
The second semester begins with an introduction to the industry approved Research Design and Development Loop (RD&D Loop) which is used for the second semester class project–design and build a rocket to take a 1.0-lb payload to an altitude of 5,280 feet.

The students, as a project team, develop the overall vehicle design using computer modeling - the design incorporates all the content mastered in the first semester 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. All component teams develop a timeline for production of their component, then begin the research of problem aspects, including 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, ability to work with, 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. After materials acquisition and individual components are complete, all systems (components) must the integrated to complete the class project. At this point the vehicle must pass the Flight Readiness Review (FRR), prior to launch, to ensure adherence to all safety guidelines. After vehicle has been tested students enter the final phase of the project by evaluating vehicle performance. Students use a Fault Tree Analysis (FTA) to aide in the writing and presenting of a complete Post Mission Analysis (PMA). The PMA is used as the second semester final exam.

Scientific Research and Design
Tsiolkovsky Level
Scope & Sequence

Knowledge Bases and Skills

Goals: Application of the student's knowledge base, addition of knowledge, and the development of life skills.

The first semester is designed to provide important information to the student through modules supported by teacher-user-friendly PowerPoints. It is also designed to ignite the student's desire to learn through the implementation of inquisitive learning contained within modules throughout the semester. The student will master problem solving tools and be informed of foundational knowledge within the four main energy systems: mechanical, fluid, electrical, and fluid.

In addition, the student will be introduced to additional life skills such as teamwork, critical thinking, problem solving, documentation, and others. Hands-on projects are contained within the inquisitive learning curriculum for the first semester to support problem solving problems. The first semester is the prerequisite for the second semester project where all aspects of the first semester will be applied to the projects.

FIRST SIX WEEKS:

Module 1.1 Why SystemsGo?
Module 1.2 Responsible Use of Technology
Module 1.3 Advanced Technology
Module 1.4 Dimensional Analysis & Significant Figures
Module 1.5 Energy
Module 1.6 Force Vectors
Module 1.7 Force Vector Lab
Module 1.8 Applied Force Vectors
Module 1.9 Torque & Mechanical Stresses
Module 1.10 Newtonian Physics
Module 1.11 Safety
Module 1.12 First Generation Rocket Development
Module 1.13 1st Gen Rocket Test/Flight Test Review (PMA)
Module 1.14 Flight Stability
Module 1.15 Six Weeks Summary and Evaluation

SECOND SIX WEEKS:

Module 2.1 Flight Stability and Six Degrees of Freedom
Module 2.2 Gen 2 Rocket Development
Module 2.3 Gen 2 Flight Readiness Review
Module 2.4 Gen 2 Flight Profile Prediction
Module 2.5 Thrust to Weight Relationship
Module 2.6 Gen 2 Test
Module 2.7 Gen 2 Post -Test Analysis (PMA)
Module 2.8 Impulse Momentum Theory
Module 2.9 Fluids: Defined, Archimedes, Bernoulli
Module 2.10 Fluids: Drag and Lift Forces
Module 2.11 Resistance
Module 2.12 Resistance Lab
Module 2.13 Problem Solving Session
Module 2.14 12 Weeks Summary and Evaluation

THIRD SIX WEEKS:

Module 3.1 Lab Intro to Modeling/RockSim
Module 3.2 Gen 3 Rocket Design
Module 3.3 Gen 3 Rocket Development
Module 3.4 Gen 3 Flight Readiness Review (FRR)
Module 3.5 Gen 3 Rocket Test
Module 3.6 Gen 3 Post-Test Analysis (PMA)
Module 3.7 Electricity in a System
Module 3.8 Electrical Circuits
Module 3.9 Electrical Lab
Module 3.10 Problem Solving Session - Advanced
Module 3.11 18 Weeks Summary and Evaluation

SECOND SEMESTER:

Teacher Notes 1st Read
PBL Project Component Plans and Rubrics
Module 4.1 Teacher Information
Module 4.2 Design &Development Loop
Module 4.3 Personnel and Project Management
Module 4.4 Safety and Scientific Payload
Module 4.5 Design – FRR, Motor Systems, Altimeter
Module 4.6 Launch Day Documentation
Module 4.7 Post Mission Analysis