



Physics and Engineering - Unit 4 - Rockets

Unit Focus

Students will build a mathematical model of the flight of a rocket based on theory. Students will build different rocket designs and test their flight characteristics. Using real time data monitoring and acquisition, students will analyze flight data taken from rocket launches in a computer model that they build. This model will be used to make design modifications and ultimately improve the flight of their model. Students will program models in the MATLAB computer system, and present their findings to the class. A strong focus is placed on modeling non-ideal conditions, in an effort to move from the theoretical world of the text book to the real world that engineers deal with on a daily basis.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
Next Generation Science <i>High School Engineering Design: 9 - 12</i> - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. <i>HS-ETS1-2</i> - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. <i>HS-ETS1-4</i> NGSS/NSTA Science & Engineering Practices <i>NGSS Science & Engineering Practices: 9-12</i> - Develop a complex model that allows for manipulation and testing of a proposed process or system. <i>SE.9-12.2.5</i> - Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. <i>SE.9-12.2.6</i> Madison Public Schools Profile of a Graduate <i>Critical Thinking</i> - Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2) <i>Collaboration/Communication</i> - Product Creation: Effectively use a medium to communicate important information. (POG.3.2)	T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions. T2 Make observations and ask questions to define a problem based on prior knowledge and curiosity that stimulates further exploration, analysis, and discovery.	
	Meaning	
	Understanding(s)	Essential Question(s)
	U1 Varying forces and varying accelerations determine the path of an object U2 A model is modified and improved by incorporating data from tests. Multiple test - modification iterations are part of the engineering design process	Q1 How are computer models used to predict outcomes and explain complex situations?
	Acquisition of Knowledge and Skill	
	Knowledge	Skill(s)
	K1 Burning fuel will reduce mass and therefore change an object's acceleration K2 Models are built on assumptions; test data can be used to modify or validate assumptions. K3 Center of mass, length, balance and center of thrust need to be optimized to produce a successful rocket	S1 Writing code loops to simulate the passing of time. Each time increment will recalculate all necessary parameters S2 Input data from sensors to MATLAB to compare results to model data S3 Design a rocket to optimize center of mass and center of thrust relationships S4 Implementation of a robust, tested and validated computer model