Engineering Design Challenge: Spacecraft Launch Structures

Kit Certification: 2 hour workshop
Suggested Grade Level: 5-9

The engineering design process used by NASA engineers forms the backbone of this workshop. Design and build a model thrust structure (the portion of the structure that attaches the engine to the rest of the spacecraft) that is as light as possible, yet is strong enough to withstand the load of a "launch to orbit" three times. Using a GoPro mounted to the launch platform, teams can view their tests in slow motion, pinpointing when and where their design failed. Design, test, and redesign for the most success in launching a filled water bottle.

Actual
The Engine and Thrust Structure of a Titan Rocket

Kits Available: 2

Kit contains:

- Launch Platform
- GoPro with mount
- Cut balsa wood
- Glue guns with glue
- Water bottle and weight
- Job titles on lanyards for team roles
- Teacher Guide with background content and activities

WV NxGen Science Standards

S.3-5.ETS.1 define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
S.3-5.ETS.2 generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
S.3-5.ETS.3 plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

S.5.GS.11 support an argument that the gravitational force exerted by Earth on objects is directed down.

S.6-8.ETS.1 define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
S.6-8.ETS.2 evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
S.6-8.ETS.3 analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
S.6-8.ETS.4 develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

S.7.PS.1 construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. _____
S.7.PS.2 develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
S.7.PS.5 construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
S.7.PS.6 apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
S.7.PS.7 plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

S.HS.PS.10 analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.