1. The “Big” Concept
    a. Groups of students are to design a lunar exploration satellite with a combination of designated hardware, such as a camera, gravity probe, heat sensor, and accompanying batteries to run the equipment.
    b. Students must observe constraints placed on design parameters
        i. Weight: 10g or less
        ii. Size: Must fit into a tube, like a poster mailer or oatmeal container
    c. The lunar space craft must be able to survive a 1-meter drop without any pieces falling off.
        i. The craft must stay upright after being dropped 1-meter
2. Standards
    a. NGSS: 3-5-ETS1 Engineering Design
        i. Science and Engineering Practices
            1. Asking Questions and Defining Problems
                a. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on material, time, and cost.
            2. Planning and Carrying Out Investigations
                a. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet criteria and constraints of the problem.
            3. Constructing Explanations and Designing Solutions
                a. 3-5-ETS1-3: 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.
        ii. Disciplinary Core Ideas
            1. ETS1.A: Defining and Delimiting Engineering Problems
                a. Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
            2. ETS1.B: Developing Possible Solutions
                a. Research on a problem should be carried out before beginning to design a solution. Testing a

solution involves investigating how well it performs under a range of likely conditions.
b. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
c. Tests are often designed to identity failure points or difficulties, which suggest the elements of the design that need to be improved.

3. ETS1.C: Optimizing the Design Solution
a. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

iii. Crosscutting Concepts
1. Influence of Engineering, Technology, and Science on Society and the Natural World

iv. ELA
1. W.5.9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

v. Mathematics
1. MP.5: Use appropriate tools strategically

3. Types of knowledge needed to perform task
a. Declarative: Students will need to understand that their lunar craft will be comprised of two parts. The craft and a designed landing system to help it retain all parts of the craft. Students should activate prior knowledge that gravity will cause the craft to accelerate toward the floor and friction (air resistance) will help slow the craft although vehicles with greater mass will create greater momentum-mass x velocity. Also, students will have to design a craft that is large enough to carry the stipulated equipment, but small enough to fit-in an oatmeal container. Arrangement of weight of the craft will help it stay upright during landing.
b. Procedural: The students will have to design both the craft and the landing structure-simple or complex- and determine how to marry the two before the 1-meter drop.
4. Objectives and ancillary concepts or content covered by this project
a. Students will acutely measure the mass of their lunar space craft using either a triple beam balance or a pan balance.
b. Students must consider some type of device to attach to their craft to slow its rate of descent so that it doesn't break apart, and it still adheres to the constraints.
c. Gravity and friction (air resistance) are factors that students must remember for slowing their craft's rate of descent.

    d. Students will experiment with the design crafts for it to stay upright after landing.
        i. Students will experiment with weight distribution for their craft to stay upright.
5. Activity: NASA’s Best Activity Guide for Grades 3-5
6. Selected Activity: “Build a Satellite” pages 16-23.