Kelsey Birdwhistell
Major Project: Engineering Design Challenge

Big Concepts:

- To engage students in the engineering design process
- To encourage interest in space exploration
- To encourage the pursuit engineering careers
- To encourage students to be creative and collaborative critical thinkers and communicators
- To give students meaning behind their learning (real-world applications)
- To empower students to make the world a better place

Standards:

- *Science* ESS 1
  - 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
  - 3-5-ETS1-2. 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.
  - 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.
  - 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. [

- *ELA Standards*
  - RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
  - RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)
  - RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)
  - WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)

- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4)

- *Engineering Standards*
  - MS-ETS1-1. 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.
  - MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
  - ETS1.B: Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
  - MS-ETS1-3. 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.
  - MS-ETS1-4. 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.

- *Mathematics Standards*
  - MP.4 Model with mathematics. (MS-ESS1-1)
  - 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1)
  - 7.RP.A.2 Recognize and represent proportional relationships between quantities.

Problem Solving and Declarative/Procedural Knowledge:

There is a lot that students will need to know before they begin on this design challenge. Students will need to understand the importance of communicating clearly by asking questions, how to work collaboratively with their peers, and how to think critically

about multiple possible solutions in a creative way. In addition to these necessary learning skills, students will also need to have appropriate background knowledge.

Some important background knowledge and declarative might include what types of materials will be available for the challenge, basic concepts of force, gravity, weight distribution and shock absorption, considerations for why it is important for astronauts and spacecraft to avoid damage during landing. This would also include helping students understand what would make for a "successful" touchdown for their craft design. As for procedural knowledge, students will need knowledge of the NASA design model so that they may make appropriate design modifications. In line with this idea, they will also need to know the defined steps and process of the challenge itself.

Objectives and ancillary concepts:

Students will need to be able to cite evidence and record their observations and track progress using the steps of the engineering design process and their ELA background knowledge. Students will also need speaking skills as they present their creations with their peers as well as listening skills as they observe the presentations of their peers.

Identify possible activities:

1. Launch It
2. Touchdown
3. Roving on the Moon
4. Heavy Lifting
5. On Target
6. Feel the Heat

Select the best activity for your classroom: *Touchdown*

Phase II – Implementation – Due Date: Final Class Session

1. Select an engineering design process to be used in your class. You should be able to identify this process based on your research in the "Comparative Analysis of Design Models" assignment.
2. Develop an implementation timeline.
3. Perform the engineering design activity, either on your own or with your students.
4. Complete an engineering design notebook. The design notebook will include your progress at each level of the design process and organized using the following sections,

1. Identify the problem
2. Brainstorming
3. Design
4. Build
5. Test and Evaluate
6. Redesign
7. Share the solution

5. Reflect upon your experience. The following questions may be used as a guideline; however additional questions might be appropriate for your project.

a. What went well with the engineering design challenge?
b. What did not go well with the engineering design challenge?
c. What concepts were covered (list standards and topics where appropriate)
d. How did the ED process help teach the science and mathematics concepts?
e. Did I choose an appropriate engineering design process? Should I simplify or make more complex?
f. How can I improve this activity to use with future students?