Major Product: Engineering Design Challenge

Phase I – Research and Planning

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Endeavor STEM Teaching Certificate Project

1. Identify the “Big” concept to be covered by the engineering design challenge.

I will be doing the “Touchdown” activity. This is a challenge from the NASA “On the Moon Educator Guide.” This challenge involves designing and building a shock-absorbing system that will protect two marshmallow “astronauts” when they land. The “Big” concept is the need for a fast-moving spacecraft that needs to land gently on the moon. Students will use the engineering design process to brainstorm and design a spacecraft, build it, then test, evaluate, and redesign. Topics such as potential and kinetic energy, acceleration due to gravity, air resistance, and measurement are all critical for this activity.

2. Research appropriate learning standards associated with the topic.

The following standards will be implemented in this activity:

Common Core Math Standards-Grade 3

CCSS.MATH.CONTENT.3.MD. A.1
Solve problems involving measurement and estimation.

National Council of Teachers of Mathematics Standards (Grades 3–8)

Problem Solving
• Build new mathematical knowledge through problem solving
• Solve problems that arise in mathematics and in other contexts
• Apply and adapt a variety of appropriate strategies to solve problems

Measurement
• Understand measurable attributes of objects and units, systems, and processes of measurement
• Apply appropriate techniques, tools, and formulas to determine measurements

Next Generation Science Standards

3-PS2-1 Motion and Stability: Forces and Interactions
3-PS2 Motion and Stability: Forces and Interactions
4-PS3-3 Energy

Massachusetts Science and Technology/Engineering Standards (Grades 3–8)

Physics (3–8)
- Observable Properties of Objects
- Position and Motion of Objects
- Properties of Objects and Materials
- Forms of Energy

Technology/Engineering (3–8)
- Materials and Tools
- Engineering Design

3. Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.

Students will need to do problem solving as they design their spacecraft. They will need to determine how they will use their materials to make the landing soft, how to keep the lander from tipping over as it falls through the air, and how to keep the "astronauts" inside the spacecraft. As they are creating, they will need to solve problems with their design that may arise. For example, what changes can be made if the spacecraft tips over, what to do if the spacecraft bounces instead of landing, how to create a spacecraft that can land safely from high distances, and how to create the best springs.

Some of the declarative knowledge that is needed are principles related to potential and kinetic energy and concepts related to acceleration due to gravity. Knowledge of air resistance is important. Students will also need to know measuring concepts.

Procedure knowledge is also needed for this activity. Students will need to know how and when to apply their understanding related to many topics. They will need to understand that objects accelerate as they fall and how to control this. They will also need to apply knowledge of air resistance as they think about the air that exerts a force on the lander as it falls. Students will

also need to use their knowledge of weight, shape, and the characteristics of the materials so they can best use them to be successful in the challenge.

4. Explore objectives and ancillary concepts/content covered by the project.

Other objectives and ancillary concepts can be the different forces that affect the lander as it falls. Students can also examine the surface of the moon and what makes it a good place to land as well as what are some of the concerns. Students can also test springs of different sizes to examine how different ways of folding the index cards and different numbers of folds affect the landing. Students can also learn more about astronauts who have traveled to the moon.

5. Identify possible activities.

- Show a video of a spacecraft landing on the moon. This will be the “phenomenon” to hook the students in and get them excited about learning.
- Read books about the moon and its surface.
- Complete pre-challenge activities related to space and the moon.
- Review the engineering design process steps.
- Work in team to brainstorm ideas.
- Provide individual planning time and then opportunities to share with others.
- Work in teams to build, test, and evaluate the designs.
- Complete a self-reflection afterwards.
- Hold a “How High Can You Go?” contest.
- Test springs of different sizes.
- Create a FlipGrid to share results and provide feedback to classmates.
- Do follow-up activities using different materials that the students suggest.
- Research jobs at NASA.
- Write about why or why not students would like to travel to the moon.

6. Select the best activity for your classroom.

I plan on using the “Touchdown” Challenge in my classroom. I would like to incorporate the activities mentioned above. I am excited for my students to use the engineering design process to design and build the best possible spacecrafts.

References

On the Moon Educator Guide. (2009). Retrieved September 1, 2019, from https://www.nasa.gov/stem-ed-resources/on-the-moon-guide.html