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E in STEM
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Midterm: Phase 1 of Major Project

Engineering Design Challenge
Phase I – Research and Planning

I chose the activity called "Touchdown" from the "On The Moon Educators Guide." In this engineering design challenge students are tasked to: **Create a platform that can safely cushion "astronauts" when they land on a table near you.** This activity can be found in the following resources: https://www.nasa.gov/stem-ed-resources/on-the-moon-guide.html https://pbskids.org/designsquad/parentseducators/resources/index.html?category=forceenergy

Grade level: 5, 6, 7
Class: Science

1. Identify the "Big" concept to be covered by the engineering design challenge.
The big concepts covered by this design challenge are understanding the potential and kinetic energy of objects and investigating how shock absorbers work.

2. Research appropriate learning standards associated with the topic.
Learning standards associated with this topic are:

- **MS-PS3-3 Energy**: 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.
- **MS-PS2-2 Motion and Stability: Forces and Interactions**: 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.
- **MS-ETS1-1 Engineering Design**: 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.

3. Identify and discuss the different types of problem solving and declarative/procedural knowledge needed.
The type of problem that this design challenge presents is most likely a moderately-structured problem, according to the continuum of problem types (Kirkley, J., 2003, Principles for Teaching Problem Solving, PLATO Learning, Inc.). There is more than one way to solve this problem. Students can experiment with different ways to use the materials. Students will need to have some declarative knowledge of gravity and air resistance. They may also need to research how shock absorbers work. They will need to use trial and error to experiment with ways to keep the cup from tipping over as it falls. The procedural knowledge they will need is to know how the

materials can act as shock absorbers and how to keep a cup from tipping over when falling to the ground.

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

- Kinetic and Potential energy: Kinetic energy is transferred to potential energy when an object stops moving. Kinetic energy of the falling lander is changed into potential energy when it lands. The potential energy gets stored in the shock absorbers.
- Gravity: The prototype lander falls due to Earth's gravitational pull. On the moon, the gravity will be less so the lander will fall at a slower rate.
- Air resistance acts on falling objects. You can increase air resistance by increasing the surface area of materials. However, there is no air on the moon so the lander will not be affected by air resistance. For the purpose of this design challenge, the prototype landers will be falling through air, so air resistance will act on them.

5. Identify possible activities.

Prior to assigning this design challenge I will do some mini-lessons and experiments with my students. Possible activities include:

- "Falling Objects" lab - Students investigate what factors affect the falling rate of objects.
- Ball energy lab - Students observe how many times balls of different materials bounce when dropped from a certain height.
- Reading and notes on potential and kinetic energy
- Motion, Forces, and Energy video from Discovery School

6. Select the best activity for your classroom.

"Touchdown" from the "On The Moon Educators Guide. The challenge: **Create a platform that can safely cushion "astronauts" when they land on a table near you.**