Jocelyn Coy
Major Project
The E in STEM: Meaningful Content for Engineering

Phase I - Research and Planning

1. Big Concept
    a. NGSS Disciplinary Core Idea PS2.B: Types of Interactions - "The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center."

2. Standards
    a. 4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.
    b. 5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.
    c. 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.
    d. 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.
    e. 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.
    f. CCSS.MATH.CONTENT.5.MD.A.1. Convert like measurement units within a given measurement system.
    g. MP1 Make sense of problems and persevere in solving them
    h. MP2 Reason abstractly and quantitatively
    i. MP4 Model with mathematics
    j. MP5 Use appropriate tools strategically
    k. CCSS.ELA-Literacy.W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

3. Problem Solving/Knowledge Needed
    a. The possible design activities related to gravity could fit into two different problem solving types because of their real world connections. Listed below are the two problem solving types and the main characteristics that match the possible activities.
        i. Rule-Using Problem - uses a procedural process constrained by rules, purposeful, need-based, unpredicted outcome.
        ii. Design Problem - acting on a goal to produce an artifact, real-world,problem situated
    b. Going into this project, students should have declarative knowledge based on facts. Students should know what gravity is and define it. As students work on the project, build their prototype and run the experiment, they will be able to identify the concepts (know that) and principles (know why) of gravity.
    c. All of the activities have a clear, expected outcome with a specific set of materials that require procedural knowledge. Using the materials provided, students will need to come up with a solution to satisfy the given problem. Students must be able to reason and evaluate their designs to meet the needs of the problem. All of these qualities show that these activities are moderately structured problems.

4. Objectives/Content
    a. Students will use evidence from their investigation to demonstrate their knowledge that the gravitational force of Earth acts on an object and pulls that object toward the Earth's center.
    b. Students will construct a prototype to simulate how an object falling to Earth is affected by gravity.
    c. Students will use an appropriate tool to measure the distance their prototype falls.
    d. Students will convert their measurements within a given measurement system.

5. Possible Activities
    a. Pool noodle marble run from https://littlebinsforlittlehands.com/pool-noodle-marble-run-activity-for-kids/ (Possible too easy)
    b. Touchdown from NASA "On the Moon Educator Guide" (Never tried before)

c. Build a Roller Coaster from https://www.shareitscience.com/2017/10/STEM-gravity-lesson-ideas.html (I have already done this activity with students.)
d. Straw Rockets from https://www.science-sparks.com/straw-rockets/ (Possible too easy)

6. Best Activity
    a. Touchdown from NASA "On the Moon Educators Guide" - Create a platform that can safely cushion "astronauts" when they land on a table near you.