

PHASE I -Research and Planning

My request to conduct an engineering design project with 3rd graders was approved by my school. I usually run reading enrichment sessions once a week with 3rd-grade classes. I saw an opportunity to integrate my reading activities with an engineering design project, thus providing interdisciplinary instruction.

For this project, I selected the “Touchdown” challenge developed by NASA and Design Squad. I also referred to NASA JPL's instructions available at <https://www.jpl.nasa.gov/edu/teach/activity/touchdown/>. Following the recommendation of Prof. Josh, I am using the EIE’s Engineering Design Process (<https://blog.eie.org/what-is-the-engineering-design-process>) as a guideline to implement and document the project with the students.

In the previous week, I read a book titled “Moonshot: The Flight of Apollo 11” by Brian Floca to the students. This reading provided them with a general background on the historic Moon landing and spark their curiosity. The students were captivated by the storybook and gained historical and general engineering knowledge about spacecraft and NASA's mission to the Moon.

In this week's session, I showed relevant video clips and introduced the students to the concept of the Engineering Design Process (Ask, Imagine, Plan, Create, and Improve). At the end of the lesson, the students were challenged to design their own back scratchers using simple materials like a ruler and a fork, following a step-by-step engineering design process. They were very excited about this simple engineering design challenge. In the upcoming weeks, they are looking forward to designing their own landing gears, much like NASA engineers.

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

The "big" concept in this engineering design challenge is applying knowledge of gravity, forces, and shock absorption system to design a safe landing gear for spacecraft. The challenge emphasizes the importance of safely landing spacecraft without harming astronauts and damaging a spacecraft. The students are learning about how to effectively use various materials to build and design the safe landing gear.

2. Research appropriate learning standards associated with the topic.

NGSS

- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into an account

relevant specific principles and potential impacts on people and the natural environment that may limit possible solutions.

- 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.
 - MS-PS-2: Motion and Stability- Forces and Interactions
 - MS-ESS1-1 Earth's Place in the Universe
3. *Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.*

The "Touchdown" project is aligned with a moderately-structured problem, characterized by its specific guidelines, clear procedures, and criteria. In this project, the students are provided with materials (paper, straws, marshmallows and index cards) and a clear objective: to design and build a shock-absorbing system for a spacecraft landing. They are given guidelines on how to construct the lander and test it. The project is focused on specific concepts like gravity, forces, and shock absorption. However, within these guidelines, there is room for creativity and multiple possible solutions.

For effective problem-solving, this project requires both declarative and procedural knowledge. Declarative knowledge includes an understanding concepts of gravity, motion, forces, and shock absorption. Also, comprehending the properties of the given materials is essential, particularly soft materials like marshmallows, straws, and index card paper (which can be transformed into a spring once folded). Procedural knowledge is equally important. It involves understanding how to use the given materials and implement specific actions (like distributing weight and designing the structure) to effectively build a shock-absorbing system for the lander.

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

In this 3rd-grade project, I aim to introduce scientific concepts of gravity, motion, forces, and shock absorption through engaging hands-on activities. The reading of "Moonshot: The Flight of Apollo 11" enriches their understanding of historical space exploration. This interdisciplinary approach is designed to cultivate students' interest in science and engineering by introducing them to the engineering design process. This learning journey will help students enhance their problem-solving skills and creativity.

5. *Identify possible activities.*

The possible activities for 3rd graders include story reading and discussion on historical space exploration, exploring materials and understanding their properties, brainstorming shock-absorbing system ideas, conducting simple experiments and building shock-absorbing systems.

6. *Select the best activity for your classroom.*

The best activity for the classroom would be to encourage students to think and build like real engineers through a hands-on crafting session. They will document their engineering design process step by step as they design and construct their shock-absorbing landing gears using the provided materials. My students are very excited about this new engineering lesson, thoroughly enjoying the hands-on experience so far!