Lunar Base Supply Egg Drop

Overview
Although attempts will be made to make any future lunar base as self-sufficient as possible, it will likely need periodic resupply from Earth. This can be achieved more cheaply and efficiently with a passive style landing of a supply payload. The lack of atmosphere on the Moon will prevent the use of devices such as parachutes or aerobrakes to slow the descent of the payload. Even in the reduced gravity of the Moon (about one-sixth that of Earth), the design of the payload package is critical to the successful resupply of the base in that it must ensure that much needed supplies arrive intact.

Purpose
The purpose of this activity is for team members to demonstrate their abilities of technological design. This activity is intended as an introduction to:
• Cooperative learning teams and the roles team members will play.
• Steps of the design process that are used to meet a challenge.

Preparation
1. Gather all materials and make copies of the Lunar Base Supply Egg Drop Student Sheets.
2. Research indicates that cooperative learning methods—having students work in small groups—can help them learn concepts and skills. Using official engineering job titles will enhance the experience. Teams of three or four will work best. If you have three students per team, one will have the combined role of facilities engineer and developmental engineer (see role cards).

Materials
Per team:
• Student Data Sheets (CD Location: Educator Resources/Guides/Student Guide)
• Eggs
• Scissors
• Cups
• Straws
• Paper towels
• Cotton balls
• Plastic bags
• Bubble wrap
• 17.78-cm round balloons (limit three per team)
• String
• Drop cloth
• Role Cards
• Masking tape (about 60.96 cm per team)

Note: Specific construction materials can vary as long as all teams have equal access to materials.

Procedure
1. Set the scene properly before you bring up the topic of the egg drop. The discussion should center around the problems of a passive landing on the Moon without the ability to use aerobrakes or parachutes to slow the vehicle.

2. Introduce the challenge. This is an exercise using one’s ingenuity to package a delicate object (the egg represents the payload) to withstand impact. Their task is to design and construct a package for the raw egg payload that will allow the raw egg payload to be recovered unharmed (both the shell and yolk should be intact) when dropped from a second story (height of at least 9.144 m).

3. The package can measure no larger than 20.32 × 20.32 × 20.32 cm.

4. Divide the class into teams.

5. Distribute role badges and explain the responsibilities of each team.

6. Distribute Student Sheets and discuss the steps of the design process.

7. Students should use the Student Sheets to guide the design process.

8. Each team must sketch its container. Because there is no atmosphere on the Moon, no drag devices can be part of the package. The instructor must eliminate any such devices from the design before approval is given.

9. After design and construction is complete, drop the package from the given altitude.

10. Recover packages and bring them to a central location for opening and evaluation.

11. Examine the contents of the packages to determine the various levels of success.

12. Scoring will be as follows:
   a. Shell intact: complete success = 5 points
   b. Shell broken, yolk intact: partial success = 3 points
   c. Shell broken, yolk broken: mission failure = 1 point

13. Discuss the results as a class.

**Questions**

1. How many teams had complete success with their payload drop? Partial success?

2. What structures worked well?

3. What structures did not work well?

4. How would you redesign your package based on the lesson you have learned?

**Answer Key/What is Happening?**

The materials used to surround the egg payload act like airbags and cushion the payload. Materials can also be used to create a suspension that protects the payload. Much like crumple zones in a car protect the occupants, some of the external wrapping materials can absorb impact to protect the payload.