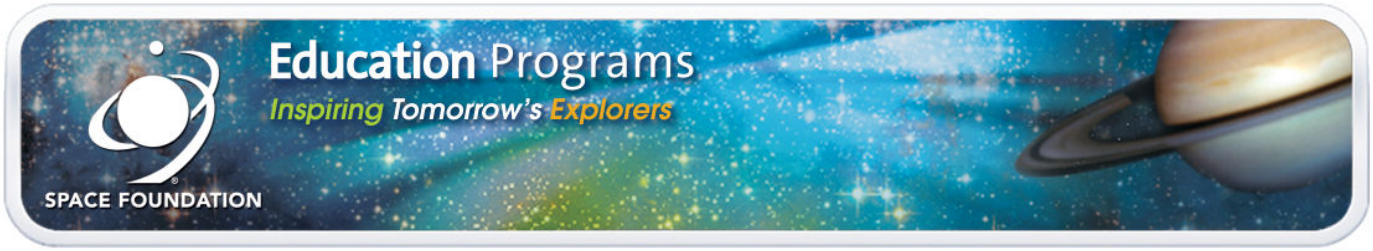

Mars (or Lunar) Lander Design Challenge

Objectives

Students will:

- Design a lander that will keep two astronauts safe on a simulated landing.

Suggested Grade Level

4th -12th

Subject Areas

Science, Engineering, Art

Timeline

60 minutes

Standards

- 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.
- MS-ETS1-1. 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.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

21st Century Essential Skills

- Critical Thinking & Problem-Solving
- Creativity & Innovation
- Communication and Collaboration
- Creativity & Imagination

Background

This challenge has students designing and building a system that will safely land astronauts on the Mars. Students must understand the principle of gravity and how things fall. They should also be instructed on what might make a hard or soft landing as well as what might keep a craft upright as opposed to falling over. As described below, they must also understand the principle of kinetic energy and the transfer of energy.

In this challenge, students will encounter a challenge where kinetic energy is transferred from the vehicle impacting the surface of an object to the astronauts in the capsule. Usually, this will result in the astronauts being ejected from the capsule. Students must, therefore, design a

suspension system that will absorb and distribute the energy of the impact without harming the astronauts.

Vocabulary

Suspension, impact, force, gravity, kinetic energy, transfer of energy

Materials

- 1 piece of stiff paper or cardboard (approximately 4 x 5 in/10 x 13 cm)
- 1 small paper or plastic cup (1 per group)
- 3D printed astronauts, small toy soldiers, or mini marshmallows (2-3 per group)
- Index cards (3 x 5 in/8 x 13 cm) (2 per group)
- Rubber bands (2-3 per group)
- Plastic straws (2 per group)
- Pipe cleaners (2 per group)
- String (1 ft per group)
- Coffee filters (1 per group)
- Small craft sticks (2 per group)
- Toothpicks (3 per group)
- Balloons (1 per group)
- Scissors (1 per group)
- Tape (1 dispenser per group)
- Ladder

Lesson

1. Prior to the lesson, glue a Dixie cup into the center of each cardboard square.
2. Tell students what their objective is. Ask them how they could achieve that.
3. Let students know they cannot strap their astronauts in (i.e. using tape or rubber bands) nor trap them into the cup (putting anything over the opening of the cup that would prevent them from falling out).
4. Put the students into teams of 2-4.
5. Have students brainstorm the system that they will build to land safely on Mars.

Optional Deployment Extension

Students will need to engineer a functional deployment piece to the lander. This can be in the form of a rover going down a ramp, solar arrays deploying, portion of the habitat unfolding, etc.

Spirit unfolding- https://www.youtube.com/watch?v=6t3IARmIdOI
Curiosity landing- https://www.youtube.com/watch?v=gwinFP8_qIM
Mars habitat- https://www.youtube.com/watch?v=AIrH01N9AsE

6. Give the students time to design, build, and test their vehicle design before the official attempt.
7. Have each group discuss their design with the class and explain why they chose that design.
8. Execute the drops. This should be done by the teacher from the top of a ladder.
9. Allow students to go back and redesign their vehicles for another drop test.
10. Assess student participation and success of their vehicle.

Extensions

- Challenge the students to design a vehicle that will survive from ever increasing heights.
- Assign prices to each of the above-listed supplies and tell students they have a certain amount of money from NASA to spend on their lander. This will force the students to do some budgeting and critical thinking as far as what materials they think will benefit them best.
- Have students design a deployment feature that must automatically deploy on landing (as described above).
- Incorporate using a Green Screen App to simulate landing on Mars.

Resources

Dunbar, B. (2010, January 25). On the Moon Educator Guide. Retrieved from http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/On_the_Moon_Guide.html