



Drexel-SDP GK-12 ACTIVITY

Activity: The Mars Rover Challenge

Subject Area(s) Space engineering, Astronomy

Associated Unit Space, module 3

Associated Lesson embedded

Activity Title The Power of Flight

Grade Level 6 (3-8)

Activity Dependency None

Time Required 3-4 50 minute lessons

Group Size 2

Expendable Cost per Group approx. \$2

Summary

An “Eggcellent” egg drop designed to model the requirements of dropping a NASA Mars Rover. Students were given a parts list, prices for each part and a budget of \$30 to build a “rover” that would drop from the 3rd floor window from the school without breaking their fragile equipment (an egg).

Engineering Connection

Space exploration would not be possible were it not for the work of engineers. In this activity, students will explore some of the principles involved in the design of the Mars Rover, and will engage in the process of designing and testing a shelter to safely drop the Mars Rover onto the surface of the planet.

Keywords

Space, flight, astronomy, Mar Rover, aeronautical engineer

Educational Standards

3.1.7 B Describe the use of model as an application of scientific or technological concepts.

3.2.7 A,B,C & D Inquiry & Design

3.4.7 C. Identify and explain the principles of force and motion

3.6 C. Explain physical technologies of structural design, analysis and engineering, personal relations, financial affairs, structural production, marketing, research and design.

3.7 A Describe the safe and appropriate use of tools, materials and techniques to answer questions and solve problems.

Pre-Requisite Knowledge

None.

Learning Objectives

Students will learn

Forces and motion and apply engineering logic to solve a problem.

Students will design models for mars rover drop and evaluate and modify this design.

Students will assess the effectiveness of a models as rover in relation to a real NASA mars rover.

Materials List

Optional: 50 Years of NASA, video, available from www.education.nasa.gov

Student directions sheet (Space SD-2)

Student activity worksheets (Space SA-2.1-2.4)

Construction paper/ card stock/ some heavier weight paper

Paperclips/ binder clips

Scotch Tape

Straws

Tooth Picks

Bubble Wrap

Paper Plates

String

Plastic Cups

Packing Peanuts

Plastic Sandwich Bags

Play-doh / Modeling Clay

Plastic Food Storage Containers (eg gladware)

Balloons

String

Rubber Bands

Standard Weights (1kg, 2kg, etc)

Introduction / Motivation

Students will use their knowledge of forces and motion and apply engineering logic to solve a problem. Students will design model mars rover drop and evaluate and modify this design. Students will assess the effectiveness of a model rover in relation to a real NASA mars rover.

Review the background material with the students, discuss the vocabulary, then begin the activity.

Vocabulary / Definitions

| Word | Definition |
|-----------------------|--|
| Aeronautical engineer | An engineer concerned with the design and construction of aircraft. |
| Mars Rover | Any of a number of small unmanned remote-controlled vehicles sent to the planet Mars to do scientific research |
| drag | The force that resists the motion of the aircraft through the air. |
| Shock absorption | Smoothing out or dampening of shock impulse, and dissipation of kinetic energy. |

Procedure

Background

Students will be able to identify forces and explain why they lead to a specific motion. The students will understand the concept of lift, as well as the basic Bernoulli principle of flight. Students will design model paper airplanes and evaluate and compare designs. Students will assess the effectiveness of a model airplane in relation to a commercial airplane.

Before the Activity

Collect and distribute materials.

With the Students

Procedure:

1. Show students NASA video on the Mars Rover project as an introduction to the engineering and the basics of the project. Discuss with the students challenges in the design, how to “drop” the rover successfully without breaking it, ideas and questions they might have.
2. Introduce the “challenge” and hand out the Student project description worksheet (Space SD-2). Students must design a model Mars Rover drop that can be dropped from XX ft without breaking the fragile sensor equipment (in the model it will be an EGG). The rover must also be able to sustain the G-Forces involved in take-off and space travel. Therefore their model will be tested for how much weight it can hold. Students are to use only the given materials on their list, but must first create their design and then “purchase” their materials from the \$30 budget. (each material has a given price-assigned on their project description worksheet).
3. Have teams work on their design (SA 2.1).
4. Once the team agrees on a design, they may bring it up to the teacher (must include the list of parts, the total cost, must cost \$30 or less, must include a sketch and a description of how they plan to build it).

5. If the teacher finds the design sufficient (looks plausible), the team can “purchase” their supplies and SA-2.2.
6. Teams can build their model rovers.
7. Teams can then test and improve their model rovers.
8. Prior to competition each team is to fill out SA-2.3
9. Once rovers are all completed there will be a class “rover drop” competition. All rovers will be tested for their ability to drop without breaking their egg, losing equipment (any pieces of the design), and their ability to hold weight (using known weights).
10. After the competition students are to fill out their reflections in SA-2.4

Safety Issues

- Have a lookout underneath the drop point to redirect any passers-by.

Troubleshooting Tips

Help the students to consider the concepts of drag and shock absorption in the design of their rover.

Investigating Questions

See Activity Embedded Assessment

Assessment

Pre-Activity Assessment

None

Activity Embedded Assessment

Print the following questions into a student worksheet:

Space SD-2

The Mars Rover Challenge

Team Name:

Team Members:

Date:

Engineering Challenge: To design a model Mars Rover that can carry expensive scientific equipment to Mars. The Rover needs to resist the forces of space and needs to withstand a drop onto the surface of Mars without breaking, or worse, breaking its expensive equipment. Your model Rover will therefore need to withstand a drop of at least 15-feet without breaking, or

breaking its equipment (EGG). To test how the rover will handle the G-Forces involved in take-off and space travel, each design will be weight tested to determine the maximum weight it is able to hold without destroying the egg inside.

Requirements: You can only use the supplies listed below, and you have only \$30 to spend on your design. You must discuss with your team your design and plan it out before you will be allowed to make your purchases. Your Rover must be able to drop without breaking or breaking its egg! It also must hold as much weight as possible!

Remember, the engineers in Ms. Dunn's Aeronautics Academy are working on this project as well! We want to come up with a better design than they do and beat them to MARS!

What issues do I have to consider in my design?

Design Description & Schematic:

Space SA-2.1

Team Name:

Date:

Project Notes:

Our initial design...

We decided to change...

Our final design...

Space SA-2.2

Mars Rover Parts Order Form

Team Name

| Material | | Cost | Quantity | Total Cost |
|---------------------------------|------------|-------|-------------------|------------|
| Construction Paper/Poster Board | 1 Sheet | 1.00 | | |
| Roll of Tape | each | 5.00 | | |
| Duct Tape | 1 meter | 2.00 | | |
| Paper Clips | Pack of 10 | 1.00 | | |
| Balloons | Each | 5.00 | | |
| Straws | Pack of 10 | 1.00 | | |
| Tooth Picks | Pack of 10 | 0.50 | | |
| Bubble Wrap | 1 Sheet | 10.00 | | |
| Paper Plate or bowl | Each | 1.00 | | |
| String/Ribbon | 1 meter | 1.00 | | |
| Plastic Cups | Each | 1.00 | | |
| Packing Peanuts | 1 Cup | 2.00 | | |
| Storage Containers | Each | 5.00 | | |
| Rubber Bands | Pack of 10 | 2.00 | | |
| Cotton Balls | 1 Cup | 2.00 | | |
| | | | Total Cost | |

The Mars Rover Challenge

Team Name:

Team Members:

Date:

Final Design Schematic:

Final Parts List:

Final Price:

First drop (2nd floor)

Did the egg break

YES

NO

Second drop (3rd floor)

Did the egg break

YES

NO

Total Score:

$$\left\{ \left(\frac{1 = \text{break}, 2 = \text{nobreak}}{2} \right) + \left(\frac{1 \text{ or } 2}{2} \right) + \left(\frac{\$30}{\text{Cost}} \right) \right\} * \frac{1}{3} = \left\{ \left(\frac{\quad}{2} \right) + \left(\frac{\quad}{2} \right) + \left(\frac{\$30}{\$ \quad} \right) \right\} * \frac{1}{3} = \text{---} \%$$

Space SA-2.4

The Mars Rover Challenge

Student Name:

Date:

Student Reflections on the project:

1. I thought that the project was
2. I liked/ disliked working with my group because
3. I learned
4. I would like to learn more about

Space SA-2.4

Post-Activity Assessment

Evaluation will be based upon teacher observation of student participation, completion of a rover model, and student completion of their activity worksheet (SA-2.1-2.3)/reflections (SA-2.4).

Activity Extensions

Extensions on the project could be to learn more about the Mars Rover's remote sensing and telecommunication. This could introduce the students to satellites, communications, circuits and electrical engineering applications.

Owner

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