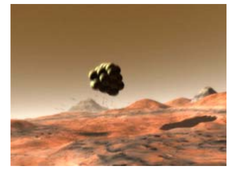


Airbags on the Moon

Engineering Design Brief (Teacher page)

Narrative: Getting scientific equipment to the Moon safely and in workable condition is a challenge for NASA scientists and engineers. Airbags in missions to Mars and in future missions to the Moon are used to cushion the landing of equipment on terrain that is rough and rocky. Sensitive scientific gear is essentially safely crash landed on the surface using inflatable airbag technology.

Problem: You are part of a team of NASA engineers who have been asked to design and create a prototype of an airbag landing system for future Moon voyages.

Learning Standards

Technology/Engineering
Appropriate materials, tools, and machines enable us to solve problems. Engineering design is an iterative process involving modeling and optimizing for developing technological solutions to problems within given constraints. Ideas can be communicated through engineering drawings, written reports, and pictures.

Research the Need or Problem: There are many good reasons to use airbag technology to land sensitive science gear on the Moon. You can learn more about airbag construction and inflatable structures at the following websites:

http://marsrovers.jpl.nasa.gov/mission/spacecraft_edl_airbags.html

http://marsrovers.jpl.nasa.gov/gallery/press/spirit/20040106a.html

http://www.lgarde.com/programs/iaearticle/awarticle.html

Materials: Balloons, hand pumps, scotch tape, meter sticks, raw egg

Brainstorming:
Students will be divided into engineering design teams of three to five students.
Cubing Activity (Attached)

Best Possible Solution:
Team members will work together to consolidate and organize their brainstorming ideas by answering the following questions: (Attached)

- What do we think we know about airbags?
- What do we still need to learn about airbags?
- What do we need to know in order to create a prototype of an airbag?

Construct a Prototype:
Each team will choose materials available to create a prototype of an airbag.

Test and Evaluate the Solution:

1. Test your airbag structure by placing a raw egg inside and drop from a height determined by your teacher. A successful design will land the egg intact.
2. Use the digital camera to photograph a movie of the airbag you have created as it is deployed

Communicate the Solution:

1. How successful was your airbag in keeping your egg safe?
2. Student self-assessment. (Attached)
3. Teacher and student evaluate the design process using the rubric provided. (Attached)

Redesign:
Based on the test results, what changes/modifications could be made to improve your airbag design?

Airbags on the Moon
Cubing Brainstorming Activity
(Teacher Page)

Background:

Cubing is a technique for *swiftly* considering a subject from 6 points of view. The emphasis is on ***swiftly*** and ***6***.

The process of cubing is one that writers use when they can't get going on a topic. It forces the writer to look at a subject from different perspectives in a 3 to 5 minute time period and then move quickly to another perspective. It is simply a technique.

The topic we will focus on in this activity is an airbag design. The goal is to have students brainstorm and focus on airbags from a variety of different perspectives. They must describe, compare, analyze, associate, apply, sketch, and make an argument to support their theory of how to design an airbag.

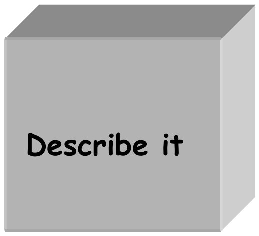
Students will be divided into groups of three to five students. Each group will be given a cube with six perspectives on the sides. Students will follow the **Rules for Cubing** on their activity page.

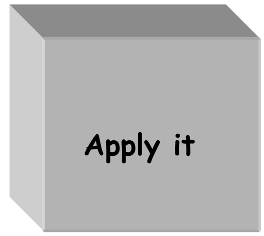
Upon completion of the cubing/brainstorming activity, groups should be encouraged to share their perspectives with the whole class.

As a result of this brainstorming activity, students will have had an opportunity to express their prior ideas about glovebox design from a variety of perspectives.

C U B I N G

Airbags on the Moon Design





RULES FOR CUBING

1. Use all six sides of the cube in any order.
2. Move fast. Don't allow yourself more than 3 to 5 minutes on each side of the cube.
3. Jot down your ideas as you progress from side to side.

For the cubing technique, you need to use all six sides. This is not an exercise in describing, analyzing, or arguing. It is simply a technique to help you brainstorm and look atairbags from different perspectives. There are no wrong answers in a brainstorming activity.

- Describe it. What do you think an airbag looks like? Color, shape, size, and so forth. Describe it.

- Compare it. What is it similar to? What is it different from?

- Associate it. What comes to mind when you think of an airbag? Just let your mind go and see what associations you can make.

- Analyze it. What materials would you need to make an airbag?

- Apply it. Tell what you can do with it. How can it be used?

- Argue for or against it. Go ahead and take a stand. Make an argument based on how you would design an airbag.

Now go back and reread the notes you have jotted down and prepare to share your team's perspectives with the rest of the class.

Sketch it. Based on available materials, make a sketch of the airbag your team will create. Your team must then work together to create a proposal, which you will present to the class, about what your team's airbag will look like.

Airbags on the Moon Engineering Design Process				
	Literal	**Developed**	**In-depth**	**Sophisticated**
Step 1: **Identify the need or problem - Cubing**	Limited perspective, many inaccuracies	Generally accurate assessment, but lacks perspective and/or accurate supportive information	Accurate and generally revealing, but needs more perspective from differing points of view	Clearly and accurately identifies problem verified by using differing perspectives
Step 2: **Research the need or problem - Evidence of Research**	Limited examination of the current state of the issue and current solutions	Generally accurate assessment, but lacks perspective and/or accurate supportive information	Thorough and accurate assessment, but needs more supportive evidence	Thorough and accurate assessment supported with strong evidence
Step 3: **Develop possible solutions – Possible Solutions Activity**	Limited perspective and limited academic disciplines explored	Limited brainstorming for possible solutions, and consideration of math or science	Good solution(s) and articulation of solution(s) in 2-3 dimensions, some use of math and science	Refined possible solution(s),articulated best solution in 2-3 dimensions, meaningful use of math and science
Step 4: **Select the best possible solutions**	Unclear about the relationship between the original requirements and the solutions	Clear understanding of the problem and the solutions, but insufficient data to determine the best solution	Good hypothesis, but lacks enough evidence even though data is extensive	Determination of best solution verified by evidence, trial and/or argument in relation to the original requirements
Step 5: **Construct a prototype**	Solutions remain in abstraction	Solution(s) can be modeled in limited dimensions	Good solution(s),but they are unable to be modeled in 2-3 dimensions	The selected solution(s) can be modeled in 2-3 dimensions
Step 6: **Test and evaluate solution(s)**	The prototype meets none of the original design constraints	The prototype meets some of the original design constraints	The prototype meets most of the original design constraints	The prototype meets the original design constraints
Step 7: **Communicate the solution(s)**	Weak presentation of how the solution best meets the needs of the problem, no inclusion of societal impact	Fair presentation of how the solution best meets the needs of the problem, some inclusion of societal impact	Good presentation and discussion of how the solution best meets the needs of the problem, societal impact and trade-offs	Excellent engineering presentation including discussion of prototype, societal impact and trade-offs
Step 8: **Redesign and Self-Assessment**	No revision, and/or little or no information	Incomplete revision, little information	Good revision, needs more information	Excellent revision based on information gathered during the tests and presentation