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| **Soft Landing System** | |
| **Background Information** | |
| Students have been studying the Earth, Moon, and Solar System. Hopefully, there has been some class discussion about the launch of the Mars Rover and the huge steps taken in space exploration, technology and documentation. Going into this project, students should have a working knowledge of space exploration technology and forces and motion. It is highly recommended that a video like the following be used to introduce this project:  <http://www.youtube.com/watch?v=h2I8AoB1xgU>  This video shows the challenges faced by NASA when they designed the landing system for the Mars Rover Curiosity.  <http://www.youtube.com/watch?v=svUJdzMHwmM>  This second video shows the reaction from engineers and technicians at NASA when they received word that the Curiosity Rover had landed safely. It’s not necessary to watch the entire video, but the big celebration is at about 3:12 into the video. 5:24 seconds shows reactions to the first images transmitted from the Curiosity. The curiosity cost roughly $2.5 billion to build and it was very important for NASA engineers to protect it! More information can be found at:  <http://www.nasa.gov/mission_pages/msl/index.html> | |
| **Design Challenge** | |
| NASA is looking for young engineers with promising skills. They want to find and help educate bright young people for future Mars and other planetary exploration! Your challenge is to create a soft landing system for a new exploration vehicle- THE EGG! Remember, this is a very expensive piece of equipment and it’s very important to keep it safe! Remember what you’ve learned about forces and motion as you work to protect this precious cargo! | |
| **Criteria** | |
| * Your egg vehicle will be inside a Ziploc bag. You will need to attach your soft landing system to the bag (Do not open the bag during construction) * Your soft landing system test will start from a height of 5 feet high. Each soft landing system that protects the egg at that height can be re-engineered to survive a drop from 7 feet. Any soft landing system that does NOT protect the egg from a 5 foot drop will be re-engineered and dropped again from the 5 foot height. * Any further testing (at higher increments) will be left up to the discretion of the teacher, based on time and resources available. * **You may use tape or glue and only 3 additional materials for your soft landing system** | |
| **Materials/Tools** | |
| * Class copies of the student journal * Cardboard building materials (tubes, boxes, etc) * Tape and/or glue * Scissors * Eggs * Cotton Balls * Resealable plastic sandwich bags * Construction paper * Balloons | * Plastic building materials * String or yarn * Popsicle sticks * Parachute material: plastic bags, wax paper, fabric scraps, etc * Bubble wrap * Newspaper * Students may request (or bring in) additional materials for construction |
| **Standards** | |
| Science:  Background Knowledge Standards:  S4E2. Students will model the position and motion of the earth in the solar system and will explain the role of relative position and motion in determining sequence of the phases of the moon.  S4E1. d. Identify how technology is used to observe distant objects in the sky.  Applied Standards:  **S4P3. Students will demonstrate the relationship between the application of a force and the resulting change in position and motion on an object.**  b. Using different size objects, observe how force affects speed and motion.  d. Demonstrate the effect of gravitational force on the motion of an object.  Math:  MGSE4.NF.3. Decompose, mixed numbers, word problems.  MSGSE4.NF.4. Multiply a fraction by a whole number. | |
| **Assessments/Rubric** | |
| * Teacher Observation/anecdotal notes * Completion of student journal * As a class, record the heights that finally cracked each group’s egg and analyze the data | |
| **Supplemental Resources** | |
| Literature Connections:  Nasir, Atika *Exploring Space for Kids: Tools That Made it Possible to Learn About Space*  (available as a Kindle Edition for free to Amazon Prime account holders)  The Curiosity Rover has a Twitter account! The posts are written as if the Rover itself posted them.  <https://twitter.com/MarsCuriosity>  Another Curiosity Video: Scientist explains how the landing system was developed <http://www.youtube.com/watch?v=weNKci8MrfI&list=PLJicmE8fK0Ejk2MO8WlaGGw7j13_fbc0A> | |

**NOTES:**

\*We recommend individuals or pairs for this activity. Small groups of 3 could work if the group is cooperative, but any larger than that isn’t a very good idea for this particular lesson. You can decide how to organize it based on the needs of individual students.

\* Feel free to talk to the students about this challenge beforehand. They may have some different items at home that they can use in their construction. Excellent!

\*The Egg is kept inside the bag for the sole purpose of containing the mess if it breaks.

\*We will provide enough eggs for each student or group to conduct TWO experiments. Please be prepared for the likelihood of someone breaking an egg before they begin testing (or even constructing). You may want to have an extra dozen or two on hand.

\*Measure and mark off a height of 5 feet (marked in fractions) and a height of 8 feet (marked in fractions) on the wall. This will be your testing area.

\*Whether you drop the egg or the students drop it is entirely up to you.

\*If you don’t get all of the requested materials, no big deal. Just work with what you have.

\*While the goal is for the students to construct their models independently, if you see a student struggle it is always a good idea to help guide their thinking.

\*The improvement step is very important to the STEM process. It is the step that teaches students to stick with it, “if at first you don’t succeed…” and all that. If their model worked great the first time, this step pushes them into a higher level of thinking about their invention. If their prototype didn’t work well the first time, this step teaches them to continue thinking, evaluate their own work, and possibly change strategies. This is what we are trying to get to transfer over to their academics.

\*Student journal pages are attached to this lesson. Feel free to alter them to suit your needs or create brand new ones (send me a copy if you do so we can share the resource).

\*Your team may decide on another “hook” or “wrap up”. Video clips, introductory activities, closing activities, etc. Totally up to you and your team. Study the lesson to decide how to break up your day.

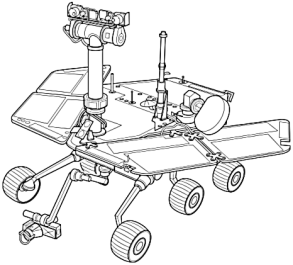
Drop Point 1- Hallway Upstairs/Downstairs

14 x 1/2= 7 ft

Drop Point 2- Playground

9/12 x 11= 8 ¼ ft

Drop Point 3- Stairwell

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Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Soft Landing System**

**Challenge:**

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**Criteria/Constraints:**

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* Your soft landing system test will start from a height of 5 feet high. Each soft landing system that protects the egg at that height can be re-engineered to survive a drop from 7 feet. Any soft landing system that does NOT protect the egg from a 5 foot drop will be re-engineered and dropped again from the 5 foot height.
* You may use **tape or glue and only 3 additional materials** for your soft landing system

**Possible Materials:**

Cardboard building materials (tubes, boxes, etc) Plastic building material

Tape and/or glue Cotton balls

Scissors Balloons

Eggs Bubble wrap and newspaper

Resealable plastic sandwich bags Construction paper

String or yarn Popsicle sticks

Parachute material: plastic bags, fabric scraps, etc Miscellaneous items

1. **ASK / ENGAGE:** What is the problem you are being asked to solve?

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1. **IMAGINE/BRAINSTORM:** What are some possible solutions to the problem that you are trying to solve? After you brainstorm, draw and label your ideas below.

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| **Idea #1** | **Idea #2** |

1. **PLAN/DESIGN:** Share your ideas with your group and collaborate to decide on a final design plan. Draw your team’s design below and make a list of the materials that you will need to complete your design.

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| **Team Design Plan** | **Materials List** |

1. **CREATE/TEST**: Use your Final Design Plan to create and build your solution. Test your design. Did it work? Why or Why not?

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1. **EVAULATE/IMPROVE:**  How well did your design work? Did your solution solve the problem within the given constraints?

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How can you improve your design? How can you make it better? Draw and label your improved design below.

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| **Improved Design Plan** |