



Classroom Teacher Preparation

Engineering 2: Rover Restraint

Please use the following to prepare for the next SfS lesson.

Description:

This module gives students a hands-on, team-oriented introduction to engineering within the context of space exploration. They learn about NASA's Mars rovers as examples of the challenges engineers face in balancing competing goals, while creating a lander for a mock rover to be tested in an egg drop.

Lesson Objectives – SWBAT (“Students Will Be Able To...”):

3rd-8th

- Solve the problem of landing an egg rover on ‘Mars’ by designing and building a lander, including defining constraints (e.g., limited materials, budget, and time) and identifying criteria for success (min. 2 for 3rd-5th, min. 3 for 6th-8th)
- Evaluate different design solutions for this problem

Disciplinary Core Idea (DCI)

ETS1 Engineering Design - EST1.A Define Design Problems

- (3rd-5th) Possible solutions to a problem are limited by available materials and resources (constraints).
- (6th-8th) The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful.

Science & Engineering Practice (SEP)

Constructing Explanations and Designing Solutions

- (3rd-5th) Apply scientific ideas to solve design problems
- (6th-8th) Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.

Crosscutting Concept (CCC)

Structure and Function

- (3rd-5th) Substructures have shapes and parts that serve functions
- (6th-8th) Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used

Preparation:

This lesson can be used as an introduction to both engineering and NASA. No preparation is necessary.

Room Set Up for Activities:

Students will work in small groups of 3-5 at their desks or tables. This lesson requires access to a controllable space where instructors can drop students’ constructions from an elevation of 8–20 feet (classroom window, open stairwell,



bleachers, etc.) If an open area is not available, a sturdy table for an instructor to stand on in the front of a classroom will work as well. *Warning:* this lesson tends to get noisy during the egg drop.

Safety:

Students should take care to only have one person blow up each balloon to avoid spreading of germs.

Allergy warning: this lesson uses latex balloons and raw eggs.

Related Modules:

This lesson may be taught as part of a sequence or group of related modules on **Engineering** or as part of a unit on **Space**. Other engineering modules include:

Engineering 3: Commuter Overload – Students build structures (e.g., bridges and tunnels) to enable commuters to cross a model of the Bosphorus Strait. Students test their designs with weights and analyze the data to see how many commuters they can support.

Engineering 4: Engineering Redesign (with Legos!) – Focuses on the redesign step of the Engineering and Design process, allowing students the chance to redesign and rebuild a Lego bookcase in order to easily transport it from classroom to classroom.

For other module sequences and groups, look here: www.sciencefromscientists.org/sequences

Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state: www.sciencefromscientists.org/standards/

Lessons are matched to both national NGSS and local state standards.

After Our Visit:

Our Classroom Post can be found on our website at sciencefromscientists.org/cohorts. Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at sciencefromscientists.org/open-response-questions. They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

For a Lesson Extension, we recommend trying a “Naked Egg Drop”. Instead of building protection around the egg, students will need to build a cushioned landing for their naked egg. This Extension can be used to make further connections to Engineering or to transition into learning about Energy! TeachEngineering offers a resource for this activity here: https://www.teachengineering.org/activities/view/ucd_eggdrop_activity1.

Additional Resources:

- NASA's home page for all Mars related missions, rovers and orbiters: <https://mars.nasa.gov/>
- Comparison of the Mars rovers: <https://www.jpl.nasa.gov/infographics/infographic.view.php?id=10889>
- The Faces of NASA: a great way to highlight careers available and humanize engineering: <https://mars.nasa.gov/people/>
- How space exploration affects our daily lives: https://spinoff.nasa.gov/Spinoff2008/tech_benefits.html
- Curiosity Rover's Twitter feed: <https://twitter.com/MarsCuriosity>
- Spirit & Opportunity's Twitter feed (“Oppy” is still active!): <https://twitter.com/MarsRovers>
- Mission control reacts as Curiosity lands on Mars (1:23): <https://www.youtube.com/watch?v=7DB60S7BYtA>
- The Curious Life of a Mars Rover – NatGeo Live (25:20): <https://www.youtube.com/watch?v=7zpojhd4hpl>