# Egg Lander

## Summary

In this activity, students will use the engineering design process to design and build devices to protect and accurately deliver dropped eggs. The devices and their contents represent care packages that must be safely delivered to people in a disaster area with no road access. Once the device is built, students will test it based on the given design criteria.

After completing this activity, students should be able to:

- Explain how engineers design and build devices to help people.
- Explain the difference between kinetic and potential energy.
- Understand the importance of a budget as it relates to building new devices

## Setting the Stage

Before the students start working, initiate an introduction/discussion about the topic using some of the following open-ended questions.

1. Have you ever heard of disaster relief supply package drops?
2. What two types of engineers would most likely work on building a lander for a delicate and expensive falling object like a Mars rover?
3. What other types of devices help cushion the impact of a material?
4. How does this design relate to football helmets or an air bag in a car?
5. Have you ever used a budget? Why are they important?

## Materials

Recommended materials based on worksheet per team:

- 1 raw egg (buy extras as inevitably some get broken before testing)
- 1 zipper bag
- 1 cup
- 1 balloon
- 1 foam sheet
- 3 rubber bands
- Measuring tape
- 1 m masking tape
- construction paper
- 3 straws
- Scissors

Teachers, you may choose to have other materials available for students as they design these egg-lander devices.

**Test Procedure**

1. Divide the class into groups of two/three students each.
2. After "Setting the Stage", inform students that engineers solve problems by first identifying the design requirements and constraints. For this design challenge, the **requirements and constraints** are:

- Design "something" that will protect your egg so it will survive the air drops.
- Not only must the dropped egg remain intact, but it must land close to the target area.
- Your building supplies are limited to what you are provided by the teacher.
- Your egg protection system will be tested from more than one height. (Tell students the heights.)
- You must leave some way for the teacher to check after each test drop to determine whether the egg is intact or has cracked. One simple method is to leave an opening or some access where the teacher can poke the egg with a finger. Feeling something wet or a flexing shell indicates that the egg has broken.
- You have _ _ _ minutes.

3. Direct students to brainstorm in their teams and then design their devices by making drawings along with short paragraphs that describe what they want to do and why. This is what engineers do. Doing this also encourages students to communicate their ideas to others, which is important when they work in groups, and helps them to analyze their ideas for merit.
4. Hand out the supplies, including the eggs. Warn students to be careful with the fragile cargo. Inform them that if they accidentally break an egg, they face a penalty (such as a loss of a few minutes of working time or loss of materials, in addition to cleaning up the mess).
5. When time is up, ask teams to bring their designs to the drop location. Perform the egg drop from the 3-foot height. Be sure the entire apparatus is above the required height. Test for broken eggs and ask students to measure and record the distances from the target.
6. Egg packages that survive the first height move on to the second height. If the teacher drops the egg, be sure to have the students indicate the desired way to drop it, as it may require a certain orientation to be most effective. Drop the eggs and test for broken shells. Ask students to help measure and record the distances from the designated target. Repeat until either all the eggs are broken, or you run out of heights or rounds.
7. Have each group discuss what they did and how their designs were intended to protect the eggs and ensure they landed close to the target. Make sure they describe what did and did not work about their designs, as well as what they might do to make them better. Ask them to relate their explanations to kinetic and potential energy and discuss how their designs dissipated energy without cracking the eggs. The most successful group is the one that survived the longest and achieved the least total distance from the target.

*Velocity Calculation:* Write an equation, and summarize student responses. Write the correct answer on the board.

- When falling, a balloon will immediately reach its terminal velocity. Drop a fully inflated balloon from 5 feet and record the time it takes to hit the ground. Have the students calculate its terminal velocity by the simple equation,

$$Velocity = \frac{distance}{time}$$

If it took 3.1 seconds to fall 5 feet, your answer would look like:

$$Velocity = \frac{5\,ft}{3.1\,s} = 1.6\,{}^{ft}/_{s}$$

## Vocabulary

- **acceleration**: The rate of change of velocity with respect to time. The measure of how fast the velocity of an object increases or decreases.
- **energy**: The capacity to do work. Several different types of energy include: mechanical, heat, electrical, magnetic, chemical, nuclear, sound or radiant. For the purposes of this activity and its associated lesson, we are focused primarily on mechanical energy since it is the energy of motion.
- **force**: Anything that tends to change the state of rest or motion of an object. Force is represented by two quantities; its magnitude and direction in space. The magnitude of a force is represented by quantities such as pounds, tons or Newtons. Direction in space refers literally to the direction a force is applied.
- **impact**: The striking of one object against another; collision.
- **kinetic energy**: The energy possessed by an object because of its motion.
- **mass**: A measure of how much matter an object contains, or the total number of particles in an object. Mass is not weight. Weight is the force caused on a mass by gravity. Thus, a person's mass would not change on different planets, but his/her weight would. For instance, you would weigh about 1/6th of your body weight now if you were on the moon.
- **potential energy**: The energy of a particle or system of particles resulting from position, or condition. Gravitational potential energy is based on how high off the ground an object is while other forms of potential energy include springs, batteries, or fuel.
- **velocity:** speed in a given direction

## Reference


Teach Engineering

https://www.teachengineering.org/activities/view/cub_mars_lesson05_activity1

https://www.teachengineering.org/activities/view/duk_consenergy_rde_act

How we landed on Mars with NASA Spirit

https://www.youtube.com/watch?v=6t3IARmIdOI

The Curious Life of a Mars Rover | Nat Geo Live

https://www.youtube.com/watch?v=7zpojhD4hpI

Special Operations Soldiers • Parachute Free-Fall Training

https://www.youtube.com/watch?v=GdwNCP1Vvl0

Protect the Egg

# Engineer's Notebook

Engineer's Name: Date:

Please list the quantity needed for each item to build your Egg-cellent Lander. Remember: you must track your costs and stay within a $1 budget.

| Item | Price | Quantity | Cost |
|---|---|---|---|
| Egg | Free | 1 | $.00 |
| Zip-lock Bag | Free | 1 | $.00 |
| Cups | $.10 | | |
| Balloons | $.10 | | |
| Foam | $.10 | | |
| Tape | $.05 per/in | | |
| | | | |
| | | Total | |

Please draw and label your Egg-cellent Lander design below:

| Trial | Height in ft | Cracked egg? |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |

Egg Lander

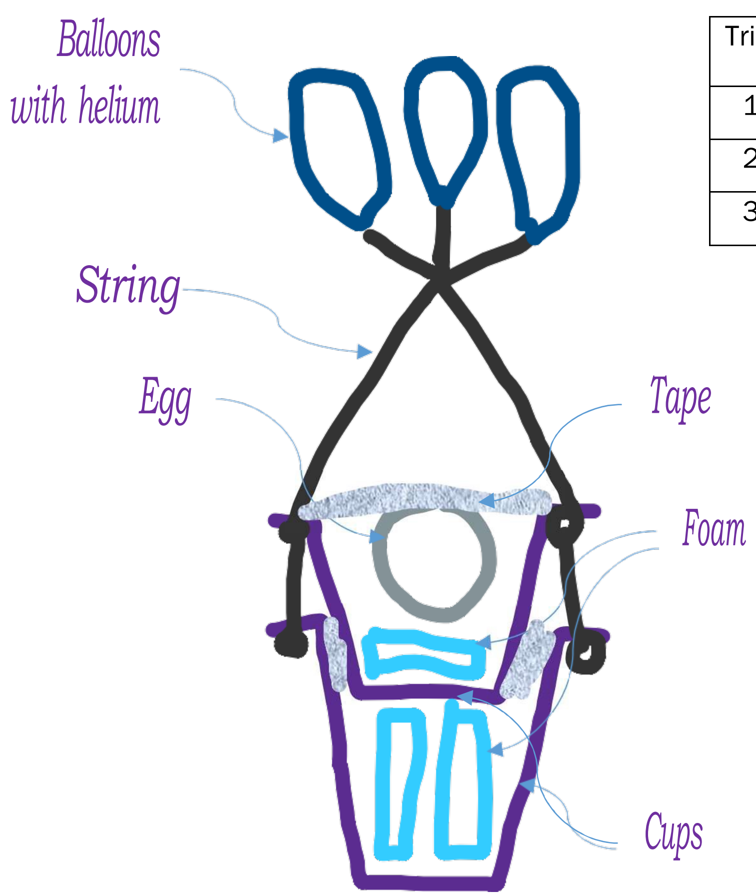
# Engineer's Notebook

Engineer's Name: EXAMPLE Date:

Please list the quantity needed for each item to build your Egg-cellent Lander. Remember: you must track your costs and stay within a $_____budget.

| Item | Price | Quantity | Cost |
|---|---|---|---|
| Egg | Free | 1 | $0.00 |
| Zip-lock Bag | Free | 1 | $0.00 |
| Cups | $0.10 | 2 | 0.20 |
| Balloons | $0.10 | 4 | 0.40 |
| Foam | $0.10 | 1 | 0.10 |
| Tape | $0.05 per/in | 4 | 0.20 |
| String | $0.05 per/ft | 2 | 0.10 |
| | | Total | $1.00 |

Please draw and label your Egg-cellent Lander design below:




| Trial | Height in ft | Cracked egg? |
|---|---|---|
| 1 | 3' | No |
| 2 | 6' | No |
| 3 | 9' | Yes |