

STEM DESIGN CHALLENGE 2013-2014



Egg Drop Challenge

Parameters

9th grade – Random groups design a single egg device

10th-12th grade – Mixed groups design a 2 egg device

Height – about 19 feet

Number per team: 3 students per team

Challenge Day: Saturday, February 8, 2014

Impound Time: Mr. Johnson's and Mrs. Faubel's room – Any time Friday until 5pm

Overview:

Part I: Students will **design and construct** a device of restricted size, which will keep a raw, Grade A, large egg from breaking or cracking. Students will have all semester to work on their device for this phase. This phase is to allow student to optimize their constructs. Winners will be determined by the scoring formula explained below. The three highest scoring entries will be awarded a prize. The Egg Drop Challenge is a test of creativity and understanding of physics. Students are tasked with creating a structure that will safely house an egg during a 19-foot free fall. The winning device will be decided upon based on a combination of lightest weight, the fewest number of parts, and the most accurate landing on the Drop Zone target (see equation at the end of the rules.) This challenge is NOT about packing an egg for a drop, as evidenced by the forbidden materials listed below. The purpose of this design is to have the lightest structure with an open air design as opposed to enclosure packaging of the egg. The Egg Drop Challenge is about redistributing impact forces. Competitors are encouraged to think outside the box, and may the best egg drop win!

Part II: The day of the challenge, students will be given new parameters on-site to build a new egg-drop device, using **post-consumable materials** within a specified time limit.

- More details coming in November.

Materials not allowed for Part I or Part II:

Packaging materials

Pre-formed boxes or containers

Bubble wrap

Styrofoam as packing material or shock absorbing

"Lighter than air materials" such as helium

Tupperware

Balloons

Any motorized items

Play dough

Bags or gloves filled with air acting as balloons Any edible items

No incendiary devices

No motors or electronics

Commercially constructed containers

Packing peanuts

Cotton balls

Bubble wrap

No parachutes

No propellants or propulsion devices

No wings

Soaked diapers

Any form of rotten liquid or rotten materials.

*** Any material students groups find questionable or they are uncertain about should be presented to the STEM squad for approval. STEM squad has final approval and may disqualify a material the day of the competition if necessary.

Rules:

1. Students must design and construct a device. **Commercially constructed containers are not allowed.** The device cannot attach to the building in any way. It must fall independently once released from the mechanism.
2. All scores will be determined using the Egg Drop Competition Official Rules equations. The goal of the egg drop competition is to obtain the lowest non-zero score. Any egg drop that results in the egg breaking receives a score of zero. All devices will be dropped from the same height.
3. Eggs may not be "**treated**" in any manner (e.g. hard-boiled as stated above, or by applying tape or any other material that adheres directly to the shell of the egg).
4. No lamination of materials.
5. The height measured for the drop is from the bottom of the release device.
6. In order to drop the device, all devices must have a loop at the top center of the device which is 1" inner diameter. The connecting loop may not extend more than three inches above the surface of the device and must still fit through the hoop.
7. The container may not contain any substance that will splatter including peanut butter, jell-o, liquids, fruits or vegetables, powdered soap, flammable substances of any kind or glass.
8. Inspected and defect-free eggs will be supplied on the day of the competition. Competitors will have the opportunity to inspect their own egg before competing. **No pre-loaded devices will be accepted. Devices must allow easy access to load eggs.**
9. The device will pass freely through an 18"-inch diameter "rigid", circular hoop (standard basketball rim) when the hoop is turned at all angles, including diagonally. "Freely" is defined as no change to the circular shape of the hoop. When the device is deployed, it may be contained in the space of a 10" x 10" x 10" cube. (The device itself does not have to be cuboidal in structure. The 10" x 10" x 10" cube is a rough building guideline and is not intended to specify the shape of the structure.)
10. The following requirements are given for the loading of the Device:
 - a. The devices should not be loaded with an egg before the competition.
 - a. All devices should be designed to be easily loaded by a third party at the competition, i.e. within one minute or less. The ease of inserting the egg into the device: the easier the device is to operate, the better the design. The following penalties will be incurred.
 - i. 0.5 – Egg does not fit in device
 - ii. 0.2 – Partial disassembling/assembling of device by staff required in order to insert egg i.e. Load Time > 30 seconds
 - iii. 0.1 – Multiple steps needed to insert egg (multiple pieces of tape/ Velcro etc) Load Time < 30 seconds
 - iv. 0 – Only one step required to insert egg (lift tape/lid/Velcro etc and insert) Load Time < 15 seconds
 - b. If there are special instructions for loading the device, these instructions should be provided on a regular 8.5" x 11" sheet of paper along with the team name(s), team members, taped to the device.
11. A successful drop is (Final discretion resides with judges):
 - a. One in which the egg lands in the target zone delineated by the image of frying pan
 - b. The egg doesn't show any signs of cracking. A broken egg is taken to be one with any cracks.
 - c. The egg remains in the device throughout the free-fall
12. A maximum of one drop will be allowed per team. Note: It is recommended that students test and redesign their device for part I of the challenge prior to competition day. "Practice the iterative process of engineering!"
13. For Part I of the challenge competition, modifications may be made to the structure prior to impounding the device. Once the device has been submitted for impound and weighing, no changes will be allowed to the device. The

device must be built before the students arrive at impound Friday February 7th, no alterations or adjustments will be permitted on site.

14. As part of the scoring process, the number of parts used for each device will be counted. Each individual piece will count as one part. For example, if the egg is cradled in 100 Styrofoam peanuts glued together the device will have 101 parts (100 parts peanuts and 1 part glue.) An Excel spreadsheet of each piece should be itemized by the group and turned in during the impound process.
15. Packages determined to be hazardous will not be dropped.
 - a. The safety cage/device can destruct upon impact. Designs may consist of any material that does not risk **shattering** upon impact, i.e. no glass components.
 - b. All devices must be **safe**, as determined by the judges. There should be no danger to spectators, the pavement, the building or anything else in the vicinity. For example, they can't be heavy enough to harm spectators.
16. The device must land in the drop zone to be considered a legal drop.
17. All devices must have the designated team number on the device.

JUDGING/ SCORING:

1. Specification Check:
 - a) Immediately upon submission for competition, the device receives a specification check to determine conformity to dimensions, materials, and construction rules. Any container that fails the specification check will be disqualified.
 - b) Package may not be modified for competition during or after specification check.
 - c) Judges **may disqualify** any entry if, in their opinion, the dropping of the package might create a safety hazard for spectators or property.
 - d) The package is weighed and its weight recorded.
2. Following the Specification Check, judges will review the Lab Report of each container that has passed the Specification Check.
3. Packages will be dropped from a **recommended** height of 19 feet. An impartial party will release the package.
4. The drop zone must be cleared by the team members after the dropping of each package.
5. Packages will be opened after the drop and inspected to determine the number of survivors.
6. Any egg broken, chipped, or cracked during extraction is considered a non-survivor.

SCORING:

$$Score = E \left[\frac{W}{5} + \frac{N}{4} + T \right]$$

Low score wins.

E = Egg Integrity Factor (1 if not cracked or 0 if cracked)

W = Weight in Grams

N = Number of Parts

T = Drop zone target points

Drop Zone points:

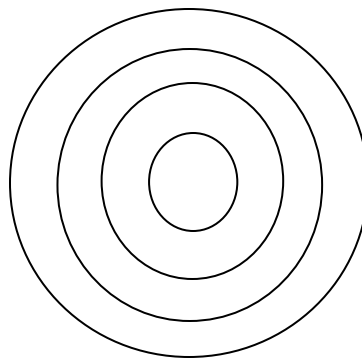
Inner ring (1ft diameter) = Zero points

Second ring (2ft diameter) = 2 points

Third ring (3ft diameter) = 4 points

Fourth ring (4th diameter) = 6 points

Outside the drop zone = 10 points



*Scoring equation and details are subject to change.

Disqualification

1. Any violation of the rules above will lead to disqualification.
2. In particular, teams that the judges feel have violated safety considerations and/or the spirit of the competition will be disqualified
3. Any team whose device hits the walls during the fall will be disqualified.
4. Good sportsmanship is expected from all participants, parents, and sponsors. Any dissension with rulings by judges, which are final, may result in participant disqualification.

STEM Squad reserves the right to modify the rules at any time, in order to clarify the competition.