Egg Drop Project

Congratulations! The National Association of Egg Shippers is inviting you design a Better Egg Shipping System (BESS). Your BESS should protect an egg that is dropped better than the traditional egg cartons seen your local grocery store.

Background - Eggs have hard shells but these shells break easily if too big of a force acts on them. When an egg hits the floor, the impact force has to be less then the shell strength or the egg will break. In other words, the smaller the impact force the better the chance the egg will survive. The impact force acting on the egg is calculated using this equation:

$$\text{Impact Force} = \frac{\text{Mass } \mathbf{X} \text{ Change in speed}}{\text{Stopping Distance}}$$

There are three ways to make the impact force small:

- Keep the mass small – So, you want your BESS to be light
- Keep the speed small – So, you want your BESS to fall slowly
- Make the stopping distance long – So, you want your egg to start stopping several cm above the ground, not right at the ground.

Cars are designed with two safety features to increase the stopping distance for passengers in a crash. The front of all cars are designed to "crush" so that the bumper hits and stops, but the passenger compartment (the seats) continues moving forward and slows down before stopping. Then, air bags allow the passengers to travel even further in a soft material before stopping. By having a long stopping distance, the impact force is kept small enough that most people are not hurt.

A good BESS will also use this same idea. It will include a "crush zone" around your egg so it has some extra distance to slow down & then stop after the outside of the container has hit the ground and already stopped.

Project Activities – Students will design and then build a BESS. The BESS should protect the egg from breaking and be able to fall on a target. The BESS will be loaded with a raw egg and tested by dropping it from at least 3 meters (1 story). Students will turn in their design and a report of their work.

Project Goal – Students will be able to explain:

1) How their BESS was designed to have the smallest impact force. Did you design your BESS to keep the mass small, the speed slow, the stopping distance long, or some combination of these?
2) Why their egg survived or did not survive the impact and
3) What they could do improve their BESS.

BESS Design

Your design needs to balance the three variables (mass, falling speed and stopping distance) to achieve the smallest impact force. The student who's egg survives, has the lightest BESS, and falls closest to the target will be declared the class winner.

Design Questions

Which force can you use to make your egg drop slowly, but still land on the target?
What kind of materials can you use to build your BESS that will keep the mass small?
How can you make a container that allows your egg to stop over a "long" distance?

BESS Objective

Create a design that prevents an egg from breaking when dropped from 3 m.

• Points will be added for lighter designs & for BESS's that fall closer to the target

Design Rules

• No pre-made containers may be used. Pre-made containers would include cups, bowls, complete boxes, plastic eggs, etc. Parts of these may be used, but not the whole unmodified container.

• You may not wrap your egg with a product & present this as your design.

• A BESS must be created by the student that demonstrates your understanding of how you will reduce the impact force. Packing a bag full of one item (like cotton) is not an example of a design. I am interested in seeing your thought process of how you will minimize the impact force when creating your design.

• I must be able to set a medium size egg into your BESS on the day of the testing. The egg can not be glued, taped or attached to the BESS.

Materials that MAY be used:

• Pieces of Cardboard cut from other containers (to make your own container) & empty cardboard tubes

• Sheets of paper – any kind of paper is acceptable

• Rubber bands & balloons that are not inflated

• Less than 10 Cotton balls

• Drinking Straws, Toothpicks, wooden match sticks

• String, wire, twist ties

• Ask your teacher if you have a different item in mind that does not fall on the unapproved list to see if it is Ok to use.

Items that you MAY NOT use include: quilt batting, bubble wrap, packing peanuts (any type), foam rubber products (Nerf balls & sponges), polystyrene products (Styrofoam), food products, insulation products, diapers or other absorbent products, rolls of toilet paper – (the empty tubes may be used), stuffed animals, no liquids, shaving cream, Gak® & Gak- like products or inflated balloons. Ask if you are uncertain if the product will be accepted or not.

BESS Containers that do not protect the egg (the egg breaks) will be thrown away immediately after the test.

What will be collected:

1. Your design picture and revisions. Plans must include a detailed sketch of your BESS (no, not every toothpick and rubber band, but groups of the same materials). Your sketch should show what your BESS will look like and where the egg will set. Label on your sketch what each part is made of, how it is connected to the other parts, and what is it for ("These toothpicks that will be glued together form my crush zone"). If you change your design while building your BESS, you will need to make a revised design picture that shows how your actual BESS looked.

2. A complete written description of your design and an explanation of why your BESS is designed that way. What were you trying to accomplish with that design? (" I was trying to design a container so my egg wouldn't break." Is not an explanation.)

3. A written explanation of why your egg survived (or did not survive) the impact and what you could do improve your BESS. Students that are striving to get an A on their project, but their egg broke, may still receive an A if they analyze in their concluding paragraph (with great detail) why their egg broke by relating the concepts of forces to their design. Design improvements should include reasons based on the concept of impact force and what can be done to minimize it that you have learned from your project and from what others did for their projects.

Egg Drop Project Rubric

Name _____
Science, Period _____
Due dates:
Design _____
Built _____
Test _____
Report_____

- Egg Contributed

Parent Signature:_____ (10 points)

Design

5 points	3 points	1 point	0 point
Completed on time		1 day late	More than 1 day late
Sketch is detailed	Sketch show some detail	Sketch shows little detail	Missing/mostly incomplete
Legend is complete. All materials identified	Most building materials are identified	Some building materials are identified	Missing/mostly incomplete
Egg location is shown and labeled on the sketch	Egg location is implied and some labels are present but assumptions must be made	Egg location is poorly shown or not labeled	Missing or confusing
Design effect on impact force is clearly stated	Design effect on impact force is partially explained	Design effect on impact force is implied	Missing or confusing
Written description explains how the design features effect the impact force	Written description mostly explains how the design features effect the impact force	Written description attempts to explains how the design features effect the impact force	Missing or confusing
Written explanation is 3 to 5 paragraphs	Written explanation is 2 paragraphs or consists of paragraph fragments	Written explanation is only 1 paragraph	Missing or less than 1 paragraph

Build

No excluded materials are used	Some excluded materials are used (1-2 parts)	Many excluded materials are use	BESS is mostly made of excluded materials
Less than 100 grams	100 to 300 grams	300 to 500 grams	More than 500 grams
BESS is built as shown in the design paper or revised design paper	BESS has minor differences from the design/revised design	BESS is significantly different than the design revised design	The design was not returned with the completed BESS

Test

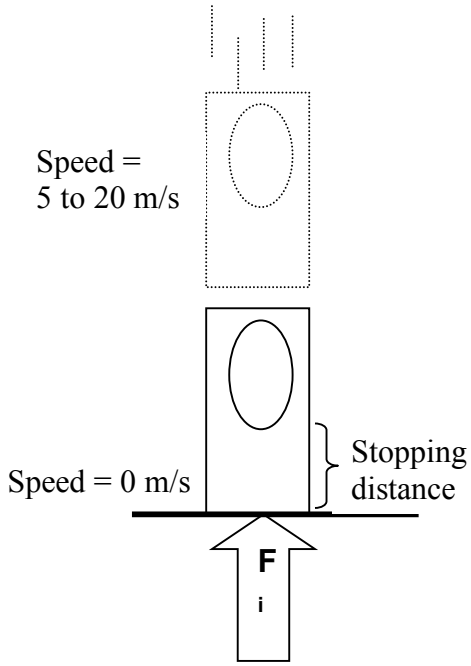
Egg Survives & can be re-used	Minor crack in egg	Egg breaks when being removed from BESS	Egg breaks in BESS
Egg lands on target	Egg lands within 1 m of the target edge	Egg lands on tarp	Egg hits wall **or** lands off of tarp

Report

Writing is only students	Student uses 1 to 2 sentence starters	Student uses 3 to 5 sentence starters	Student uses only sentence starters
Clearly explains why egg did (not) survive	Partial explanation of why egg did/not survive	Explanation attempted but confusing or wrong	Missing
Clearly explains how BESS could be improved	Partial explanation of how BESS could be improved	Explanation attempted but confusing or wrong	Missing
Report is 4 to 5 paragraphs	Report is 2-3 paragraphs or consists of paragraph fragments	Report is only 1 paragraph	Missing or less than 1 paragraph
Completed on time		1 day late	More than 1 day late

_____ Design Sheet

$$\text{Impact Force} = \frac{\text{Mass } \mathbf{X} \text{ Change in speed}}{\text{Distance needed to stop}}$$



My design will have a small impact force because:

- It will be light weight. I will build it using:
- It will fall slowly because
- It will have a large stopping distance. The "Crush Zone" space is made of

  and will be filled with

This is a picture of my BESS:

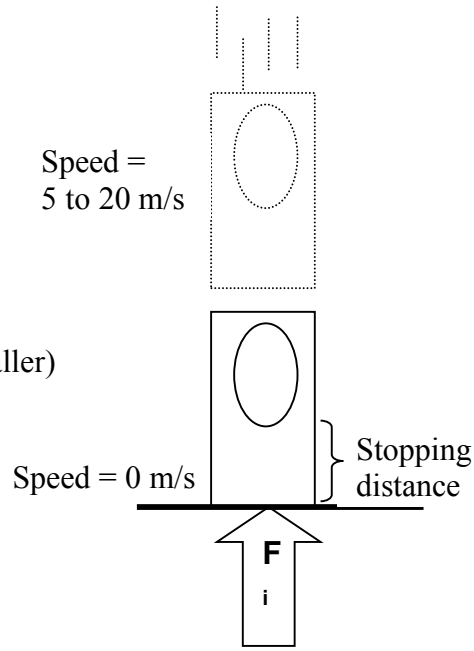
Legend
Egg =

Crush Zone =

Building Materials

_____ Design Sheet

$$\text{Impact Force} = \frac{\text{Mass } \mathbf{X} \text{ Change in speed}}{\text{Distance needed to stop}}$$



My design will reduce the impact force by:
(list each design *feature* and what it does to make the impact force smaller)

This is a picture of my BESS:

Legend