Cradle of Aviation Egg Drop

Guidelines and Rules:

Originality and creativity are encouraged!

- Students may work individually or in pairs.
- Weight cannot exceed three pounds.
- Design cannot involve liquids, helium, other gasses, glass or metal.
- Feel free to use a variety of different materials and take time in designing your device. A towel simply wrapped in duct tape is not a well thought out solution.
- Egg device cannot exceed one foot in length, width or height including wings. The egg will be placed in your container just prior to being **dropped so it must be able to open and close EASILY.**
- Eggs will be provided by the museum.
- The capsules will be dropped from different locations onto the 1st floor. There will be one drop area for each age group. The 1-2nd grade group will drop one floor while the 3-5 and 6-8 grade groups will drop two floors.
- Winners will be chosen based in this order:
  - The egg must survive the fall
  - The closest to the center (The device will score points depending on how close it is to the target)
- Participants will be assigned a scheduled drop place the day of the competition. At the time of your drop, you must report to the appropriate floor. Latecomers will be rescheduled if there is time.

Cradle of Aviation Museum One Davis Avenue, Garden City, NY 11530 ✪ 516.572.4111

Cradle of Aviation Egg Drop

Your Egg-citing Challenge

The goal of this challenge is to have a raw chicken egg survive a fall of approximately 18 feet for the 1st and 2nd graders or 30 feet for the 3rd-5th graders and 6th-8th graders. Let's look at the elements of the problem.

- Eggshells are remarkably strong. If you hold an egg in the palm of your hand and try to crush it by wrapping your fingers around it and squeezing, you will find that it takes a large force to crack the shell. However, the shell can be broken rather easily by hitting a small area with a hard object. Therefore, you need to protect your egg from very large forces applied all over and from moderate forces applied to small areas of contact.

- Falling objects are pulled toward the earth by the force of gravity. The farther they fall, the faster they will be going when they stop. When an egg reaches the floor after an 18 foot drop it will be going approximately 36 feet per second and will be stopped very suddenly when it hits the floor (this is called the impact). Its speed when it hits the floor is about 24 miles per hour.

- An unprotected egg falling 18 feet onto a hard surface will encounter the worst situation—a very large force applied to the small area where the egg first contacts the floor. The large force arises because the egg is going fast and because it is stopped suddenly. The egg will break!

- An additional factor is the mass of the egg and its package. This plays a role, since the mass of the falling object affects the impact force. By requiring that all entries use chicken eggs, we can assure that the mass of each egg is essentially the same. That is why other kinds of eggs are not allowed. But the packaging material adds mass, and that must be a consideration when the package is designed. The two things you can do to reduce the force on the egg are to slow the egg down and lengthen the time of impact. You can design a package that will do either or both of these things.

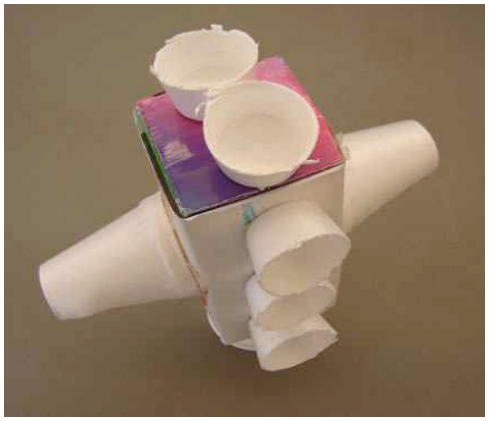
- Slowing the egg down as it falls can be accomplished by using a parachute, wings, streamers or similar device that relies on the resistance of air known as "drag." As a parachute expands during descent, more air is trapped and drag increases. With a falling object, drag pushes in the opposite direction of gravity and slows the rate of the fall. Therefore the construction of the parachute is important. Wings slow descent by increasing the surface area and therefore drag. Wings also affect the direction of fall, and should be designed to allow the egg to fall vertically. Streamers allow the device to fall straighter. They also deploy quicker than a parachute but are usually not nearly as effective. Will the size of the parachute affect the rate of fall? What materials are best for parachutes? Will the size of wings affect the fall? Is the position of the wings important? Why? Do you think it is possible to construct a parachute that is so effective in slowing the descent of the egg that the egg would not have to be protected? How long should your streamers be? Would it be better to have more, shorter streamers? What materials would make good streamers without adding too much weight?

- The faster the descent of the egg, the more important the packing around the egg. An egg in free fall (no parachute or wings) needs more effective packing than an egg with a parachute or wings.

- Soft, crushable packing that encloses a lot of air is best. Foam rubber, feathers, cotton or synthetic batting are all good "cushioners." Think of other materials that are soft and yielding, and incorporate air (foam peanuts, milkweed fluff, etc.). What soft, fluffy materials could be tried? How can you minimize the mass of the package?

- A word of caution—**water and other liquids are not permitted under the rules of the contest**. And liquids do not make good "cushioners." It is true that water distributes the impact force over the total surface of the egg, but water adds mass. This increases the stopping force considerably. Since water is virtually incompressible, the egg stops abruptly and is unlikely to survive. The use of Jell-o involves similar problems and is not allowed. What do you think would happen if you dropped a water balloon from the same height? Would it be easier or harder to protect than an egg?

Here are a few egg-samples that will get those wheels turning!



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