STUDENT ACTIVITY

Name: _____ Class: _____ Date: _____

CRASH SCIENCE IN THE CLASSROOM

EGG CRASH! ENGINEERING A CRASH CUSION

MATERIALS NEEDED

For each group of 2-3 students

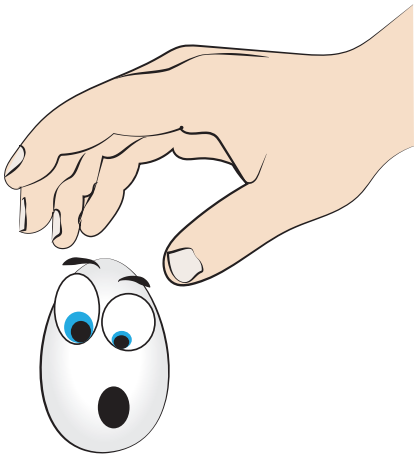
- 10 sheets of 8.5” x 11” copier paper
- One meter of masking tape
- One pair of scissors
- One raw, grade A medium or large egg (plus a few extra for accidental breakage before testing!)
- **OPTIONAL:** One plastic “Easter” egg for conducting practice “dry” runs with the crash cushions

Per Student

- One copy of the “Egg Crash! Engineering a Crash Cushion” Student Activity Sheet

Key Question(s)

- How do people survive major vehicle collisions?
- How do the laws and principles of physics demonstrate the effectiveness of seat belts and airbags?



Purpose

- To design, build, test, and evaluate the effectiveness of a crash cushion (landing pad) to protect an egg during a collision with a hard surface
- To describe a collision in terms of changing momentum, impulse, impact force, and impact time

Did You Know?

Just as scientists and engineers design and test prototypes of potential crash cushions in simulations, as part of this activity, you will work in groups to design, build, test, and evaluate the effectiveness of a “crash cusion” to protect a raw egg during a collision with a hard surface. This experience should help you observe and document the laws and principles of physics that help scientists and engineers design “EGGcellent” real-world safety devices for vehicles!

Design Challenge

Using no more than 10 sheets of 8.5” x 11” copier paper and one meter of masking tape, follow the parameters listed on the back of this sheet to design, build, and test a crash cushion (landing pad) to protect a raw egg when dropped from successively greater heights.

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Crash Cushion Engineering Design Parameters

1. The crash cushion (landing pad) can be made using less, but no more, than 10 sheets of paper.

   Keep track of the amount of paper used to build your crash cushion. In the event of a tie, the device constructed with the fewest sheets of paper will be declared the superior safety device.

2. Your crash cushion must be free-standing and moveable. During testing, groups cannot support their devices by holding them, propping them up against walls or any other structures, or taping them to the floor or another structure.

3. Nothing may be attached to the egg.

4. Scissors may not be part of the device.

5. Drop height will be measured from the bottom of the egg at the release point to the floor.

6. Eggs must be dropped by a member of each group's design team.

7. Eggs that miss the crash cushion when dropped will be eliminated even if they do not crack or break.

8. Eggs will be inspected before and after each drop. Any egg with a crack will be eliminated.

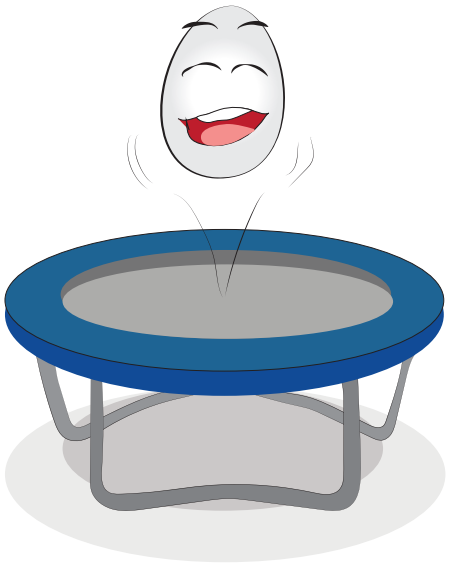
   Eggs that survive the initial impact with the crash cushion but are then ejected (roll or bounce off the device) will be eliminated even if they do not crack or break.

9. In between rounds, groups whose eggs crack or break by accident or carelessness will still be eliminated.

10. In order to simulate car collisions with greater momentum, eggs will be dropped from successively greater heights at each round (1.0 m, 1.5 m, 2.0 m, 2.5 m)

11. All crash cushions must be completed within the initial 20-minute construction time limit.

12. Groups may not make any repairs/adjustments/improvements to their devices once the testing process begins. If your device is damaged in one round, it must be used "as is" with no repair in successive rounds.



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Pre-Testing Analysis Questions

1. Draw and label a diagram of your group's crash cushion in the space below.

2. Briefly describe your team's crash cushion and the reasoning behind your design. In other words, explain WHY you chose the particular design features of your device.

EGG CRASH! ENGINEERING A CRASH CUSHION

Post-Testing Analysis Questions

1. Overall, which types of crash cushions features were the most and least effective in this simulation and why?

2. As the drop height increased with each round, the amount of momentum the eggs experienced in their collisions with the landing pads also increased. Identify at least 2 crash cushion design features that were especially important/useful for successful drops of eggs from greater heights (i.e., collisions with greater momentum).

3. Often, even groups with well-designed and soundly-constructed crash cushions are not successful when eggs are dropped from greater heights. Identify at least 2 other reasons egg drops from greater heights are more challenging regardless of the quality of the landing pad.

4. After your class discussion/review of the concepts of **momentum**, **impulse**, **impact force**, and **impact time**, use **all four** of these terms to explain how your group's crash cushion could be modified to better simulate the safety benefits of vehicle airbags.
(HINT: To reduce the chances of injury, should the momentum, impulse, impact force, and impact time of a vehicle occupant's collision with the interior of the vehicle be increased or decreased?)

Post-Testing Analysis Questions (continued)

5. Compare the impulses, impact forces, and impact times in the following two scenarios:

A. Speeding Race Car #1 comes to a stop by hitting the wall of the track head on.

B. Speeding Race Car #2 comes to a stop by skidding a great distance and scraping its side along the wall of the track.

6. According to the National Highway Traffic Safety Administration, thousands of people are alive today because of the addition of airbags to vehicles that already contain seat belts. Explain why airbags alone are NOT safe alternatives to seat belts, but instead are intended to be used along with seat belts to prevent or reduce injury.