Paper Car Crash Design Requirements

Crash Inquiry Questions

- Is it possible to build a car frame and body from paper and glue that is strong enough to protect a raw egg during a head-on collision?
- What engineering and design features determine a vehicle's crashworthiness?

Purpose

The object of the Paper Car Crash Design Contest is to apply your science knowledge and skills to design and build the most crashworthy car that includes a minimum of 3 safety design features. Crashworthiness will be based on two criteria: 1. The car with the greatest momentum at the time of collision, and, 2. A car in which the occupant (egg) is neither injured (cracked shell) nor killed (broken shell) as a result of the collision.

Grouping Format

You may work alone or with a partner.

Materials Provided (per student or pair of students)

- Copy paper, 2 sheets, 21.6 cm x 27.9 cm (8½ in. x 11 in.)
- Scissors
- Wheels and axles (2 sets)
- Plastic drinking straw (only used for axle housings)
- Glue (glue sticks and glue guns)
- Colored pencils, crayons, and markers for vehicle decoration (no stickers or paint)
- Centimeter ruler
- Metric balance
- One raw, Grade A, large egg (NOTE: Wash hands thoroughly with soap and water after handling raw eggs, especially if they crack or break!)
- Stopwatch

Design Considerations

Successful science and engineering inquiry requires a variety of skills to identify problems/needs, create initial design plans, and test, change, and improve designs. Habits of mind and other traits such as logical reasoning, patience, insight, energy, creativity, persistence, and openness to new ideas must be combined with a sound knowledge base in order to succeed. To assist with your design process, consider the following questions:

- Should your vehicle be rigid and strong (like a 1950s muscle car) or is it better if it collapses (like an Indy racing car)?
- Should the occupant (egg) be able to move freely in the vehicle or should it be strapped tightly to the vehicle?
- How can your vehicle be designed to easily remove and inspect the egg after a crash?

Design Product/Presentation

Your challenge is to design and build a car with the greatest momentum (i.e., fast and massive) using only two sheets of copy paper and unlimited amounts of glue for the car's

frame and body. Your paper car must be able to carry a raw egg down an inclined racetrack ramp and protect it during a crash with a concrete block. Your teacher will provide the wheels, axles, and axle housing for construction of your car. Read the rules/specifications listed below before beginning your design process and remember that in order to win, you must have BOTH a car with the greatest momentum AND an egg occupant that survives the crash unharmed.

On the day of the car crash contest, you must introduce your design to the class and identify at least 3 safety design features you incorporated into your car's design.

Design Timeline

You have one week to design and build your car. Approximately 100 minutes of class time (two 50-minute periods) will be provided for design brainstorming, vehicle building, vehicle testing, and design revision. The rest of your work should be completed on your own time.

Rules and Specifications

1. Maximum car width: $\leq$ 6.5 centimeters (including axles and wheels)
2. Maximum car length: $\leq$ 16.5 centimeters
3. Minimum car mass without the egg: $\geq$ 40 grams
4. Glue, paper, wheels, axles, and the straw-axle housing are the only construction materials allowed. The entire frame of the car must be made of paper and glue.
5. Your vehicle will be disqualified if it exceeds length and width dimensions, does not meet minimum mass requirements, or contains stickers, paint, tape, cardboard or any other non-licensed materials that contribute to the structural integrity of the vehicle.
6. Vehicle designs must allow for easy access to and removal of the egg (occupant) for inspection after the crash.
7. Vehicle designs should be able to withstand 2-3 trials/collisions without parts replacement or repairs.
8. There can be no physical contact between the vehicle and the designer once the vehicle has been released onto the track.
9. All vehicles must visibly display the following information on their frames:
   a. vehicle name
   b. builder's name
   c. vehicle length in centimeters
   d. vehicle mass in grams