Engineering Design Challenge: Egg Car Crash

Overview: You are a member of an automotive design team. The company’s newest model has come under some criticism since being released last fall. It has been determined that the bumper and restraint systems are “not all they were cracked up to be.” They do not perform as well as previously tested.

Your Challenge:
You and your design team must redesign the bumper and safety restraint system of a car. The vehicle's occupants (eggs) must survive a full speed head-on collision.

Materials:
Each group will receive the same materials
- 1 sheet of computer paper
- 1 foam ring
- 4 rubber bands
- 18” piece of masking tape
- 6 wooden coffee stirrers
- 6” x 3” piece of foamboard
- 2 paper cups, 3 oz size
- 4 paper clips
- 6 foam packing peanuts
- 4 straws

Each group can bring one material from home to use. The material must not exceed 6” x 6” and ½” thick.

Purpose:
With the materials given to you, design 1) a restraint system to hold your eggs on the vehicle, and 2) a bumper system to help protect your eggs during a head-on collision.

Procedure:

Day 1: Brainstorming
1. Students will be given samples of the building materials, but students CANNOT modify the materials or begin building.
2. Each student will brainstorm with their team to come up with initial designs for the restraint system and bumper system that they will build on Day 2.
3. Students will plan with their team members what materials they would like to bring in from home (optional).
4. Students may choose to create and share a Google Doc with their team members, so they can collaborate on their design outside of class (optional).
5. Initial plans must be submitted to the teacher before teams can start building on Day 2.

Day 2: Building
1. Teams will submit their initial plans to the teacher before they can start building.
2. Any materials brought from home must be approved before use. All materials brought from home must fit within a 6” x 6” square, and must have a depth of no more than ½”. Materials from home cannot be folded or compressed in any way.
3. Teams will build their bumper and restraint systems during class. Building requirements are as follows:
   a. Teams can only use materials given in class and approved materials from home.
   b. Only one material from home can be used per group.
   c. If a material is ruined during building, no replacement materials will be provided.
   d. The bumper and restraint system must built so they can be attached to the car within 3 minutes. Students must attach their systems to the car immediately prior to testing. A sample test car will be available for teams to view, but bumper and restraint systems may not be attached to the cars until the test day.
   e. Eggs will be available for teams during building.
   f. Eggs and completed bumper and restraint systems must remain in the classroom; students are NOT allowed to take their designs home.

Day 3: Testing
1. No building will be allowed on Test Day. Each team will be given 3 minutes to assemble their restraint and bumper systems on the test vehicle.
2. The restraint system holding the eggs must be placed so that it makes contact with the front bumper of the test vehicle.
3. Two eggs will be placed in a snack size clear plastic bag prior to testing (provided by your teacher). No other items can be placed in the bag with the eggs. Excess air will be removed from the bag.
4. Prior to testing, students will measure the mass (in kilograms) of their test vehicle with the attached bumper and restraint system. The eggs must be inside the vehicle when the mass is measured.
5. Students will launch their test car on the track provided by the teacher. Students will time how long it takes for the test car to travel down the track and into the barrier.
6. Using the time and mass data collected, students will calculate:
   a. the weight of the vehicle, \( F = ma \), \( a = \text{gravity} = 9.8 \text{ m/s/s} \)
   b. the speed of the vehicle, \( S = D/T \)
   c. the acceleration of the vehicle, \( A = (V_f - V_i)/T \)
   d. the force of impact of the vehicle, \( F = ma \)
   e. the momentum of the vehicle, \( p = mv \)
Egg Crash Group Project Score Sheet

Names ___________________________________________________

Block # ________  Group # ________________  Teacher _______________

Material from home: ___________________________  Teacher initials __________

Initial Design:

<table>
<thead>
<tr>
<th>Restraint System</th>
<th>Bumper System</th>
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<tbody>
<tr>
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</tbody>
</table>

Final Design (finished project):

<table>
<thead>
<tr>
<th>Restraint System</th>
<th>Bumper System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Finished Project:

Total **Mass** of car, restraint, bumper and eggs: ____________ (grams)

__________________________ (kilograms)

**Distance** of track: ______________________________ (cm)

_____________________________ (m)

**Time** for car to reach wall after start: ____________________ (s)

Calculations (**remember to include the correct units!**):

1. **Weight** (**remember, gravity is an acceleration and weight is a force!**)

2. **Speed** (**velocity**):

3. **Acceleration**:

4. **Force**:

5. **Momentum**: 