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 are required to design and build: a seat, restraint system (seat belt), body/roll cage, and a bumper. The vehicle's occupants (eggs) must survive a full speed head-on collision.

**Materials**

The following materials will be available in class to use. You do not need to use everything.

* Wheels (up to 4 per group)
* Wooden Dowels
* Straws
* Popsicle Sticks
* Rubber Bands
* Paper Clips
* Hot Glue
* Cardboard
* Foam Base (up to 1 per group)
* Duct Tape
* Pop bottles
* Styrofoam Cup
* Cotton Balls
* String
* Index Cards

**Each group can bring material from home to use. The material must be approved by me first before it can be brought in and used.**

**Constraints**

The vehicle carrying your egg will need to meet certain requirements.

* Egg must be able to see, meaning: there must be an opening, front window of some kind
* You may not use a system to slow down… brakes, parachute, etc.
* The vehicle must be no more than 8 inches wide.
* The vehicle must reach the bottom of the ramp.
* It must be possible to remove the egg from your vehicle.
* The car may not travel down the ramp backwards.
* No part of the egg may be glued to any part of the car or safety device.

Here are a few places to start research:

<http://www.physicsclassroom.com/mmedia/newtlaws/cci.cfm>

<http://www.physicsclassroom.com/Class/newtlaws>

<http://www.mrmont.com/games/crashtest.html>

**Procedure:**

**Day 1: Brainstorming/Research**

1. Students will be given a list of building materials but students cannot modify the materials or begin building.
2. Each student with their team members will research science concepts involved in a car crash (newton’s laws, mass, acceleration, etc.) and will research crash protection features (crumple zones, seat belts, roll cage, head restraints, air bags, etc.).
3. Each student will brainstorm with their team to come up with initial designs for the safety systems of their car, which they will build on day 2.
	1. Each team will come up with three different designs, agree on one of the designs to build and provide reasoning why you choose this design.
	2. Label each design with the materials used.
4. Students will plan with their team members what materials they would like to bring in from home (optional).

***Due before you are allowed to build:*** *The facts and information your team has researched to help better understand the task at hand. Three detailed diagrams of your crash car that you could build with the parts labeled. A list of materials that you will be using in your design process, including the ones you will bring from home if any.*

**Day 2&3: 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.
3. Teams will build their safety systems during class. Building requirements are as follows.
	1. Teams can only use materials given in class and approved materials from home.
	2. If a material is ruined during building, no replacement materials will be provided.
	3. Eggs will be available for teams during building for measurement and dimension purposes only
4. Each team will be given two days for construction.

**Day 4: Testing**

1. 15 minutes will be allowed at the beginning of class for any final adjustments to your design on test day.
2. **One Egg** 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.
3. Students will launch their test car on the track provided by the teacher.

**Scoring Rubric**

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| --- | --- | --- | --- | --- |
| **Category** | **4** | **3** | **2** | **1** |
| **Background Research** | The research is thorough and uses scientific terms to explain how common safety devices protect passengers in a crash. | The research is thorough, but only makes a limited attempt to use scientific terms to explain common safety devices. | The research identifies a number of common safety devices, but makes no attempt to connect them to scientific terms. | The research is very limited and does not reference any scientific terms. |
| **Designs** | The write-up includes three different designs with a thorough discussion of the strengths and weaknesses of each and a justification for which will be built, plus has a detailed list of materials. | The write-up includes three different designs with a very brief discussion of the strengths and weaknesses of each and a justification for which will be built. Provides most materials used.  | The write-up includes two different designs with some discussion of their strengths and weaknesses and a justification for which will be built OR has three different designs, but is missing the discussion. A few materials are listed.  | The journal has a single design with some discussion OR has more designs, but no discussion or analysis. No list of materials.  |
| **Final Product** | In addition to the requirements for a 2, the egg survives the crash completely intact. | In addition to the requirements for a 2, the egg has only a few cracks after the crash. | In addition to the requirements for a 1, the egg remains in the vehicle after the crash. | The vehicle fits on the ramp and holds an egg. When inside, the egg is visible and can be removed. |
| **Constraints Met** | Met all constraints | Did not meet one constraint | Did not meet two constraints | Did not meet three or more constraints |