2014

Transportation Technology

Egg Crash Vehicle

Developed By: Mr. Scott E. Mitchell

2014 Transportation Technology - Final Project

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Egg Crash Vehicle (ECV)

The Egg Crash Vehicle follows a proven hands-on, real-world problem-solving approach to learning. Students work in teams or as individuals to sketch and develop an original solution to a valid open-ended technical problem by applying the technical problem solving process. Students perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams or individuals sketch, build, and test their solutions.

Throughout the Egg Crash Vehicle, students learn and apply the design process, acquire strong teamwork and communication proficiency, and develop organizational, critical-thinking, and problem-solving skills. Through this hands-on project, students apply multiple disciplinary standards and document their work.

It's STEM education, and it's at the heart of today's high-tech, high-skill global economy.

The Egg Crash Vehicle complements traditional mathematics and science related courses and can serve as the foundation for STEM-centered or specialized technical education. The project is designed to prepare students for life after high school and to pursue a post-secondary education and/or careers in STEM-related fields.

KEY QUESTIONS

- What is the "PERFECT" crash?
- How does a seatbelt work?
- What is the right way to wear a seatbelt?
- Why can "strategic weaknesses" be a strength in vehicle safety?
- In a collision, what are bumpers good for?
- What are crumple zones, and what are they good for?
- By what percent do airbags reduce the risk of dying in a frontal crash?

At the end of the section students should be able to:

a. Create a sketch of their vehicle ideas
b. Select appropriate materials for the application and properly applied or manufactured
c. Construct a product that is aesthetically pleasing
d. Clearly state the problem to be solved
e. Convey a clear and concise message about the process taken to develop the product, and its features

Expectations

This project has been designed to demand approximately 10 hours per week of your time. It is expected that each student will prepare for and attend all of the class sessions and will regularly enhance class discussions. Most important though are substantial and continuous contributions to the progress of the team project. Experience with project-based technical courses is that students often develop high expectations for their projects and devote substantially more time than is required by the instructors. The Design Technology staff applauds this enthusiasm, but this class will not penalize students who establish a ten hour per week average time constraint for their efforts. After schools hours are always optional. Ask instructor for dates and time.

The Problem

You are a newly developed car company planning on designing and fabricating a vehicle to be built as the safest automobile on the road today. The CEO of the company has hired you to design and build their companies first commercially available vehicle developed to assure the safety of its passengers during any impact situation. The automotive industry is constantly striving towards having a higher level of safety in today's automobiles. Each new model line must pass through rigorous testing and standards and perhaps the most important testing that occurs is the ***Crash Test***. Vehicles are tested to their limit and safety is always the number one priority. Your vehicle will be subjected to the harshest crash testing scenario developed by the national automotive safety industry. Your vehicle will crash into walls or other cars to determine if the occupants would survive a real life crash, and the types of injuries they may sustain.

Objectives

- To design and construct a complete Egg Crash Vehicle using a restraint system and safety features to protect an occupant from a head on collision and/or rollover accident while using the appropriate materials that will safely carry an uncooked egg (driver) over a given distance without causing injury (cracked egg) or death (broken egg) to the driver upon impact with a barricade (concrete block) or another vehicle.

- If the egg (driver) survives the first crash test with no injuries then your vehicle and driver will be tested on the rollover ramp. If the driver survives the rollover test without injury or death, that student will receive Extra Credit.

Criteria & Rules of the ECV

- Vehicle needs to be developed based on your research of real world-automobile safety features.
- The vehicle must have 3 components to qualify for testing:
    - Frame with incorporated bumpers (suspension optional)
    - Interior (seat, seatbelts, protection suit, etc.)
    - Body (hardtop or convertible)
- The vehicle must be no longer than 15" in length including all bumpers and safety equipment.
- Vehicle must have some type of a front bumper ***system***.
- The vehicle must have 4 wheels minimum supplied by the instructor.
- The vehicle must fit within the limits of the ramp supplied by the instructor. (Inside rails only)
- The vehicle cannot be powered by any other means except for the incline it rolls from.
- The vehicle must carry an uncooked egg (driver).
- The egg must remain securely in the vehicle at all times.

Criteria & Rules of the ECV (continued)

- Egg must be placed vertically in vehicle.
- Egg cannot be glued or taped in the vehicle.
- Egg must be removed from car (after instructor approval) within 15 seconds after crash.
- No peanut butter or other food items are to be used.
- The driver/passenger must have an unobstructed 180 degrees field of vision out of the front and sides of the vehicle.
- A minimum of One-half (½) of the egg must be visible.
- Egg must be restrained by a seatbelt or seatbelt system.
- Egg must be removable, interchangeable and not hard-boiled.
- Vehicle must obtain a certain MPH determined by the instructor on test day.
- Remember, the vehicle's condition is not the important factor in assessing its success, as is the case in a real accident. The condition of your occupant(s), or egg, will be assessed immediately following the impact. ***NOTE:*** Students may have no interaction with the vehicle until the instructor has been able to determine the passenger's physical conditions.
- The teacher will supply eggs at the time of the competition and each egg will be returned to the teacher at the end of the class period. If egg breaks while testing, student must clean up egg before final grade is given. Failure to follow the above rules will result in a letter grade of "F".

Material List

Students must use only the material supplied by the instructor. Students may use their own material with instructor approval. The following is a list of appropriate material(s):

- Sintra (frame rails, vehicle exterior body and/or suspension components)
- Matte Board (seats or vehicle exterior body)
- Aluminum Sheet - .100 – .125 thick
- Copper Axle Rod .125
- Plastic Axle Bushings
- Thin Clear Plastic Sheets (window material)
- Rubber Bands (any size or length)
- String (any size or length)
- Plastic Wheels (provided by instructor)
- Cotton or Cotton Balls
- Straws – any type
- Fastener – any type
- Washers – any type
- Springs (purchased or hand-made)
- Syringes
- Rubber
- Styrofoam (internal or external use)
- Plastic
- Sponge (internal or external use)

Project Procedures

Research

Research Egg Crash Vehicles using the Internet or from past projects located on the school districts "I" Drive

The Design Process

Your sketched drawings are a road map to the final product and one of most essential parts of the overall concept. These drawings will be seen by the customer for review and used to help you in the fabrication process to build the product to the exact manufacturing specification.

Fabrication

It's time to build! Now that all of your documents have been assembled and approved by the instructor you can finally begin the building process. Rule number one: **SAFETY FIRST!** If at any time you abuse the fabrication lab rules and compromise the safety of yourself or your peers you will be removed from the fabrication lab for a day.

Measure twice; cut once is the old saying. Precision cutting and manufacturing is of the utmost importance. Machines are made to cut theoretically perfect; while hand sanding is an inaccurate process. You should think quality over quantity at this point and a better product means a better outcome for you…***YOUR GRADE***.

Remember other teams or individuals are using the same tools as you so be patient and wait for an open machine. Also remember you will only be given supplies and materials that are documented. If you make a mistake this costs time and money so try to keep them to a minimum.

Final Summary Reflection Report

This is the final section of the project. Once you've created your product you will be required to turn in a Final Summary Reflection Report. Your instructor will discuss with you the details and requirements of this final report. See Summary Report Reflection Report Handout.

Time Line – Weekly Event Schedule

Description	***Week No.***	***Days of the Month 2013***
• Introduction / Research	Week 1	Apr 23rd – Apr 25th
• Design Sketches	Week 2	Apr 28th – Apr 29th
• Fabrication	Week 2 – 4	Apr 30th – May 16th
• Performance Testing	Week 5	May 19th – May 23rd
• Final Summary Reflection Report	Week 6	May 30th Only

Grading / Assessment

Individuals and team efforts are measured according to multiple factors including the design, fabrication, testing and participation. The final product will be measured first, by its function. Does the solution solve the problem defined by the outline in class and does it work properly? Does the solution use unique or just the required materials? Is the solution's starting size within the specified limits? Was solid research used to determine the best outcome of the project? The second is how the solution compares to the competition.

See below for scoring and grading.

- Points will be earned and calculated by using the entire design and fabrication process while successfully completing the Egg Crash Vehicle Challenge.
    - The Design Process (sketches) – **50 pts**
    - Fabrication Craftsmanship – **100 pts**
    - Teamwork / Participation– **50 pts**
    - Performance Testing – **300 pts**
    - Final Summary Reflection Report – **100 pts**

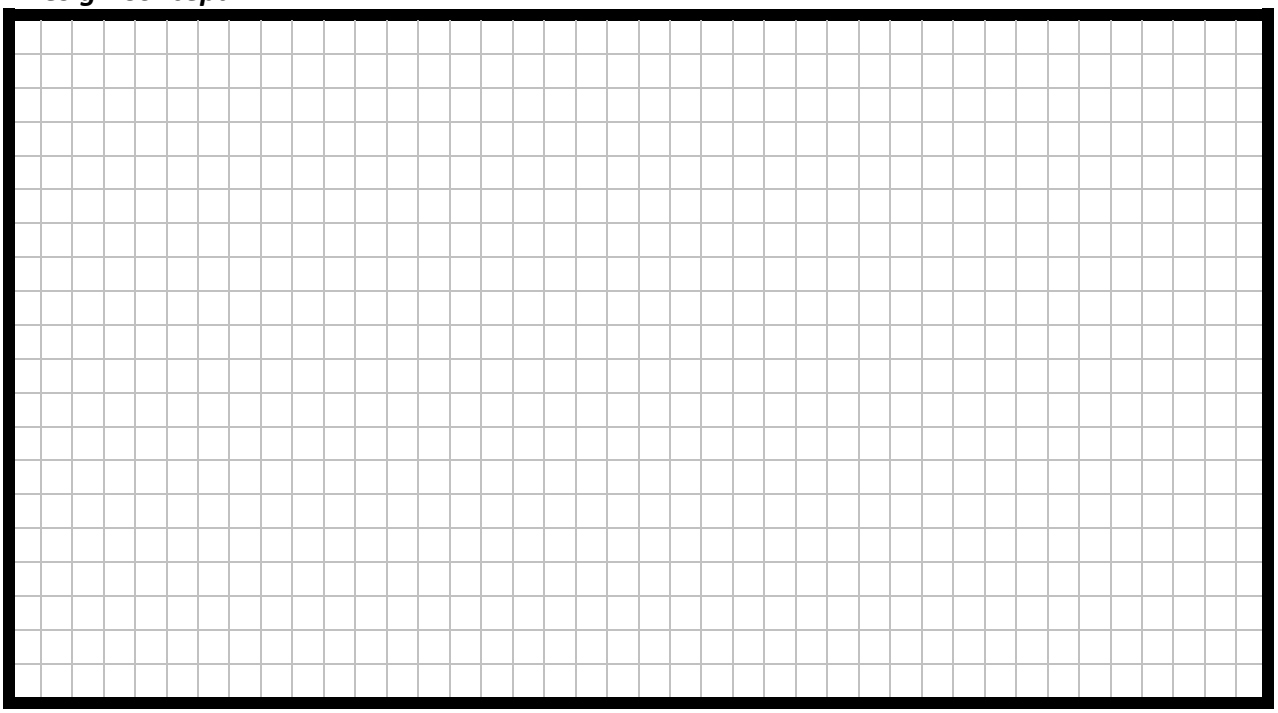
- Total Project Points: **600**

	Excellent	Good	Acceptable	Unacceptable
Design Process	Uses the Problem Solving Method. Has three or more documented resources and a complete set of sketches within specifications. **50**	Evidence of the problem solving with three or more references used and a complete set of sketches within specifications. **40**	Designs discussed. Has two or more references and a complete set of sketches within specifications. **30**	Little or no problem solving evident, little or no research and/or sketches. 10
Teamwork or Participation	Cooperates and interacts well with team. Workload shared equally. **50**	Cooperates and interacts well with the team. Shared the duties. **40**	Seldom interacts well with team. Workload not equally divided. **30**	Does not interact well with the team and the workload is not evenly distributed. **10**
Specifications Craftsmanship	Prototype agrees with neatly prepared sketches, meets criteria, and all assembly and fabrication done well. **100**	Prototype agrees with sketches, meets criteria, and all assembly and fabrication done well. **80**	Prototype agrees with sketches, meets criteria, poor assembly and fabrication. **70**	Prototype disagrees with sketches, meets some criteria, assembly and fabrication poorly implemented. 10
Performance Test	The egg passenger survives impact with no physical injuries and remains seated securely inside the vehicle. **300**	The egg passenger survives with minor or zero injuries, but is no longer seated in its original position. **250**	The egg passenger survives the impact with minor or serious injuries and is no longer seated securely inside the vehicle. **200**	Our dearly departed egg passenger did not survive the impact. **100**
Report	Report accurately identifies core concepts of the assigned project and independent research. Information is synthesized to highlight key concepts of the topic. **100**	Report accurately identifies most core concepts. Information is synthesized to highlight most key concepts of the topic. **80**	Report partially identifies core concepts for the audience. **70**	Report does not identify any aspects of the project **10**

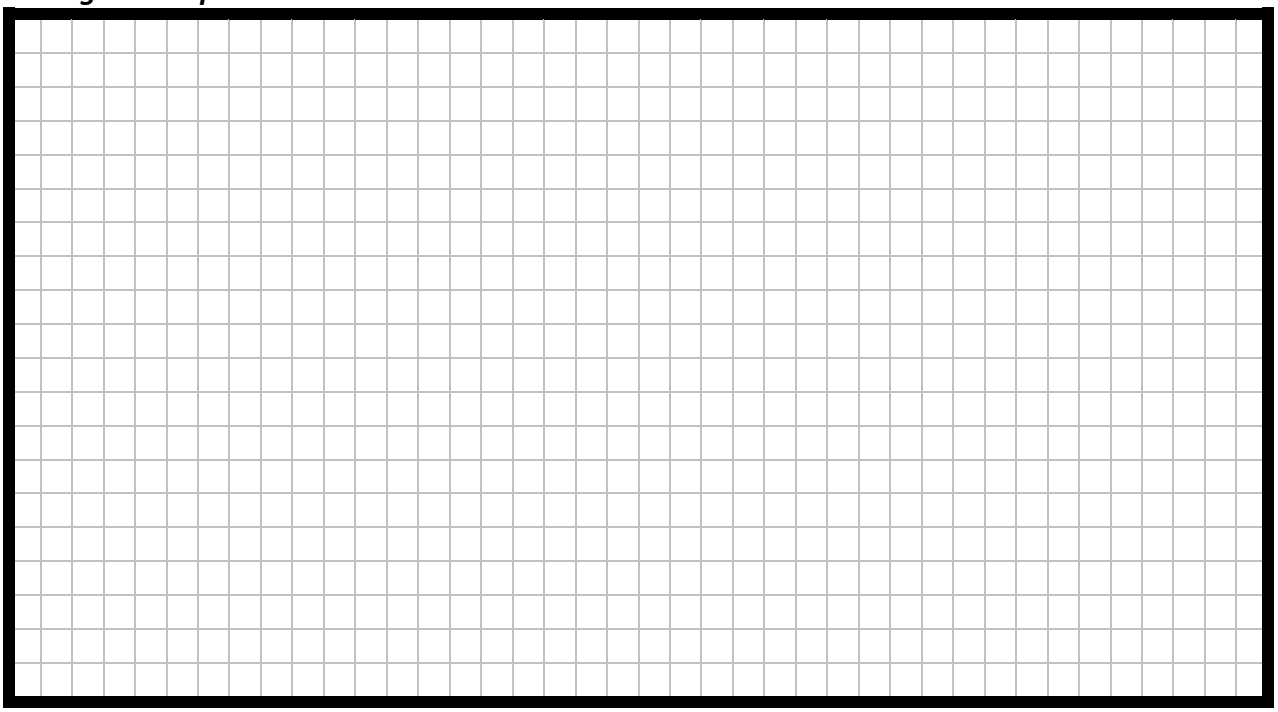
Initial Brainstorming Worksheet

Please provide a minimum of three design concepts in isometric or orthographic projection using the graph paper blocks below. The company designing your vehicle will use this information and sketches to develop a working set of drawings to send to the manufacturer to build your product. Please sketch these designs to some type of scale, considering that each block may equal one foot of one-half foot etc.

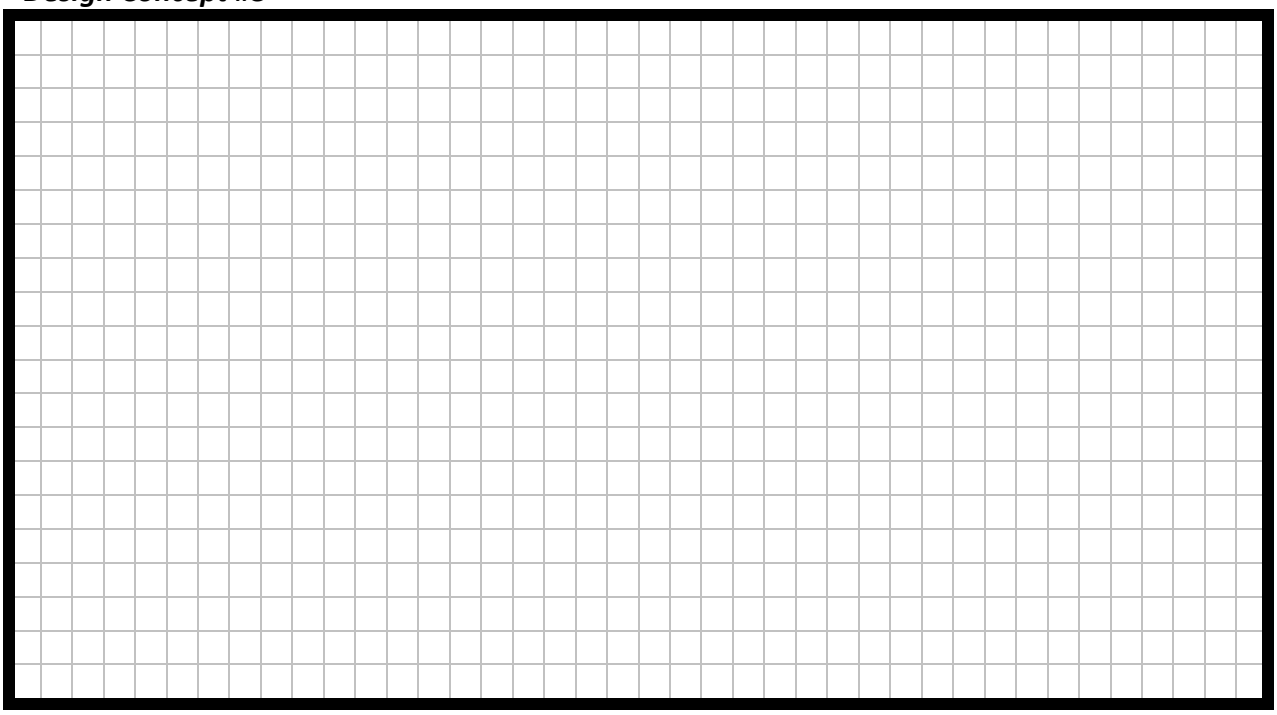
Design Concept #1



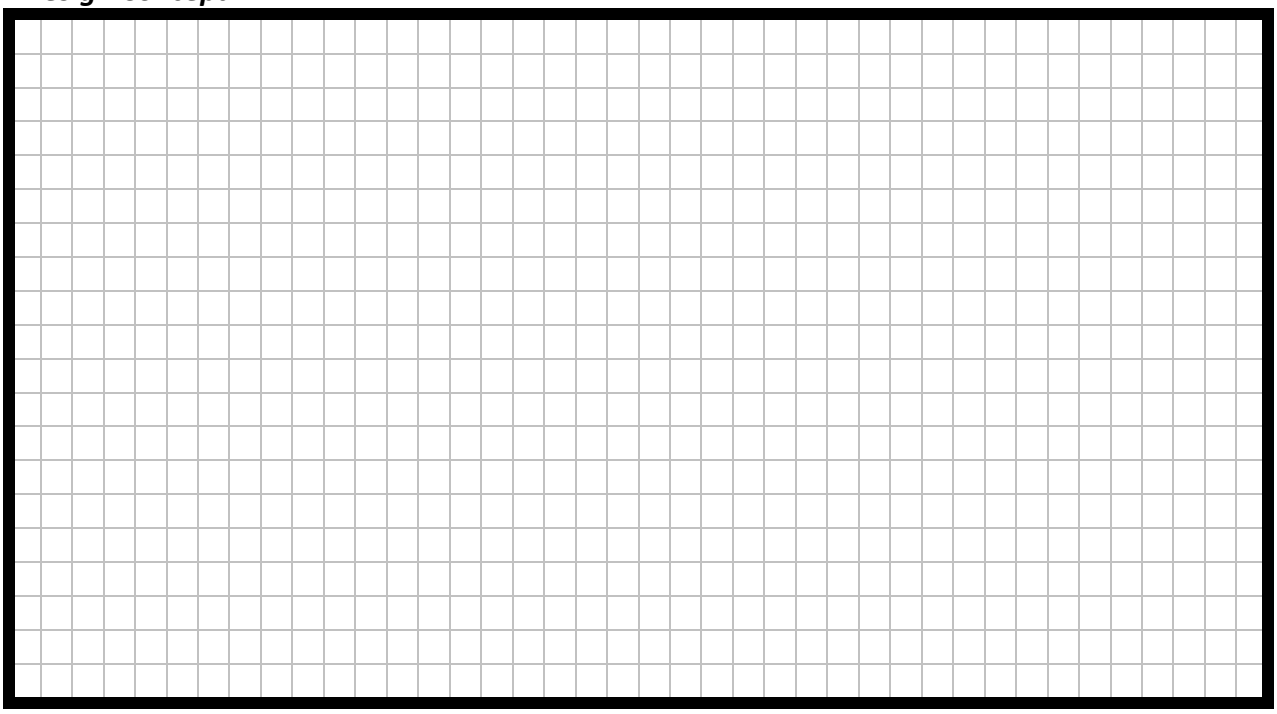
Design Concept #2



Design Concept #3



Design Concept #4



Which is your best design? Please explain why you believe this is the best.