2017

PRODUCT INNOVATION CHALLENGE

Dakota High School

Design Technology Program

Course: **Engineering Design**

Developed By: Mr. Scott E. Mitchell

March 20, 2017

Good Morning:

Welcome to your first day of owning your very first automotive company.

You have been selected from an elite group of Engineers to research, design, develop, fabricate and test a completely new vehicle for the **Design Innovation Challenge**. Our customer will need important updates as soon as possible so you will need to generate a team and start working immediately to find the best solution for the assignment. Please review all of the information included in this packet to complete the assignment of documenting the ***Product Innovation Challenge***.

The Product Innovation Challenge

The Product Innovation Challenge follows a proven hands-on, real-world problem-solving approach to learning. Students work in teams to design and develop an original solution to a valid open-ended technical problem by applying the engineering design process. Students perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams design, build, and test their solutions while working closely with industry professionals who provide possible mentoring opportunities. Finally, student teams present and defend their original solution.

Throughout the Product Innovation Challenge, 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 engineering standards and document their work. Students use industry standard 3D modeling software to help them design solutions to solve proposed problems, document their work using an engineer's notebook, and communicate solutions to peers and members of the professional community. Students use the same industry-leading 3D design software used by companies like Intel and Lockheed Martin.

Students will discover the answers to questions like how are things made and what processes go into creating products? They learn how a company is developed from the ground up and the associated costs. They will also see the struggles some companies face when challenged with communication issues, outsourcing of work, material shortages and difficult employees. They explore mechanical design and precision fabrication while applying engineering concepts related to Product Development. Topics include mechanisms, energy, statics, materials, and kinematics. They design, test, and actually construct a working prototype and/or device used in real-world applications while working collaboratively on a crowning innovative project. It's STEM education, and it's at the heart of today's high-tech, high-skill global economy.

The Product Innovation Challenge complements traditional mathematics and science related courses and can serve as the foundation for STEM-centered or specialized engineering 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

- Why emphasize developing engineering specifications?
- How can you identify the "customers" for a product?
- Why is it so important to understand the voice of the customer and work to translate this into engineering specifications?
- How can you best benchmark the competition to understand design and business opportunities?
- How can you justify taking time at the beginning of a project to do specification development instead of developing concepts immediately?

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

a. Create a timeline complete with formatting tasks, dates and persons assigned to tasks
b. Accurately represent how a prototype is used and or developed with complete drawings, pictures and photos
c. Design a product that is complete, matches the proposed design and needs minimal improvement
d. Create a 3D software model of the product
e. Select appropriate materials for the application and properly applied or manufactured
f. Describe the Human/Product interaction
g. Construct a product that is aesthetically pleasing, has no visible flaws with logos or colors that are appropriate for the consumer
h. Clearly state the problem to be solved
i. Review how Business and Industry were involved with the development of the final product
j. Describe the sources for supplies and the utilization of appropriate materials for their application
k. Defend the data and information that is presented in the solution
l. Presents easy-to-follow information that is logical and adequately detailed.
m. Convey a clear and concise message about the process taken to design the product, and its features
n. Describe calculations, complete with detail, relevant formulas and labels
o. Design drawings complete with detail and relevant materials and labels & associated back with a 3D model
p. Perform a complete formatted cost analysis with pricing, sources and total costs per item
q. Accurately represent the team product and the process that was completed to generate the final product
r. Conduct a presentation that was with no bias and in a professional manner

Objectives

The focus of the Product Innovation Challenge is the integration of marketing, design, and manufacturing functions of a company in creating a new product. The project is intended to provide you with the following benefits:

- Competence with a set of tools and methods for product design and development.
- Confidence in your own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
- Enhanced team working skills.

Expectations

This project has been designed to demand approximately 10 hours per week of your time. It is expected that each participant 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 design courses is that participants 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.

Quick Project Overview

Students will develop a start-up company from the ground floor and hire employees that best fit their needs to perform the day-to-day operations of financing, bookkeeping, engineering, CAD designing, fabricating and customer relations along with other relates responsibilities. You will be tasked with designing and fabricating a product for a customer especially designed for this challenge. Students will have to communicate effectively and efficiently while working together to build and develop a product that will be precision made and meet the highest quality standards set forth by the industry.

The Problem

You are a newly developed car company planning on designing and fabricating a vehicle for another company so they may have the safest automobiles 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.

Your Challenge

- To design and construct a complete vehicle for another company 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.

- Your company may design and develop a vehicle of its own for prototype purposes only but will not count towards a final testing grade.

- 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 Challenge

- Vehicle needs to be designed 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 that touch the ground at all times 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 down.
- The vehicle must carry a Large Grade "A" uncooked egg (driver).
- The egg must remain securely in the vehicle at all times.
- 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 10 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".

Automotive Product Information

In automobiles, a **bumper** is the front-most or rear-most part, ostensibly designed to allow the car to sustain an impact without damage to the vehicle's safety systems. They are not always capable of reducing injury to vehicle occupants in high-speed impacts, but are increasingly being designed to mitigate injury to its occupants and pedestrians struck by cars.

An automotive **seat belt**, also known as a ***safety belt***, is a vehicle safety device designed to secure the occupant of a vehicle against harmful movement that may result during a collision or a sudden stop. A seat belt functions to reduce the likelihood of death or serious injury in a traffic collision by reducing the force of secondary impacts with interior strike hazards, by keeping occupants positioned correctly for maximum effectiveness of the airbag (if equipped) and by preventing occupants being ejected from the vehicle in a crash.

An automotive **chassis** consists of an internal framework that supports a man-made object in its construction and use. It is analogous to an animal's skeleton. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted) with the wheels and machinery. In the case of vehicles, the term rolling chassis means the frame plus the "running gear" like engine, transmission, driveshaft, differential, and suspension.

An automotive **body** (sometimes referred to as "coachwork"), which is usually not necessary for integrity of the structure, is built on the chassis to complete the vehicle. The body is determined or classified by its size and weight.

For research into safety, the **Highway Loss Data Institute (HLDI)** takes into account a combination of both vehicle size and other vehicle features with all passenger cars that do not fit the definition of either "sports" or "luxury", are classified on the basis of both vehicle length and wheelbase.

HLDI classification	Definition
Sports	Those cars with significant high performance features
Luxury	Higher-end cars that are not classified as sports
Large	Length more than 495.3 cm (195 in) and wheelbase more than 279.4 cm (110 in)
Midsize	Length 457.3–495.3 cm (180–195 in) and wheelbase 266.8–279.4 cm (105–110 in)
Small	Length less than 457.2 cm (180 in) and wheelbase less than 266.7 cm (105 in)

The **National Highway Traffic Safety Administration (NHTSA)** separates vehicles into classes by the curb weight of the vehicle with standard equipment including the maximum capacity of fuel, oil, coolant, and air conditioning, if so equipped.

NHTSA classification	Code	Curb weight
Passenger cars: mini	PC/Mi	1,500–1,999 lbs.
Passenger cars: light	PC/L	2,000–2,499 lbs.
Passenger cars: compact	PC/C	2,500–2,999 lbs.
Passenger cars: medium	PC/Me	3,000–3,499 lbs.
Passenger cars: heavy	PC/H	3,500 lbs. and over
Sport utility vehicles	SUV	*Over 4,000 lbs.
Pickup trucks	PU	*Over 4,000 lbs.
Vans	VAN	*Over 4,000 lbs.

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) or other type of rubber
- 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
- Styrofoam (internal or external use)
- Plastic
- Sponge (internal or external use)

Project Procedures Summary

- Choose Team
    - 1st - Team Leader
    - 2nd - Team Worker
- Company Name (engineering / manufacturing related)
- Company Logo
- Company Flow Chart (see example)
- Product Name
- The Design Process (see example)
- Complete Drawing Set
- Associated Costs / Expenses (see sample cost / purchase order forms)
    - Material Cost
    - Parts Cost – Purchased or Stock
    - Labor Cost for Design
    - Labor Cost for Fabrication
    - Outsourcing Costs
    - Engineering Changes
    - Overhead Costs
    - Office Staff –Bookkeeping
    - Safety Violations
    - Teamwork
    - Miscellaneous
- Final Cost Analysis
- Engineering Changes
- Correspondence / Communication
    - ***By Letter ONLY*** (see example)
- Fabrication
- Photo Documentation
- Timeline
- Final Summary Reflection Report

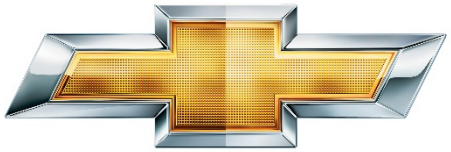
Project Detailed Procedures

Choose Team

Each team will consist of 2 members that will have many different roles during the entire process of this challenge. It is prudent to have team members that are willing to work towards one common goal for the betterment of the company. You will need team members that are well-rounded and are able to do multiple tasks. Your staff will have to be designers, engineers, fabricator, laborers, office staff, photographers, writers and accountants. To make this challenge as realistic as possible volunteers will be asked to be the Team Leader but remember this comes with great responsibility and one that should not be taken lightly. You will get the opportunity to choose your first employee. (Note: sometimes your best friend is not always the best employee.) This person should be your right-hand man/women and one that can step in when you are not present or are off doing another task. In the end you want to have a team approach and one that will work together to design and build the best product on the market for your customer.

Company Name and Logo

What's in a name? Everything!!!!! Each team will have the opportunity to choose and design a company name and logo that best describes and defines their product. Keep in mind that you are working in the engineering and/or manufacturing area.



Company Organizational Flow Chart

With each great company comes a working understanding of its Chain of Command and the duties each team member brings to the table and how the company operates on a daily basis. Each member of the company is just as important as the next from the top down to make the best product for the customer. Remember without you there is no product in the end. Design a Company Organizational Flow Chart with job titles and duties using one of the following: CAD, Excel, Power Point or MS Word. See example or research another idea.

Product Name

Your product could be worth millions or pennies depending on the name given. Some companies have great products but terrible names for example, what are the following products from one well-known manufacturer: dv8000z, PSC 2350, vp6300? One is a printer, one is a laptop computer and one is a projector. How can you tell? How can you differentiate one product in a given range from another? The answer is, quite simply, that you can't. While others have names like iPhone or the iPod or the iPad. A product's name is part of its identity. If you tell someone you have an iPhone 5, most people will know what it is, and they'll know it's made by Apple. Choose a product name that reflects that great things your company creates.

The Design Process

The **Design Process** is the formulation of a plan to help companies build a product with a specified performance goal. This process involves a number of steps, and parts of the process may need to be repeated many times before production of a final product can begin.

Research the design process and review the sample. Choose a design process that best fits your company's needs and use this as a guide to point your company in a positive direction.

Designs

Your 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 by the fabrication department to build the product to the exact manufacturing specification. To complete the design process the following below will be needed to complete the project.

Your ***Assembly Drawings*** must include the following:

- Standard company Title Block
- Proper ANSI design standards and lineweights are required
- More than one detail may be drawn on a sheet of paper
- Create part identifier balloons for each detail
- Completed Materials List
- General and specific notes
- Place drawings on "D" size paper
- Drawings printed only on "B" size paper

Your ***Detailed Drawings*** must include the following:

- Standard company Title Block
- Proper ANSI design standards and lineweights are required
- More than one detail may be drawn on a sheet of paper
- Create callouts for each detail indicating: detail #, detail name, # required, material, and any additional general or specific notes
- Place drawings on "D" size paper
- Drawings printed only on "B" size paper

Your ***3D Rendering Drawings*** must include the following:

- One Presentation Render
- One Photo Realistic Render with Background or Scene
- One Pictorial ISO Assembly
- Place each drawing on an "A" size paper

Associated Costs / Expenses

Costs and expenses are all part of making a quality product. The saying that "nothing in life is free" is exactly true. Making a simple product costs money and the more employees you have, the more parts and supplies you have, the more changes you make all add up. But there is an efficient way of doing business. Understanding your product and your manufacturing process can greatly reduce the bottom line.

Use the cost guide below to determine the cost of your product from the day you start your company. You will find that the numbers listed below are an industry average. Your goal is to design and build the best product in the most efficient way possible as this is what your customer expects. See Parts and Material Cost Sheets below for all associated costs and expenses. Keep a detailed invoice of all you used parts and material. (See sample)

Parts and Material Costs

Description	Cost	Unit
1" Sintra	$5.00	Sq. In.
¾" Sintra	$4.00	Sq. In.
½" Sintra	$3.00	Sq. In.
¼" Sintra	$2.00	Sq. In.
1/8" Sintra	$1.00	Sq. In.
Matte Board	$0.25	Sq. In.
Aluminum Sheet – up to .125 Thick	$5.00	Sq. In.
.125 Copper Axle Rod	$0.75	Linear In.
Large Plastic Wheels	$1.50	Each
Small Plastic Wheels	$1.00	Each
Plastic Axle Bushings	$0.25	Each
Thin Clear Plastic Sheets	$0.50	Sq. In.
Rubber Bands (any size or length)	$0.25	Each
String (any size or length)	$0.05	Linear In.
Cotton Balls	$0.10	Each
Straws – plastic type any size	$0.25	Each
Fastener – any type up to ¼" Dia.	$0.50	Each
Washers – any type up to ¼" Dia.	$0.10	Each
Springs (purchased or hand-made)	$0.50	Each
Syringes – any size up to 1"	$2.00	Each
Rubber – up to ¼" Thick	$0.50	Sq. In.
Styrofoam – up to 1" Thick	$0.75	Sq. In.
Misc. Plastic – Clear Lexan	$1.00	Sq. In.
Sponge – up to 1"	$1.00	Sq. In.
Miscellaneous – Per Mr. Mitchell	?	?

Labor Costs

- Labor – Design (LD)
  - $25 per hour per person

- Labor – Fabrication (LF)
  - $50 per hour per person

- Labor – Fabrication Outsource (LFO)
  - See Chart
  - Misc. TDB by Instructor

- Engineering Changes (EC)
  - Design $50 per change
  - Fabrication $100 per change
    - Plus Labor to make change

- Instructor Consultation (IC)
  - $100 minimum per session

- Overhead (OH)
  - $250 per day (all utilities)
    - Electric
    - Gas
    - Water
    - Computer
    - Printer
    - Paper
    - Misc.

- Office Staff – Bookkeeping (OSB)
  - $5 per 15 min

- Safety Violations (SV)
  - $2000 Per Incident – Team member(s)removed from project for the day and must fill out incident report

- Major Communication Violations (MCV)
  - $5000 Per Incident (see communications)

- Teamwork (TW)
  - Positive - $100 Bonus
  - Negative - $200 Deduction

- Miscellaneous (MISC)
  - Rate determined by instructor

Final Cost Analysis

Your product will have a final cost associated with it and you will see for yourself how cost effective your company was compared to others that build a similar product. Remember it's not always the cheapest that's the best it's the final product results. Ask yourself - Does the customer like it? Does it work as designed? Are you proud of the final result? I'm sure if you had another opportunity you could always make changes and make it better.

Engineering Changes

Unfortunately changes are inevitable and a part of life, it's how you react to change is what makes the difference from your company being successful or not. Within the industry changes are a daily occurrence. Engineering changes can make your product better, safer and more efficient but at a cost to everyone. One simple change could cost a company millions of dollars so researching the best solution is always important before making any change. Your project will have engineering changes along the way so be patient and positive. All changes will be documented for future use which helps guide the product to the final outcome.

Communication

Effective communication is a fundamental part of the business world because it provides an essential link between the people who make up an organization. Effective communication eliminates the questions and confusion that may cause projects to delay or assignments to be put off due to the need for further clarification. When people communicate effectively in the office, employees can be more productive because they'll know what is expected of them the first time around. Effective communication is used to improve conversations with customers and make customers feel like they are being heard and valued by employees. In turn, this can help employees and companies build strong customer relations.

Once you have a common expectation of the work, you then need to communicate proactively regarding the status, issues, and risks associated with the work. This task can be completed several ways, including:

- Status reports
- Status meetings
- E-mail updates
- Informal meetings

Your task is to communicate with your customer by sending them written documentation. You should communicate with your customer about the design or fabrication of your product or any changes that may need to be checked. All communication must be addressed specifically to the person who is handling the problem. Your communication must be in a sealed envelope and sent via the inter-class mail system. No verbal communication may happen during class time; including while in the fabrication lab. Violations to this policy will incur a severe penalty ($5000 Fine). The instructor will give the students a one free communication day during the design and build process without penalty.

Fabrication

It's time to build! Now that all of your documents have been assembled and approved by the customer 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 team for a day and given a severe violation penalty of $2000. Once again, you're on a team for a reason! Assign tasks to each member to make the process go faster.

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. The customer expects quality over quantity at this point and a better product means a better outcome for both you and the customer…***YOUR GRADE***.

Remember other groups 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 and will be added to your final cost analysis.

Photo Documentation

Photos show a snapshot of the work completed by each individual and the team. Customers like to see progress made and the best way to do this is to send them a quick picture or two of their project. This intern lets the customer know you are making progress and meeting the strict timelines needed to develop this product.

Each team should make an effort to take as many pictures necessary the show progress during the entire process of designing and building of the product. A minimum of 10 pictures must be taken within the required time to develop this product.

Voice of the Customer

Understanding the design problem is an essential foundation for designing a quality product. "Understanding the design problem" means to translate customers' requirements into a technical description of what needs to be designed. *Or, as the Japanese say, "Listen to the voice of the customer."*

It is defined as the perceived-value customers seek from the purchase of a good or service. The major six customer expectations are: customers expect solid information, customers expect options, customers expect superior communication, customers expect consulting, and customers expect a seamless relationship. Meeting these expectations will cement the relationships, increase their satisfaction, help to gain customer loyalty, and which intern retains the business.

In today's uncertain business climate, it is more important than ever to secure the Loyalty of your customers. Loyalty is the trust, the understanding and the emotional bond you have with your customers, and they with you. Nurturing this emotional bond is the heart of loyalty advantage. If customer expectations are met, then customer satisfaction is the result.

Customer-Focused Engineering is a process designed to ensure that products meet customer expectations from their initial concept to the end of their life. Customer-focused engineering is a form of quality control that ensures product reliability and subsequently improves customer satisfaction and profitability.

The discipline of customer-focused engineering ensures that an organization meets customers' expectations at every stage in the development, manufacture and support of a product. The framework of customer-focused engineering helps an organization to meet its customers' requirements first time.

Your task is to meet the high expectations of the customer and design and build them the best possible product on the market today that will be cost-effective, safe and reliable.

It's up to you and your team as you just might have the next million dollar idea.

Helpful Hints and Questions to Consider

- The possibilities are almost endless, but why wait, Let's create something right now! Within the Industry Design Challenge you and your group will work to take an idea and make it into reality. This challenge will go beyond the computer, and into the actual building of a product. Now's your chance to apply what you've learned!
- Be sure to read each of the following steps, and follow them closely. Should your group get stuck be sure to ask your instructor for help to get you back on track. Most importantly, be safe and have fun!
- Though it may seem like a big project with a lot of grades and responsibility try not to get discouraged. The important thing is to work with your team and stay organized. We've set aside plenty of time for you to get everything done as long as you stay on task and work hard.
- Work with your new group to start ***brainstorming*** some ideas. Don't get caught up in trying to figure everything out today. Here are a few suggestions of things to get started on:
    - Team name
    - Create a list of at least 5 different ways to complete the challenge
    - Assign roles to your team members
    - Share contact information (email, phone numbers, etc.)
- Create a calendar and assign each person task to complete. Start to sketch some ideas on paper to show what you want to build.
- Keep people constantly informed of your progress and what you are working on.
- What are the most important attributes of a successful engineering business?
    - ***Self-Awareness:*** Understand your capabilities, strengths and weaknesses
    - ***Foresight:*** Be aware of coming trends both economically and in your field
    - ***Adaptability:*** Do not limit yourself or be afraid to grow or expand
    - ***Integrity:*** Never sacrifice quality for financial gain
    - ***Honesty:*** Always be upfront with your clients
- All team members have a voice and are sure to offer ideas and suggestions to make your project better. After all, participation is part of your grade!
- Remember that you're part of a team for a reason!
- Be prepared to make sacrifices
- Assemble the RIGHT team and do not discount chemistry
- Give your employees a say in the direction of the company and make them feel like it is a family
- Before a single part is ordered or a cut is made you'll need to show what you need and how much in cost. At the end of this section you will be required to turn in a bill of materials and cost analysis. When thinking about different parts consider the tradeoffs. While one material may far exceed your requirements its cost may be outside of you or your customer's budget.

Final Summary Reflection Report

This is the final section of the project. Once you've created your product your team will be required to turn in one group 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 2017***
• Introduction / Research o Choose Team o Company Name /Logo o Flow Chart o Product Name o Design Process	Week 1	Mar 20th – Mar 24th
• Design o Complete 2D /3D Drawing Set and Renderings	Week 2 – 5	Mar 27th – Apr 21st
• Spring Break	Week 3	Apr 3rd – Apr 8th
• SAT Testing / Good Friday	Week 4	Apr 10th – Apr 14th
• Fabrication o Material / Parts Distribution o Prototype	Week 6 – 9	Apr 24th – May 19th
• Performance Testing	Week 10	May 24th – May 26th
• Engineering Report Due	Week 11	May 30th Only

- ***Special Note:*** You should be working on all cost sheets and communication letters from the beginning of the project. These items will be an ongoing process and checked periodically and turned in for final grading with your engineering report.

Grading / Assessment

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 customer and does 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.

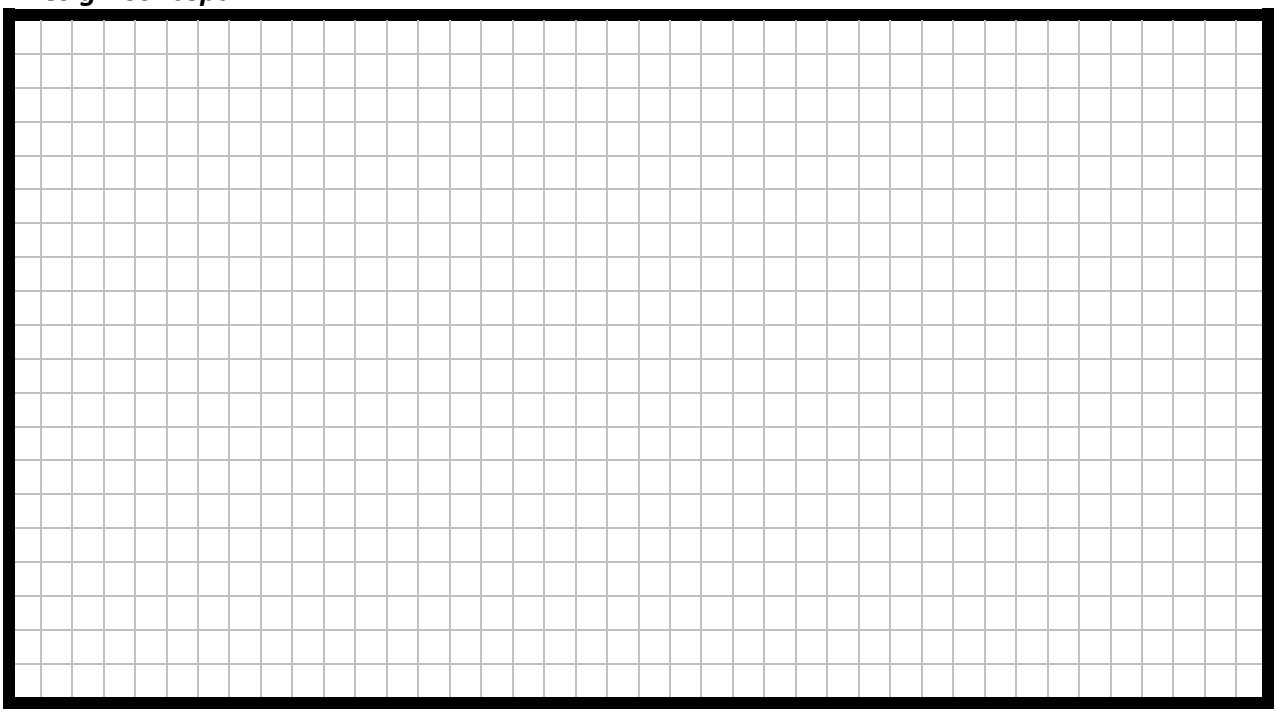
- Points will be earned and calculated by using the entire design and fabrication process while successfully completing the Product Innovation Challenge.
    - Company Name – **25 pts**
    - Company Logo – **25 pts**
    - Company Flow Chart – **25 pts**
    - Product Name – **25 pts**
    - The Design Process – **25 pts**
    - *Complete Drawing Set – **400 pts**
    - Associated Costs / Expenses – **150 pts**
    - Final Cost Analysis – **100 pts**
    - Engineering Changes – **50 pts**
    - Correspondence / Communication – **200 pts**
    - *Fabrication and Finish – **300 pts**
    - Photo Documentation – **75 pts**
    - Teamwork / Participation– **100 pts**
    - Performance Testing – **300 pts**
    - Final Summary Reflection Report – **200 pts**

- Total Project Points: **2000**

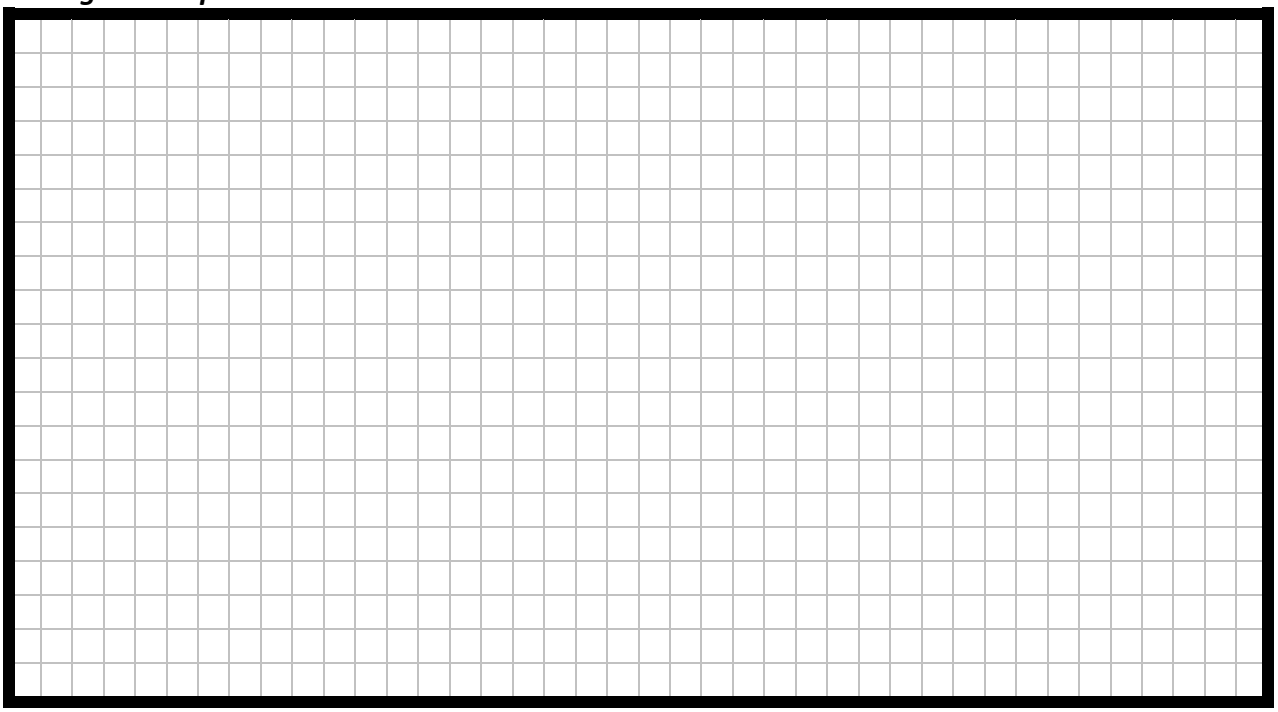
Initial Brainstorming Worksheet

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.

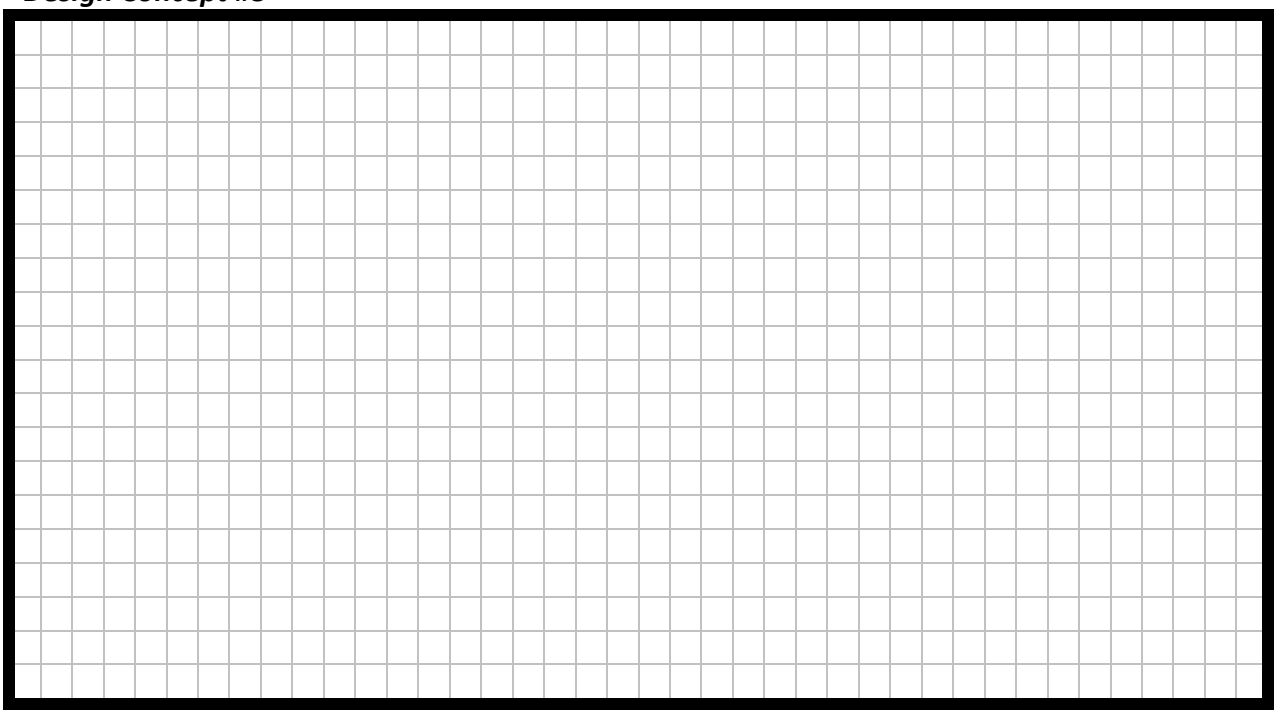
Design Concept #1



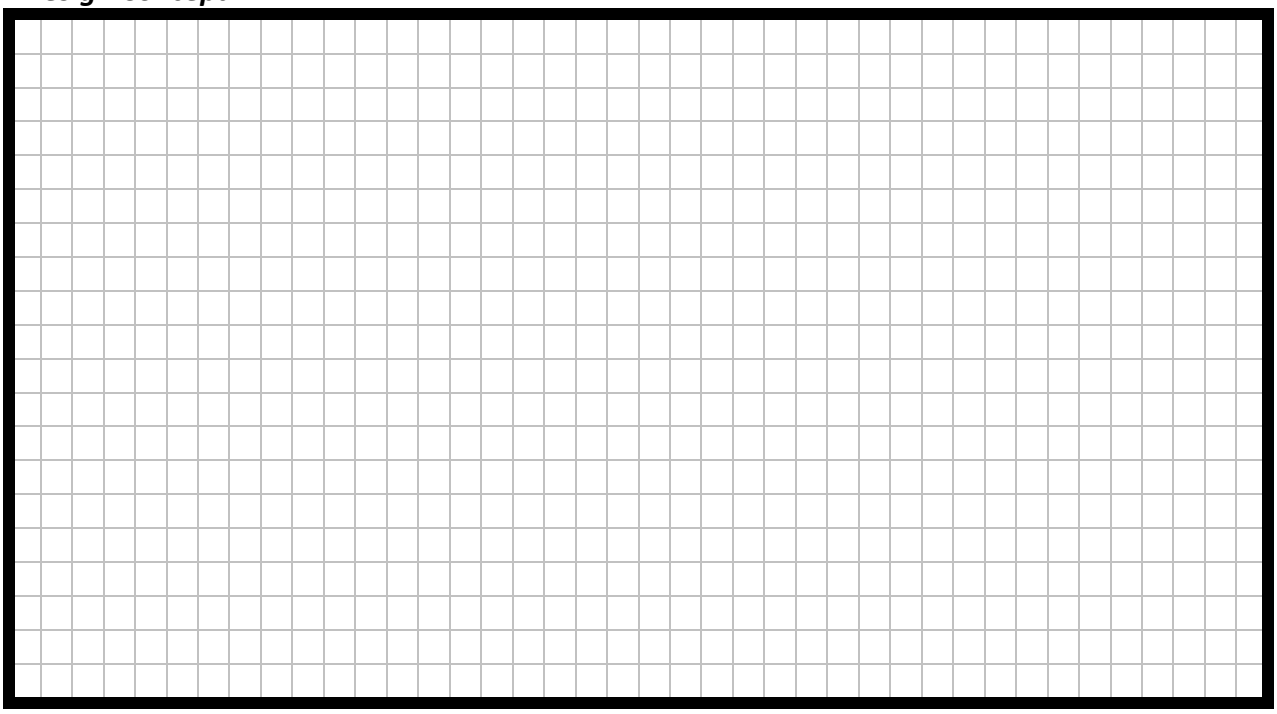
Design Concept #2



Design Concept #3



Design Concept #4



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