

2020 - 2021 Monster Truck Challenge

Design Challenge:

The student will design and fabricate a **Monster Truck** with articulated suspension and a fully functional drive train with FWD (four-wheel drive) or AWD (all-wheel drive) that will be able to overcome various terrain obstacles.

Objectives:

In the participation and the development of this project students will:

- Work with tools to process materials and assemble a product
- Incorporate problem solving, design and engineering techniques
- Better understand Newton's Laws of Motion
- Better understand the characteristics of electric circuits
- Understand the characteristic of a Monster Truck Suspension
- Apply mathematical calculations and measurements
- Work with tools to process materials and assemble a product
- Demonstrate fastening techniques
- Incorporate design and sketching techniques
- Incorporate 2D and 3D CAD techniques
- Demonstrate skills in accommodating friction and alignment geometry
- Demonstrate the application of electricity to generate motion
- Better understand characteristics of electrical circuits
- Demonstrate the ability to solder an electric component
- Work individually and cooperatively as well as competitively

Constraints:

Students must use project materials assigned and/or approved by the instructor.

• Electric Motor (1 or 2)	• Prototype Wheels	• Axle Material (weld rod)
• 18 Ga. Wire	• Misc. Fasteners	• "O"- Rings
• Sintra	• Plastic Gears	• Springs
• Traction Material	• Clear Plastic Tube	• Matte Board

- The Monster Truck will have exclusive naming rights with no two being the same across the Design Technology Department
- The vehicle must be four-wheel drive.
- The vehicle must provide 2 wires extending through the top of the body in order to connect to the overhead power cable / clips.
- The maximum vehicle width, including wheels, cannot exceed 8".
- The maximum tire diameter cannot exceed 3".
- The maximum vehicle length, including wheels, cannot exceed 10".
- The wheelbase can be no less than 4", measured center-to-center of axles.
- There is no vehicle height requirement.
- The body wheel well center line profile must align to the center of the wheels within ½" center-to-center. Vertically aligned and horizontally measured.
- Body width must be proportional to give the true monster truck stereotype distorted appearance of wheel width to body width ratio.
- The vehicle must have a body which will be designed and built using only paper and matte board. The matte board body will be laser cut. No die-cast or plastic models or other forms of body material can be used.
- Since this is a Monster Truck Challenge the vehicle body must resemble a style of truck, examples: pick-up, semi, delivery van, school bus, SUV etc. Instructor must approve the body style before design and construction.

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Safety First:

Be cautious, follow all safety rules and avoid injury when working with tools and equipment. Disclaimer: This product requires the use of tools that could be dangerous and might cause an injury if not handled with care. Follow all safety procedures and guidelines for each tool as provided for by the instructor and identified in the fabrication lab safety guidelines.

Basic Design, Build and Assembly Information:

- Read and listen to all instructions carefully first.
- Keep in mind that precision fabrication will result in better performance during vehicle testing.
- Students should keep in mind the size and weight of their monster truck. Most of the time longer is better. Shorter vehicles tend to veer or roll over easily.
- Keep in mind mounting points to the chassis. Determine where components will be placed and using appropriate means (drilling, fastening, gluing) mount them to your vehicle.
- Design vehicle body and shape into the desired vehicle profile using Inventor and AutoCAD
- Cut out vehicle matte board body using the CO₂ Laser with Corel Draw
- Assemble vehicle parts.
- Identify each of the material components provided and possible purposes they will serve.
- Brainstorm ideas for your vehicle design and placement of components.
- Draw preliminary sketches for the truck design showing locations of components and how it will work. **Note:** More views make for an easier build.
- Select the best design from your preliminary sketches.
- Create a 3D Solid Model Assembly – Inventor .iam and .ipt files.
- Adjust body drawing to match chassis specifications. (edit dimensions in .IPT)
- When making the body with paper and matte board: Design / color print body fold outs on paper. Construct, fold, and glue body into shape of vehicle utilizing matte board for internal structural strength as you assemble the body structure. Keep in mind mounting points to the chassis.
- Create 2D IDW (detail drawing) with dimensions for all components to be fabricated by you.
- Fabricate or alter parts per drawing dimensions in the Fab Lab. (quality and precision of each part will ensure a smooth and functional assembly process)
- Assemble parts.
- Wire and solder electric motor with long enough wires to protrude through the upper portion of your body. **Note:** *wire too long will drag.....wires too short will disconnect from power source prematurely.*
- Pre-test vehicle and make needed adjustments to the suspension and power transmission systems.
- Mount vehicle body to the chassis and provide for quick release. (4) mounting points.
- Modify if necessary and retest.

Helpful Hints

- Design and fabricate for speed and power. The most successful monster trucks are usually those that are built with precision and have adjustability. (Example: articulating suspension)
- Think about what is important; speed, torque or a combination of both.
- Design and fabricate for durability. Accidents can damage a fragile design.
- Design and fabricate for easy repair. Keep it simple. Complex designs are more prone to breakdowns and are difficult to repair.

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Official Testing:

Testing:

- The vehicle may be unofficially tested as much as needed without penalty. Upon deadline, vehicle MUST be tested.
- Student must state “**official run**” before a scored run. “**This must be witnessed by the instructor**”
- Vehicle **must complete the entire course** for full points. The course surface and obstacles will vary somewhat due to positional change and prior runs; therefore the challenge will be variable and have a range of difficulty.
- Completing the course:
 - Start vehicle with four wheels on the start platform. Vehicle must travel to the end platform and rest with all four wheels on the end platform (no wheel can be in the last obstacle section) to be considered a completed run. At no time may the vehicle be touched or interfered with in any way.
 - Overruns or falloffs will be considered incomplete runs.
 - Course must be completed in 60 seconds or less.

Official Grading:

Grading:

- Points will be earned and calculated by completing sections of the test track. Each track section is valued at 3.125 points and there are 32 track section. The number of completed sections (32), multiplied by 3.125 per section, equals 100 points per official run.
 - Contestants must attempt / complete (3) official runs. The sum of the total points of three runs will be averaged and this will be the total score for testing.
 - Points for each section are earned by having all four wheels in the section, breaking the plane of the next section with the wheels (not the body) will earn half a section points. Scores will be entered into the spread sheet as completed sections and automatically calculated by the spread sheet.
 - Overruns or falloffs will be considered incomplete runs. Falloff / overrun at the end platform will earn 87.5 points. No reversal extra credit attempt will be allowed. Falloff mid course will earn the point at which the falloff occurred minus 12.5 points. (watch your throttle control)
 - The design and build of the monster truck are each worth 100 points. The total project is total **points earned / 300**
 - Extra credit is earned by reversing the course **from the finish platform untouched**. You may only attempt extra credit once. You may not touch the vehicle in any way to reset the position for the reverse run. Run must be attempted from final resting position. Points will be added to the total score as follows. Each completed section will be worth 25% of its original value. This total will be added to your final averaged sum of three runs.
 - Racing speed extra credit. A 10% bonus grade will be added to the performance sum for the fastest speed in class. (bracket racing) First to the end wins in all heats.

The Monster Truck Challenge Cup

The ultimate winner between classes in an optional afterschool event will earn a custom trophy and bragging rights until the next Challenge Cup year. Each vehicle entered will require a \$5 entry fee and the cost per driver for pizza and soda. Vehicle owners may not assign a designated driver to race their vehicle if they cannot attend the evening event. **“NO DRIVER.....NO RACE”**

References:

- Refer to pictures of previous models located on the department website: www.dakotadesigntech.com or network drive to serve as hints in designing suspension and power transmission systems. Students are encouraged to develop their own designs.
- Review the models built by the instructors and former students.
- Search the WEB for suspension and body ideas.
- Refer to the provided pages for other suspension ideas. These are merely ideas as there are many options and very few limits. RESEARCH and be CREATIVE.

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Timeline – Weekly Event Schedule

<i>Description</i>	<i>Week No.</i>
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| • Introduction | Week 1 |
| • Research | Week 1 |
| • Preliminary Ideas | Week 1 |
| • Design Idea / Sketches Due | Week 1 |
| • Design (Working Drawings) | Weeks 2 – 5 |
| • Monster Truck Construction | Weeks 6 – 9 |
| • MT Preliminary Testing | Weeks 10 – 11 |
| • Official Testing (Grade) | Week 12 |
| • Mini Challenges / Fun (Extra Credit) | Week 13 |
| • MT Jamboree (Atrium) | Week 13 |
| • Engineering Report Due | Week 14 |

Note: *Weekly Events Schedule subject to change at any time due to the school district calendar or unforeseen events scheduled throughout the school year.*

