2015 Electric Race Vehicle (ERV)

Background:

Everyone is trying to go green these days, and automakers are listening. Concerns about the environment and rising costs of fossil fuels are driving automakers to design and build cleaner, more energy efficient vehicles. Much of the focus is on electric vehicles (EVs).

Did you know the electric car was older than the gas-powered car? It is believed that the first electric car was invented between 1832 and 1839 by Scottish inventor Robert Anderson. The contraption was not more than a carriage with an electric motor and non-rechargeable batteries. In 1835, American inventor Thomas Davenport is credited with building the first practical electric vehicle, a small locomotive.

Design Challenge:

Students will design and fabricate a multi functional Electric Race Vehicle that will be able to travel down a track over a given distance, climb a hill, drag race or other specified events determined by the instructor.

Objectives:

- Work with tools to process materials and assemble a product
- Demonstrate fastening techniques
- Incorporate design and sketching techniques
- Incorporate 2D and 3D CAD techniques
- Incorporate problem solving techniques
- Better understand Newton's Law of Motion
- Demonstrate skills in accommodating friction and alignment geometry
- Demonstrate basic understanding of aerodynamics and the effects of rapid acceleration.
- Demonstrate the application of electricity to generate motion
- Better understand characteristics of electrical circuits
- Demonstrate the ability to solder an electric component
- Apply mathematical calculations and measurements
- Work individually and cooperatively as well as competitively

Constraints:

- The vehicle must have at least 4 wheels that touch the ground at the same time
- The maximum vehicle width requirement, including wheels, cannot exceed 6"
- The maximum vehicle length requirement, including wheels, cannot exceed 12"
- The maximum vehicle height requirement cannot exceed 6"
- Maximum of 2 electric drive motors per vehicle (FWD, RWD or 4X4)
- Must use the electric motor(s) and wheels supplied by the instructor
- No vehicle weight limits (do not add Hot Glue for weight)
- Vehicle must pick-up electrical current from each side of track
- Vehicle must include a matte board body cut from the CO2 laser
    - No other forms of body material will be used

Material:

- Students may use any materials in the fabrication for their ERV including the following:

• Electric Motor	• Large Rear Tires	• Small Front Tires
• 16 Ga. Wire	• Screws and Nuts	• Axle Rod
• Plastic Pulleys	• Plastic Gears	• Motor Holder
• Sintra Base	• Straw	• Matte Board
• O-Rings	• Small Rubber Bands	• Fasteners
• Colored Plastic Sheet	• Large Rubber Bands	• Large Paper Clips

Safety First:

Be cautious and avoid injury when working with all tools. 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:

- 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 ERV. Most of the time longer is better. Shorter vehicles tend to veer or spin out easily.
- Identify each of the material components provided and possible purposes they will serve.
- Brainstorm / sketch preliminary ideas for your vehicle design and placement of components. Use graph paper to lay out in full size your plan for the vehicle. Include the placement of the motor, gears or pulleys and wheels.
- Draw refined sketches for your ERV showing locations of components and how it will work. ***Note:*** More views makes for an easier build.
- Fabricate or alter parts in the Fabrication Lab. (quality and precision of each part will ensure a smooth and functional assembly process)
- 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 body using the CO2 Laser with Corel Draw
- Assemble vehicle parts.
- Pre-test vehicle and make needed adjustments to the wheel alignment.
- Mount vehicle body to the chassis and provide for quick release if possible.
- Modify if necessary and retest.

Helpful Hints

- Design and fabricate for speed and power. The most successful vehicles are usually those that are built with precision and have adjustability. (Example: multiple pulleys and sliding motors)
- 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.

Official Testing / Grading:

Testing:

- The vehicle may be unofficially tested as much as needed without penalty. Upon deadline, vehicle MUST be tested…….*No Exceptions!!!*
- 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 may be flat or inclined thus the challenge will be variable and have a range of difficulty.

Distance:

- Students will test their ERV using various voltages to maximize the distance traveled over flat or inclined track surfaces. Farthest distance wins and all others will be graded on distance traveled.

Drag Race:

- Students will be timed in a drag race style event while using a common starting and ending point. Instructor will determine distance of race on testing day. Students with the fasted elapsed time wins and all others will be graded based on finish time.

Hill Climb:

- The hill will be a single inclined plane set at an angle determined before the start of the event. Student should design their ERV to be variable in movement to be able to climb an incline plane between 0° and 75°. Each inclined plane will be 6 inches wide and 24 feet long.
- After 30 seconds or when all motion has stopped, whichever comes first, the vehicle that climbs the hill the furthest will be declared the winner.

Open Testing

- Instructor will provide a testing scenario or gaming event depending on time left with project.
    - Testing may include: Bowling, Demolition Derby, Ramp Jumps, etc…..

Grading:

- Points will be earned and calculated by using the entire design, fabrication and testing process.
    - Students must attempt / complete (3) three runs. An average of all three attempts will be used for grading. **100 points** maximum per event
    - Drawings, Sketches and Renders: **100 points**
    - Over-all Vehicle Appearance: **50 points**
    - Chassis Build Quality / Craftsmanship: **100 points**
    - Matte Board Body Build Quality / Craftsmanship: **50 points**
    - Participation: **100 points**
    - **Total Project: 500 points**
    - Extra Credit: up to **25 points** determined by the instructor

Time Line *(subject to change)*

Introduction	Day 1
Science, Tech, and Math Principles	Week 1
Preliminary Ideas	Week 1
Design Concepts / Working Drawings	Week 1 - 2
Fabrication Lab Safety / Test	Week 3
Vehicle Construction	Weeks 4 - 6
Vehicle Preliminary Testing	Week 7
Vehicle Modifications	Week 7
Electric Race Vehicle Competition	Week 8
ERV Summary Report	Week 9

Final Summary Report

- Students will develop an ***Electric Race Vehicle*** project summary and reflection paper.
    - Instructor will hand out requirements after the final testing has been completed.