

Environmental Education Program: Electric Vehicle Challenge

Grades 6-8



2021-2022

A Note about the 2021-2022 School Year

goHunterdon understands that the 2021-2022 school year continues to present unique challenges to teachers, students, and parents. Each school will be modifying their operations and school schedules as appropriate to their community.

goHunterdon will continue to support teachers, students, and parents by offering an environmental education program that focuses on highly interactive lessons that engage students to understand issues related to air quality, alternative energy, and the impact of transportation choice on the environment.

goHunterdon will again provide our Environmental Education Program remotely.

This will include:

- “Lessons in a box”- Supplies delivered to schools to allow teachers to conduct “hands on” lessons with students in person.
- Adaptations of lessons for “at home learning”
- Participation of goHunterdon staff via videoconferencing

individual car building kits to allow students with the flexibility to build in school or at home. Additionally, students can build without sharing supplies and follow social distancing guidelines.

EV Challenge Races will be conducted at individual schools upon request. No countywide race will be held in 2022.

We know that there is much uncertainty as to what the coming school year will look and feel like. Please know that goHunterdon remains dedicated to sharing our environmental education programming with Hunterdon County students.

We invite you to reach out to Jodi Bettermann, Environmental Education Coordinator, jbettermann@gohunterdon.org, to discuss how we can best assist this year.

Follow us on Twitter @HunterdonEVC for program updates

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Electric Vehicle Challenge

The Electric Vehicle Challenge replaces the Junior Solar Sprints Program for the 2021-2022 School Year.



goHunterdon's Electric Vehicle Challenge program engages students to design, build, and race electrically powered model cars.

The EV Challenge is an environmental education program that aligns with STEAM curriculum (Science, Technology, Engineering, Arts, and Mathematics); bridging the gap between these important educational disciplines.

Working individually, students will work to transform a few components including a motor, wheels, axles, and a battery pack into a unique and functioning model race car. Beyond these materials, students may use anything they like to build their vehicle. The only two required materials that must be used are the battery pack and motor; everything else is fair game.



The EV Challenge Program may be incorporated into "in person" classroom curriculum, remote learning, or used as part of an after school club.

Student vehicles may be evaluated on Engineering, Craftsmanship, and Use of Upcycled Materials.

Races will be conducted at individual schools as requested. There will be no Countywide Race in 2022.

The lessons that follow teach students about aerodynamics, gear ratios, and the alternative energy supplied by batteries, just like in a real electric vehicle. These lessons will guide them as they design and build their model cars. All lessons meet NJ Core Curriculum standards (details available on request).

goHunterdon staff will be available to provide lessons remotely via videoconferencing.

Additional lessons on alternative fuels, engineering design, and information related to race day are also included to complement the EVC program and provide students with all of the information needed to be successful.

Teacher Workshops

Workshops are designed to provide teachers with practical information to allow them to help student teams to participate in the Electric Vehicle Challenge Program (EVC).



Workshops will be offered remotely this year and will offer an overview of the EVC program, timelines for preparing students, and details and benefits of the lesson offerings. If desired, teachers can receive their own building materials and can design and build a race car to familiarize themselves with the vehicle components and the design and build process.

Other topics discussed in the workshop will include Judging Criteria, Engineering Design Journal, Vehicle Requirements, Testing, and Program Rules and Regulations.

Participation is strongly recommended for those teachers who want their classes to participate in the program

If you are not available to attend one of the virtual scheduled workshops or would like some more personalized options we can also arrange for a workshop to be remotely conducted with you individually. This approach will provide you with more targeted materials and information for your specific school and/or program.



Environmental Lessons

One of the goals of providing the Electric Vehicle Challenge is to increase awareness of how the transportation we all use in everyday life affects our environment. In goHunterdon's Environmental Education Offerings catalog, lessons that educate students about air quality and greenhouse gases, alternative fuels for transportation, and electric vehicles and vehicle charging are included. As part of participation in this year's Electric Vehicle Challenge, it is expected that at least one lesson from the Environmental Education Offerings is included. Here are some great choices which are also clearly indicated in this catalog with this symbol:



- Drive It Green
- Transportation & the Environment
- Green Marketing
- Electric Vehicle series of lessons

Sample Schedule

Lessons are designed to build on each other to teach all concepts needed for students to create a successful vehicle. The amount of time needed for construction and testing of students' creations will vary, and more time may be needed than is included here. Environmental Education lessons can be included anywhere in the series of lessons.

Week 1	Environmental Education lesson
Week 2	Introduction and Basics of Design
Week 3	Battery Power
Week 4	Aerodynamics
Week 5, 6	Introduction to Gears
Week 7	Prototypes
Weeks 8, 9	Construction and Testing
Week 10	At the Race Line
Week 11	Final prep for races

Basics of Design & Building Your Model Car Lesson

Grade(s): 6-8

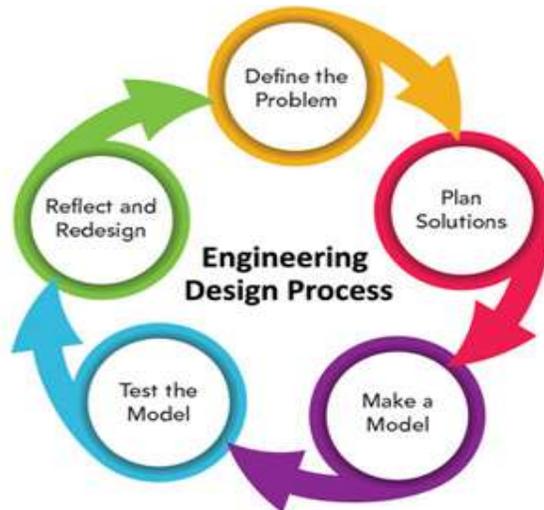
Learning Goals/Essential Questions

- What are the basic design strategies?
- What are the best materials for strength vs. weight?
- How does the structure of my vehicle impact its durability?



Overview

Using the continuous feedback loop seen below, students will learn the steps necessary to successfully build a working model electric vehicle.



This information will be extremely important as students move through the stages of building their Electric Vehicle Challenge cars and developing not only a working vehicle but one that might win the races.

Following the informative lesson, students will participate in a building exercise that will engage them in the building and design of shapes that could help them improve the overall strength of their vehicles without sacrificing added weight.

Remote Delivery: Lesson in a Box supplies for hands on building activity

Home Instruction: Use common household items for hands on building activity

Battery Power! Lesson

Grade(s): 6-8

Learning Goals/Essential Questions

- How does a battery work?
- Do different batteries produce different amounts of electricity?
- What happens when more than one battery is used in series?



Overview

Do different batteries really impact electric power output that much? Find out with this lesson that is designed to test that exact question. We will review the basics when it comes to batteries; how they work, how much electricity different batteries produce, and what happens when they are connected in series.

Utilizing test batteries and multi-meters students will investigate the electrical output of different batteries. By taking measurements using different batteries the students will get to see the importance of the power of their battery packs during the races.

Remote Delivery: Lesson in a Box with multi-meters and test batteries.

Home Instruction: Use batteries found at home.

Aerodynamics Lesson

Grade(s): 6-8

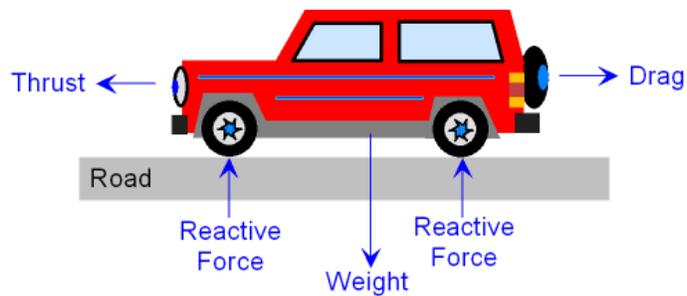
Learning Goals/Essential Questions:

- What is Aerodynamics? How does it impact my vehicle?
- How can I make aerodynamics work for me?



Overview

How does the aerodynamics, or shape, of an object moving through the air increase or decrease the friction (drag) on that object? In this lesson we explore the four (4) forces of aerodynamics: Lift (or Reaction), Weight, Thrust, and Drag. We will discuss these different forces and describe how each of them works with or against a vehicle.



For the experimental portion of this lesson students will be asked to design, using foam pieces, different shaped objects that will be put into a homemade wind tunnel to test how they interact with the air. Students will place their shapes into the wind tunnel and record the amount of time it takes to cross the finish line.



Remote Delivery: Lesson in a Box and wind tunnel.

Home Instruction: Use common household items and a fan for the activity.

Introduction to Gears & Gear Ratio Lesson

Grade(s): 6-8

Learning Goals/Essential Questions

- What is a gear and how does it work?
- How do you determine a gear ratio?
- What is torque vs. speed and how do they impact the way gears operate?

Overview

What is a gear? How does it work? How does the size of the gear and different gear arrangements impact the overall performance of the gears?

In this lesson we answer all of these questions and more. Students will be introduced to gears, and gear ratios. Students will also learn about torque and speed and how to determine if the gear ratio that they are using is utilizing either of these.

The second part of the lesson, after the students are familiarized with gear ratios, focuses on how to incorporate these concepts into their Junior Electric Vehicle Challenge vehicles. During this portion of the lesson we will discuss how wheel size directly impacts the gear ratio needed to move the vehicle and how to best find the proper ratio to use.



Remote Delivery: Lesson in a Box supplies with testing gears and worksheets

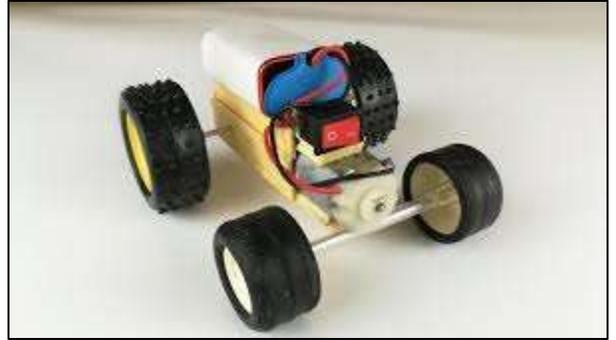
Home Instruction: Online gear testing platform and worksheet.

Prototypes Lesson

Grade(s): 6-8

Learning Goals/Essential Questions:

- What do the different gear ratios mean for car design?
- How do you decide what gear ratio to use?



Overview

As a follow-up to the Introduction to Gears lesson, students are provided with an opportunity to test different gear ratios. Utilizing equipment supplied by goHunterdon the students will build and test a working prototype and will have the opportunity to see how gear choices impact their car.

This workshop is designed for the students to design and build a working prototype which will help them in refining their actual design. Documenting the Engineering Design Process with their ideas and iterations becomes important and will be discussed.

Remote Delivery: Lesson in a Box with prototype supplies.

Home Instruction: Building supplies taken home by students.

Construction and Testing Lesson

Grade(s); 6-8

Learning Goals/Essential Questions:

- How do I apply what I have learned to create a successful electric vehicle?
- What materials should I use?
- How will I decide what works and what doesn't for my electric vehicle?



Overview

The prior lessons lead up to this one where students use everything they have learned so far to construct their Electric Vehicle Challenge vehicles. This is where it all comes together! Students will document their design ideas for the vehicle's chassis, axles and wheels, gear setup, body/shell, and materials they will use. Then students will construct, test, document, and modify their vehicle using the engineering design process. Consideration of strength of materials, the effects of friction and weight, and aerodynamics will all be needed to successfully build their electric vehicles. The Electric Vehicle Challenge vehicles have two design requirements that must be incorporated: 1) the motor and battery pack provided by goHunterdon must be used and 2) the vehicle must hold a standard soda can as a passenger which can be easily removed without affecting the structure of the vehicle.

It is likely that this lesson will occur over a few weeks as students build their vehicles and goHunterdon staff provide check ins and support during the build and test process.

Remote Delivery: Lesson in a Box with supplies and virtual mentoring sessions.

Home Instruction: Virtual mentoring sessions.

At the Race Line Lesson

Grade(s): 6-8

Learning Goals/Essential Questions:

- Why do we attach our cars to a race line? What is the race line and what does it do?
- How do I attach and detach my vehicle easily from the race line?



Overview

Race line attachment is a consistent challenge for students on race day. Student vehicles must attach (and remain attached or they are disqualified from that race) to a 60# fishing wire that stretches the length of the track. This lesson will help your students feel more confident and understand what they need to do prior to race day.

Utilizing simply designed balloon powered cars with different race line attachments students will have the opportunity to experiment with different set-ups to find one that would work well with the design of their vehicle.

Remote Delivery: Lesson in a Box with race line supplies.

Home Instruction: Use common household items to test.

What to Expect on Race Day Information Session

Grade(s): 6-8



Information Session Goals:

- Making students comfortable with what will be happening on Race Day.
- Providing opportunities for last minute fixes, and tweaks to vehicles.

Overview

This workshop will be tailored to the specific needs of the race at your school. The lesson will provide your students' with specific information about what to expect on race day, what to do and how the event works. The main goal of this lesson is to make sure your students and their vehicles are ready to race on Race Day.

This may include answering last minute questions, soldering/wire connections, vehicle inspection to provide useful tips for students, and test race line for students to test their vehicles.



Remote Delivery: Virtual presentation and check in.

Home Instruction: Virtual presentation and check in.