2022-2023

Program Offerings

goHunterdon
Promoting Sustainable Transportation

Table of Contents

Air Quality 4

How Clean is the Air? Air Quality Experiment 5

Anti-Idling Education Program 6

Clean Air Week Campaign 7

Transportation Choices 8

Drive it Green 10

Transportation and the Environment: Energy, Fuels and Emissions 11

Electric Vehicles and Climate Change 12

Busting Electric Vehicle Myths 12

Green Marketing 13

Electric Vehicle Visit 15

Electric Vehicle Challenge 16

Basics of Design & Building Your Model Car Lesson 20

Battery Power! Lesson 21

Aerodynamics Lesson 22

Introduction to Gears & Gear Ratio Lesson 23

Prototypes Lesson 24

Construction and Testing Lesson 25

At the Race Line Lesson 26

What to Expect on Race Day Information Session 27

goHunterdon's free Environmental Education Program explores the connection between transportation choice and impact on the environment.

The FREE program is designed to educate students in **grades 4-8.** All lessons meet NJ Core Curriculum standards.

Lessons have been organized this year to align with Sustainable Jersey for Schools criteria to allow schools to earn points under the following Action Items:

- Healthy School Environments
- Student and Community Outreach

Program Delivery Changes for 2022-2023

Please note the following changes to the Environmental Education Program delivery for this school year:

- **"Lessons in a box" Approach**- Lessons, online resources, and related supplies will be delivered to schools for teachers to conduct lessons. goHunterdon staff will not be available to teach lessons directly.

- **Facilitated Professional Learning Community**- gohunterdon staff will facilitate a professional learning community of participating teachers and provide trainings and videos to support programming. **Participating teachers must agree to participate in the professional learning community to support other teachers.**

- **Teacher Workshop-** Attendance in a teacher workshop to be scheduled remotely in October will be required for all teachers participating in the EV Challenge. Workshops will include additional instructions on reserving lessons in a box and ordering build kits.

- **Electric Vehicle Challenge Pre-requisite Lessons**- Prior to receiving EV Challenge build kits, students will be required to have participated in prerequisite lessons as noted on page 18.

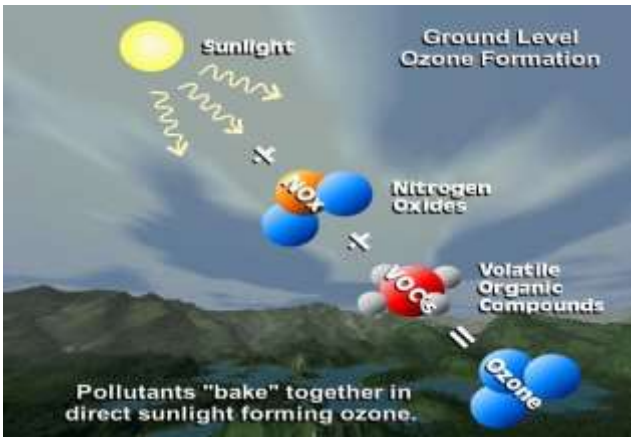
- **EV Challenge Countywide Race-** goHunterdon will conduct a countywide speed race for participating students in May 2023.

These changes have been made to allow goHunterdon to continue to provide high quality programming to the maximum number of students in Hunterdon County and to ensure consistency with goHunterdon's mission.

For more information we invite you to contact: Margret Thompson, Sustainable Hunterdon Coordinator, mthompson@gohunterdon.org

goHunterdon
Promoting Sustainable Transportation

Air Quality



The air we breathe is made up of a mixture of gases in the Earth's atmosphere, mainly nitrogen and oxygen. Human activity on Earth adds additional ingredients to our atmosphere which can affect our health and the climate in negative ways. These additional ingredients can be categorized as **air pollutants and greenhouse gases.**

The federal Environmental Protection Agency (EPA) has identified six common **air pollutants:** ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide and lead.

Automobiles and other modes of transport (buses, trucks, etc.) play a large role in the emissions of many of these types of dangerous pollution, emitting four of the six common pollutants into the environment.

In New Jersey, we exceed the air quality standard level for ground ozone in all counties which affects the quality of the air we breathe.

Greenhouse gases in our atmosphere are defined as gases that absorb and trap heat. Greenhouse gases are needed to keep the Earth warm enough for life to survive, but concentrations of greenhouse gases that are too high contribute to global climate change. While certain levels of these greenhouse gases are necessary to make the Earth inhabitable, concentrations that are too high cause the planet to become warmer, affecting our climate.

The burning of fossil fuels such as natural gas, diesel, and gasoline contributes to higher concentrations of greenhouse gases and air pollution in our atmosphere.

In New Jersey, the transportation sector is the largest source of air pollution including particulates, nitrogen oxides, and greenhouses gases. 45% of greenhouse gas emissions and 71% of nitrogen oxide emissions can be traced to transportation here in New Jersey. New Jersey's Energy Master Plan adopted in 2019 includes a goal of 100% clean energy by 2050. This includes electrification of the transportation sector in order to reduce emissions of greenhouse gases and air pollutants that contribute to climate change.

The lessons that follow are designed to provide students with information and activities related to air quality and greenhouse gases while increasing their awareness of these as a source of global climate change.

How Clean is the Air?
Air Quality Experiment

Learning Objectives

Students will be able to:

- Define air quality
- Describe what makes up air pollution
- Explain the scientific method

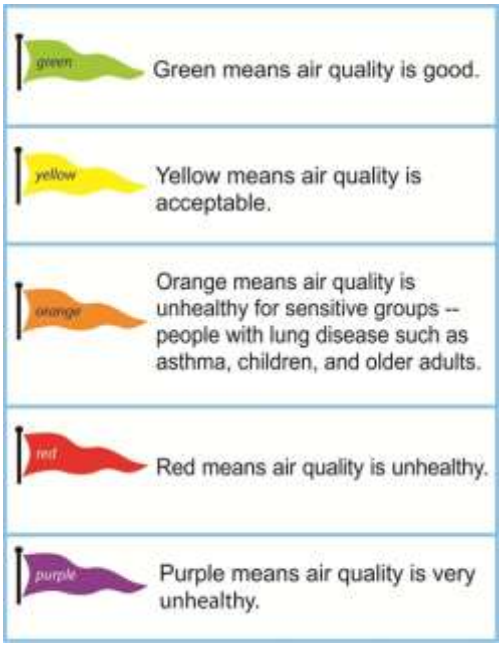
Overview

How clean is the air you are breathing right now? How about the air at home? That is what students will find out in this lesson!

Students will create air quality monitors that they can hang at home or at school. The air testers are hung and monitored for a week. Students will look for air pollution residue on the card and will chart and graph their findings.

Lesson Application

Use this lesson as a springboard for an air quality flag program at your school which qualifies for points as a Sustainable Jersey for Schools.



Remote Delivery: Lesson in a Box with all necessary supplies

Sustainable Jersey For Schools Action
https://www.sustainablejerseyschools.com/actions/

Anti-Idling Education Program

Learning Objectives

Students will be able to:

- Define vehicle idling
- Explain how vehicle idling can impact them and their community
- Develop strategies to improve air quality at the school

Overview

Vehicle idling happens everywhere- at school, home, and the store. Idling cars, trucks, school buses, public and private transportation buses, and off-road construction vehicles/equipment all contribute to the degradation of local air quality. Current regulations limit engine idling for both diesel and gasoline vehicles to three minutes with limited exceptions.

The Anti-Idling Education Program increases students' awareness about idling, its impacts, and alternatives. Then students are engaged to design a custom sign, to communicate New Jersey's "No Idle" law.

A custom sign can be produced by goHunterdon, free of charge, for installation at your school.

**Schools may request an official New Jersey anti-idling sign, at no cost, as well.*

Remote Delivery: Lesson in a Box with supplies for activities

Sustainable Jersey For Schools Action
https://www.sustainablejerseyschools.com/actions/

Idling Audit

Using stopwatches and tally sheets, students conduct several days of observation and data collection of the number of vehicles idling beyond NJ's 3 minute idling law outside of their school.

The data collected in the school pick-up and drop off zones establishes a baseline of information that can be used to prior to beginning a school or community wide education/awareness program.

Following education/awareness efforts, students will conduct a follow up audit to see if idling behavior has changed. Student can present this information to the school board, PTO, or municipal body.

Clean Air Week Campaign

Learning Objectives

- Describe the importance of keeping the air clean at school
- Define and use alternative forms of transportation such as carpooling, walking, bicycling

Overview

A Clean Air Week campaign challenges students, parents and faculty to reduce their impact by pledging to carpool, walk, ride the bus to school, and reduce idling every day for a week. It is a great way to improve air quality around the school and raise awareness of the harmful impacts of idling which disproportionately affects children. Clean Air Week Campaigns create friendly competitions at schools, whether divided up by classrooms, or grade level, school bus, or the school as a whole to see who is a "Clean Air Champion".

Sample activities include:

- Alternative Transportation Pledges
- Anti-Idling Education/Awareness Efforts
- Public Service Announcements
- Poster and Lawn Awareness Signs
- School Bus Driver Appreciation
- Walk/Bike to School Events (walking districts)
- Bicycle and Pedestrian Safety Presentations

Remote Delivery: Virtual presentation

Sustainable Jersey For Schools Action
https://www.sustainablejerseyschools.com/actions/

Transportation Choices

Alternative Energy: Renewable vs Non-Renewable Fuels

Alternative fuels are materials and substances that can be used as vehicle fuel that are other than traditional fossil fuels such as gasoline and diesel fuel.

These fuels include **electricity, biodiesel, hydrogen, compressed natural gas** and **propane.**

Electric Vehicles

In April 2020, Governor Phil Murphy announced that New Jersey will work toward electrification of the transportation sector in support of the goal of 100% clean energy by 2050.

New Jersey's transportation sector is the source of 45% of greenhouse gas emissions and 71% of nitrogen oxide emissions in the state. These emissions lower the quality of the air we breathe, contributing to health effects like asthma in our communities. They also contribute to climate change by increasing the concentration of greenhouse gases in the atmosphere.

The energy source for a traditional internal combustion engine for a vehicle is gasoline or diesel fuel, both of which are fossil fuels burned to provide power to the vehicle to make it move. The energy source for an electric vehicle is electricity. The electricity comes from charging the batteries in the vehicle by plugging it into a charging station. The charging station gets its electricity from electric utility lines which can receive electricity from a power plant, solar array, wind turbine, or other source of energy. In New Jersey the emissions from electricity generation is much lower than from transportation at only 18% of the state's greenhouse gas emissions.

New Jersey's energy strategy for the future relies on electrification of transportation. Improvements in battery technology have reduced the prices of electric vehicles and charging stations are becoming more prevalent.

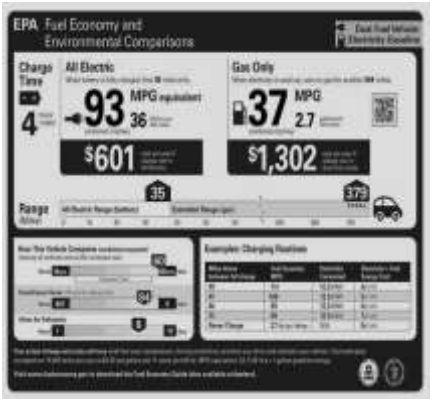
Electric vehicle sales in New Jersey have been growing and currently there are more than 80,000 electric vehicles registered. Here in Hunterdon County we have 1,224 electric vehicles on the road as of April 2022. The goal is to have 330,000 light duty vehicles on the roads in New Jersey by 2025, only 2-3 years from now.

The lessons in this section introduce electric vehicle concepts and increase awareness of the benefits to us and to our environment.

On the following pages, lessons notated with this icon are prerequisites to the Electric Vehicle Challenge Program

Drive it Green

Learning Objectives



Students will be able to:

- Discuss fuel efficiency and what it means for the environment
- Understand how transportation choices impact the environment
- Understand the types of fuel that can power motor vehicles

Overview

Students start out the lesson by looking at a list of seven (7) reasons that a person might consider when purchasing a vehicle (color, style, brand name, etc.)

Students are then directed to select a vehicle (sports car, sedan, pick-up truck, etc.) that they will utilize for the remainder of the class period. Students select their vehicle prior to being given any further information about the activity. Only after the student teams have selected their vehicles are they provided with a "window sticker" which will give them additional information, such as gas mileage, EPA ratings, etc.

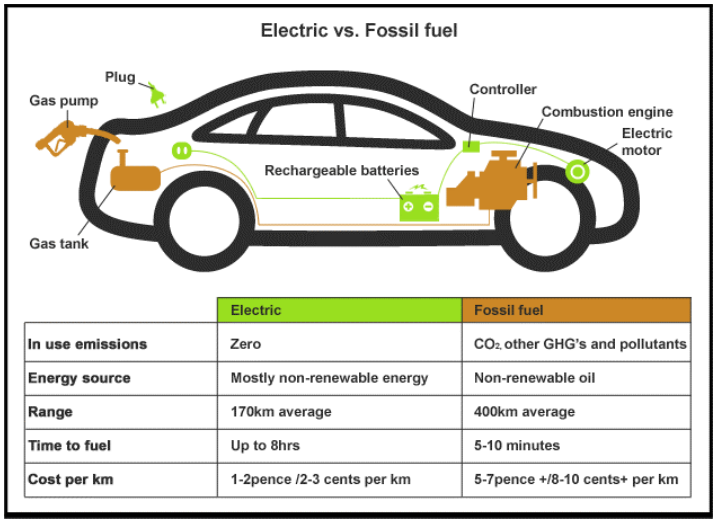
Students repeat the activity with a second vehicle which is more fuel efficient or which runs on alternate fuels such as a hybrid vehicle. They compare information from both vehicle choices and discuss alternative fuels and more sustainable forms of transportation.

Remote Delivery: Lesson in a Box with supplies

Transportation and the Environment: Energy, Fuels and Emissions

Learning Objectives:
After this lesson, students should be able to:

- Understand the sources of energy used to power vehicles.
- Understand the difference between fossil fuels and renewable/advanced fuels
- Explain why advanced fuels have lower emissions



	Electric	Fossil fuel
In use emissions	Zero	CO_2, other GHG's and pollutants
Energy source	Mostly non-renewable energy	Non-renewable oil
Range	170km average	400km average
Time to fuel	Up to 8hrs	5-10 minutes
Cost per km	1-2pence /2-3 cents per km	5-7pence +/8-10 cents+ per km

Overview

In this lesson students delve into the different ways that vehicles can be powered and how each works:

Gasoline/Diesel

Hybrid electric

Battery electric

Biodiesel

Compressed natural gas/propane

Hydrogen fuel cell

Students will then have the opportunity to apply what they have learned by designing their own eco-friendly transportation vehicle of the future. Design criteria will include New Jersey's goal to have 100% clean energy by 2050 as well as to appeal to consumers of the future.

Remote Delivery: Lesson in a Box with all necessary supplies

Electric Vehicles and Climate Change

Learning Objectives

After this activity, students should be able to:

- Identify how climate change is affected by greenhouse gases.
- Use a digital interactive graph to predict climate change outcomes.
- Evaluate how electrification of transportation Will impact climate change.
- Write an evidence based statement supporting an environmental policy.

Overview

Digital tools can help us to visualize and predict outcomes. The En-ROADS simulator tool allows us to see how changes in the use of greenhouse gas emitting technologies change the overall warming of the planet. Students will gain a better understanding of climate change with a video from National Geographic with Bill Nye. Then, students will use the En-ROADS simulator tool to change transportation to electrification to evaluate the change in predicted temperature. Students will write a statement to make an evidence based recommendation about electrification of transportation.

Remote Delivery: Lesson in a Box with all necessary supplies

Busting Electric Vehicle Myths

Learning Objectives

After this activity, students should be able to:

- Research using digital tools, print and video sources to comprehend an issue.
- Use speaking and listening strategies to engage in discourse using technical vocabulary of the subject accurately.
- Evaluate arguments using facts from trusted sources.

Overview

There are many myths about why electric vehicle adoption is not a good idea. Students will use video, web, and print sources to research some of these myths and find out how they are false.

Students will role play explaining why an electric vehicle myth is not true through an interactive game structure. In the process, they will learn about how to advocate for positive change through combatting disinformation.

Remote Delivery: Lesson in a Box with all necessary supplies

Green Marketing

Learning Objectives

After this activity, students should be able to:

- Write an advertisement for a hybrid vehicle.
- Use a full range of strategies to comprehend technical writing, newspapers, magazines, etc.
- Write in the content areas using the technical vocabulary of the subject accurately.
- Learn the principles of comparative analysis.

Overview

Part of successful engineering invention and innovation is exploring the factors that determine success or failure in the competitive marketplace. This includes knowing your product, your competition and your potential customers. Successful engineers have strong written and oral communication skills suitable for a range of audiences. Even though engineers themselves may not create the advertising, they must clearly explain to the advertisers the product benefits.

Students will learn basic marketing concepts and use professional marketing techniques to compose an advertisement for a hybrid vehicle. In the process, they will learn about hybrid vehicle technology and why it is good for the environment.

Remote Delivery: Lesson in a box with all necessary supplies.

Electric Vehicle Visit

Learning Objectives:

- Students will identify the parts of an electric vehicle and how they are different from internal combustion engine cars.
- Students will develop questions to enhance their understanding of electric vehicles.

Overview:

Students have been learning about different types of cars including electric vehicles. Students will develop questions to ask and identify answers to as they get to know an electric vehicle in person.

Remote Delivery: Lesson in a Box with all necessary supplies

Electric Vehicle Challenge

To successfully participate in the EV Challenge, teachers and students should anticipate an 8 month program schedule, starting in October.

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.

Following prerequisite lessons on the impact of transportation on the environment, students will work in teams of 2-4 students 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. Student vehicles may be evaluated on Engineering, Craftsmanship, and Use of Upcycled Materials. Scoring criteria is available upon request.

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

EV Challenge Countywide Race will be conducted in May 2023.

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 facilitate the establishment of a professional learning community so teachers can support each other in implementing these lessons.

Teacher Workshop-
Mandatory

The introductory program workshop will provide teachers with practical information to allow them to help student teams to participate in the Electric Vehicle Challenge Program (EVC).

Workshop will be offered remotely this year and will offer an overview of the 2022-2023 EVC program, timelines for preparing students, and details and benefits of the lesson offerings. Teachers will receive a build kit to allow them to 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 prerequisite lessons, program rules and regulations, judging criteria, engineering design journal, vehicle Requirements, testing, and race day preparation.

Participation is required for those teachers who want their students to participate in the program.

Prerequisite Lessons

The Electric Vehicle Challenge provides a hands on learning opportunity to teach students about the impact that transportation choice has on the environment as part of goHunterdon's broader environmental education program.

This year, teachers will be required to instruct 3 of the following 5 lessons prior to beginning the EV Challenge "design and build" lessons or receiving build kits.

The EV Challenge prerequisite lessons are listed below and included in this catalog:

- **Drive It Green**
- **Transportation and the Environment**
- **Electric Vehicles and Climate Change**
- **Busting Myths About Electric Vehicles**
- **Green Marketing**

All teachers are also encouraged to coordinate with goHunterdon to arrange to have an electric vehicle visit the school.

Sample Program Schedule

The following schedule includes all of the prerequisite lessons. Three (3) of the five (5) lessons are required prior to starting the EV Challenge "design and build" lessons. The "design and build" lessons should be taught in the order presented so that students learn 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. The following time line may be used to help plan your program year.

2022-2023 Schedule

Week 1	October	Drive It Green
Week 2	October	Electric Vehicles and Climate Change
Week 3	November	Busting Electric Vehicle Myths
Week 4	November/December	Transportation and the Environment
Week 5	December	Green Marketing ***
Week 6	December/January	Electric Vehicle Visit
Week 7	January	Introduction and Basics of Design
Week 8	January	Battery Power
Week 9	February	Aerodynamics
Weeks 10 and 11	February/March	Introduction to Gears
Week 12	March	Prototypes
Weeks 13 and 14	March/April	Construction and Testing
Week 15	April/May	At the Race Line
Week 16	May	Final Prep for races

*** teachers may order EV kits

DESIGN AND BUILD LESSONS

Basics of Design & Building Your Model Car Lesson

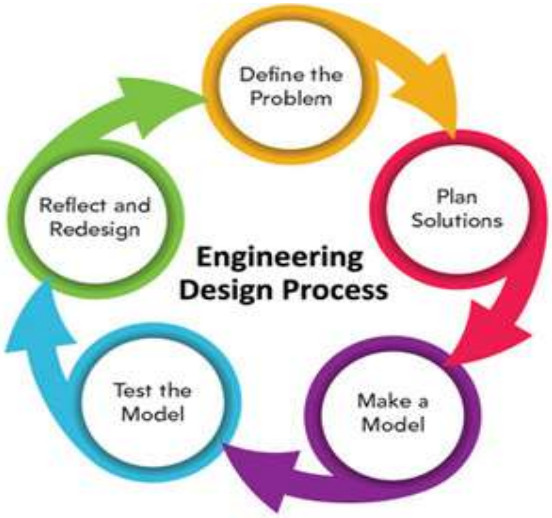
Grade(s): 6-8

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

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.

Aerodynamics Lesson

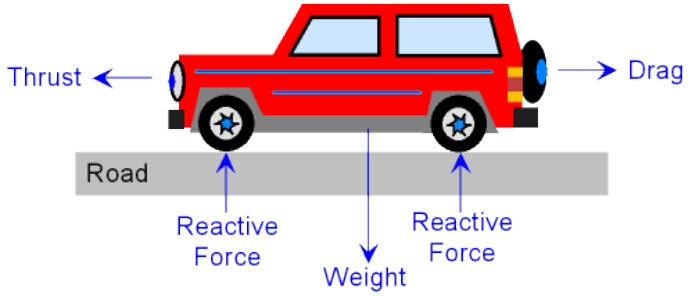
Grade(s): 6-8

Learning Goals/Essential Questions:

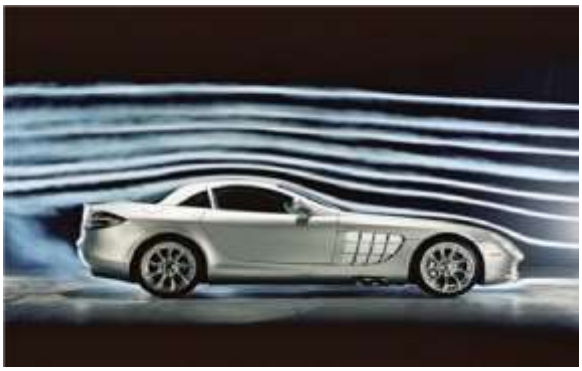
- What is Aerodynamics? How does it impact my vehicle?
- How can I make aerodynamics work for me?

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.

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

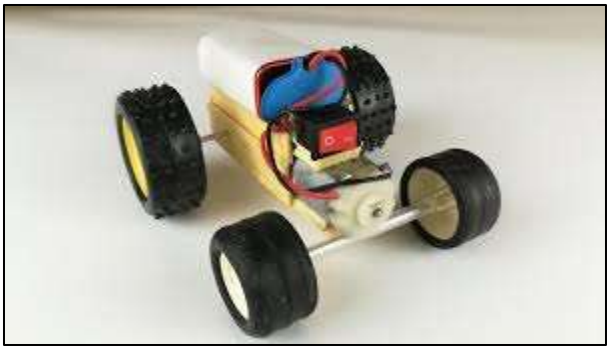
What is a gear? How does it work? How does the size of the gear and different gear arrangements impact the overall performance of the gears?

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.

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.

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 is 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.

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.

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 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.