Build an EV

Objective

Students will design, build and test a simple electric vehicle (EV).

Curriculum Focus

Science
Technology
Engineering
Math

Materials

- Motors of different sizes
- Various batteries of differing sizes
- Wiring
- Various household items for chassis construction
- Yardstick or tape measure
- Stopwatch or photo gate
- Multimeter
- Balance or digital scale
- Calculator

Key Vocabulary

Acceleration
Current
Force
Mass
Voltage

Learning Standards

MS-PS1 – 6
MS-PS2 – 3, 5
MS-PS3 – 5
MS-ESS3 – 3
MS-ESS3.C
MS-ETS1 – 3

HS-PS2 –5
HS-PS3 –1
HS-PS3 – 3, 5
HS-ESS3 – 4
HS-ESS3.C
HS-ESS3 – 6
HS-ETS1 – 3
HS-ETS1.B

Recommendation

This is a STEM rich activity requiring substantial time, supplies and student skill in problem-solving. If teachers have access to equipment, such as STEM kits, 3D printers or photogates, they can be incorporated into the lesson but none are required.

Introduction

In an electric vehicle (EV), the motor replaces the engine in the traditional vehicle's engine location. Other parts are needed in an EV to transform energy into motion like batteries and controllers. To learn more about how EVs work, go to *afdc.energy.gov/vehicles/how-do-all-electric-cars-work*.

Procedure

1. Review the basics of how an electric car works and the relationship between the battery pack and the output of the motor.
2. Explain that students will be tasked with designing an electric car with the motors and the batteries provided and any other materials teachers choose to supply.

3. If teachers do the "Get Your Motor Running" activity, they should review the relationship between voltage and rotations (rpm) of the motor and how voltage would vary with different numbers and circuit configurations of the batteries. (Hint: A quick internet search on connecting batteries in series versus parallel is helpful.)

Design, Build, Test

4. Each group of students
   A. Using spreadsheet software, create a data table to record important data on the variables affecting the EV's performance.
   B. Using the materials available, design and build a car chassis (wheels, axles, baseplate) that will accommodate a motor, gears and batteries.
   C. Attach the motor and batteries to the chassis and gears.
   D. Determine the mass of the EV.
   E. Test the EV over standardized distance (6.5 to 13 feet) and calculate the final speed and its acceleration using the yardstick and stopwatch.
   F. Review the motor and gear system for any improvements that can be made for speed and distance traveled.
5. If students have access to a 3D printer, they should design the car body to mount on their chassis and print it.

To Know and Do More

1. Add a remote control system to the EV.
2. Connect the motor to a propeller instead of directly to the wheels.
3. Go BIG and build a full size car and participate in the Solar Car Challenge *solarcarchallenge.org/challenge/*

Alternative methods to power the EV:

- Solar panels
- Hydrogen fuel cells

Student Sheet: Build an EV

In an electric vehicle (EV), the motor replaces the engine in the traditional car. Other parts are needed in an EV to transform energy into motion like batteries and controllers. Go to *afdc.energy.gov/vehicles/how-do-all-electric-cars-work* to learn more.

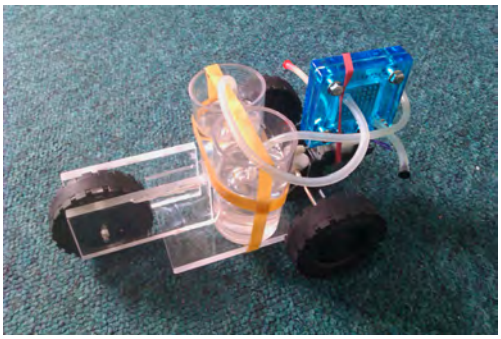
Procedure

1. Create a digital diary or presentation slides to showcase the planning, designing and building of your EV. Make sure to cover reasons for your choice of materials, design and any revisions to your design after testing.
2. Using spreadsheet software, create a data table to record important data on the variable affecting the EV's performance.
3. Using the materials available, design and build a car chassis (wheels, axles, baseplate) that will accommodate a motor, gears and batteries.
4. Attach the motor and batteries to the chassis and gears.
5. Determine the mass of the EV.
6. Test the EV over standardized distance (6.5 to 13 feet) and calculate the final speed of its acceleration using the yardstick and stopwatch.
7. If you have access to a 3D printer, design the car body to mount on the chassis and print it.

To Know and Do More

Other optional parameters to test your EV's capabilities:

1. Test uphill acceleration on a track.
2. Find the towing capacity of the EV.
3. Evaluate how the weight of materials used impacts the EV's performance.



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