Zero-Emission Vehicles & Low-Carbon Driving

The GM Learning Lab

Getting Started

Welcome to the Zero-Emission Vehicles & Low-Carbon Driving Learning Lab! This resource will walk you through some fun and hands-on experiments to support your learning around zero-emissions vehicles, electricity, and renewable energy. We recommend that you review the other Zero-Emission Vehicles & Low-Carbon Driving resources before doing these activities, to gain a foundational understanding of how these activities relate to zero-emission vehicles and low-carbon driving.

Key Considerations

The folllowing activities can be done in the classroom, at home, or any other appropriate indoor location.

These activities are best suited for students in Grades 2-8, however, all are welcome to participate.

Safety first! All activities should have adult supervision with proper safety precautions. We recommend the use of safety glasses and safety gloves for some activities, where specified.

Educators are encouraged to adapt the activities in this guide to their unique needs and contexts.

Using the Scientific Method

These activities were designed with a focus on scientific inquiry and technological problem solving. The scientific method is the process of establishing facts through testing and experimentation. This includes: forming a hypothesis, conducting an experiment and following procedures, recording observations and findings, and finally analyzing and communicating the results. Use the lab report template on the next page to document your process and record your findings.

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Lab Report Template

Title of experiment:	
Purpose • What question are you exploring in this experiment? • Why is it important? Include any real-world connections here.	
Hypothesis • What do you think will happen during the experiment?	
Materials • What do you need to complete the experiment?	
Procedure • Discuss each stage of the experiment step-by-step.	
Results • Write your observations here, what did you see happen? You can include pictures.	
Discussion • Was your hypothesis correct? Why or why not? • How could you expand on this experiment?	

Zero-Emission Vehicles & Low-Carbon Driving

The GM Learning Lab - Activity 1

ACTIVITY 1: Let's make a battery!

Curriculum Connections

Sciences, Design & Technological Studies: Design, build, and test a device that produces electricity. Follow established safety procedures for working with electricity and use appropriate science and technology vocabulary.

Intended Grade Levels: Grades 2-8

EcoSchool Resource Connection: Charging Zero-Emission Vehicles

Recommended Class Time: 2-3 periods

Key Considerations

- Safety first! Please ensure that there is adult supervision with proper safety precautions.
- It is strongly recommended that all students wear gloves and safety glasses throughout the activity.
- It is recommended that students work in small groups of 2-4 (depending on their age) to ensure equal participation.

Key Terms

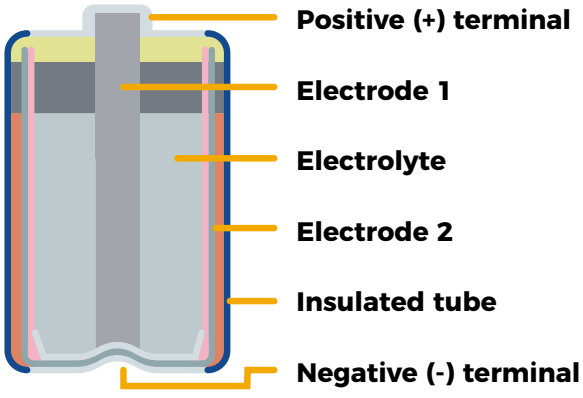
The following terms can be found in bold.

They include: **battery, electrodes, electrolyte, electric current, zinc,** and **nickel battery.**

Background Information

A **battery** is a device that stores chemical energy and converts it to electrical energy. Batteries are used to power various equipment such as, clocks, flashlights, laptops, electric bicycles, cars, and many other useful items that humans use on a daily basis.

A battery consists of **electrodes**, which are conductors through which electricity enters and leaves the battery, as well as electrolyte, which is a liquid or gel that assists electricity to flow between electrodes.



When two different metals are placed in the **electrolyte**, negatively charged ions (electrons) will flow from one electrode to the other via an external wire. This flow of electrons is called an **electric current**, which can be used to make electric equipment work (e.g., light up a flashlight or make the hands of a clock tick). Different materials can be used as the electrodes and electrolyte, this will impact how the battery works and how much energy it can store.

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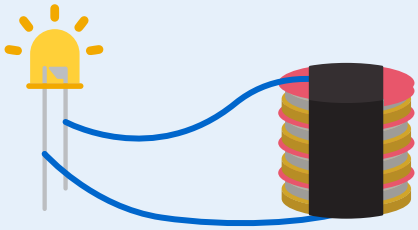
The GM Learning Lab - Activity 1

In this activity, you will be making a zinc and nickel battery where nickel and penny coins will act as the electrodes & vinegar will act as the electrolyte.



Materials

Per student:

- [ ] Safety Glasses
- [ ] Safety Gloves

Per group:

- [ ] 8 Nickels (or an alternative nickel material*)
- [ ] 8 Pennies (or an alternative zinc material*)
- [ ] Sandpaper
- [ ] ½ cup of Vinegar
- [ ] Construction Paper (acts as a separator)
- [ ] Tin Foil (acts as wires)
- [ ] Tape (masking tape, duct tape, electrical tape)
- [ ] Scissors
- [ ] Pencil
- [ ] Cutting board, cardboard, or an appropriate work surface

**As coins have become increasingly difficult to find, consider referring to your local hardware store or an online shop for alternative flat materials made of zinc and nickel.*

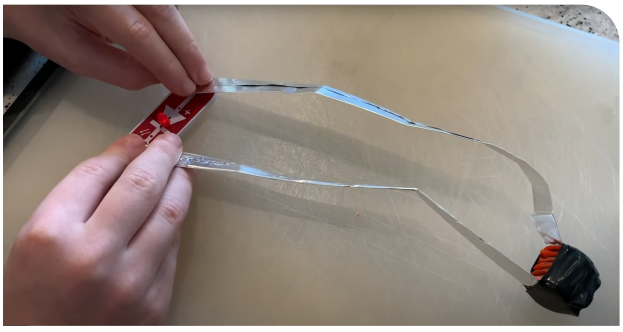
Optional:

- [ ] Digital multi-meter or something that measures voltage
- [ ] A small LED light, that you can light with your battery

Procedure

For a full explanation of on how batteries work and how to build a zinc and nickel battery, watch this video (14 minutes, 45 seconds) created by GM Canada:

https://www.youtube.com/watch?v=4a2-iIPQ4CE
(NOTE: Instructions begin at “6:15”).



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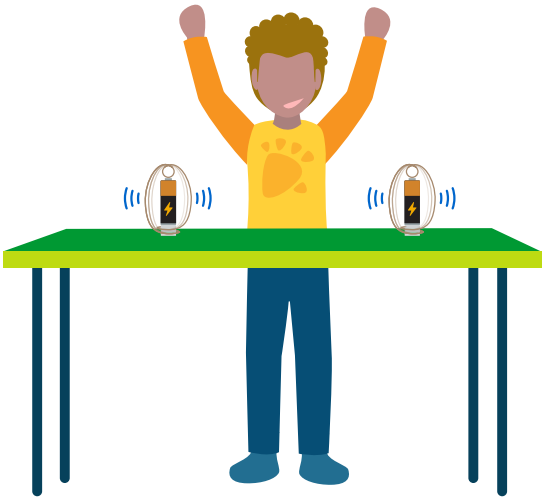
The GM Learning Lab - Activity 2

ACTIVITY 2: Let's Make an Electric Motor!



Curriculum Connections

Sciences, Design & Technological Studies: Design, build, and test a device that produces electricity. Assess the short and long-term environmental effects of the different ways in which electricity is generated in Canada. Follow established safety procedures for working with electricity and use appropriate science and technology vocabulary.

Intended Grade Levels:
Grades 2-8

EcoSchool Resource Connection:
Exploring Zero-Emission Vehicles Resource

Recommended Class Time:
2-3 periods

Key Considerations

- Safety first! Please ensure that there is adult supervision with proper safety precautions.
- It is strongly recommended that all students wear gloves and safety glasses throughout the activity.
- It is recommended that students work in small groups of 2-4 (depending on their age) to ensure equal participation.

Key Terms

The following terms can be found in bold.

They include: **internal combustion engine vehicle (ICEV), zero-emissions vehicle (ZEV), electric motor.**

Background Information

In an **internal combustion engine vehicle (ICEV)**, there is an engine that takes fuel from the gas tank to make the vehicle move. In a **zero-emissions vehicle (ZEV)**, there is an electric motor that takes electricity from a battery to make the vehicle move. In a ZEV, the electric motor spins the gears, the gears turn the shafts, and then the shafts turn the wheels.

Electric motors work by using electricity from a battery to create physical movement. Electric motors can be found in appliances and toys, even in gas powered cars to move the windshield wipers or the seats.

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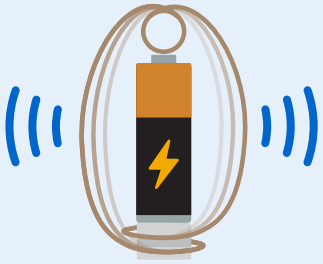
The GM Learning Lab - Activity 2

This activity will provide guidance on how to build a simple electric motor using a battery and magnet.



Materials

Per student:

- [ ] Safety Glasses
- [ ] Safety Gloves

Per group:

- [ ] 1 AA battery
- [ ] Copper wire
- [ ] 1 strong magnet (recommended type is a neodymium magnet)
- [ ] Pliers

Procedure

For a full explanation on how to build an electric motor using a battery and magnets, watch this video created by GM Canada:

https://www.youtube.com/watch?v=7fpClaO0H-g
(NOTE: Instructions begin at “3:53”).

Zero-Emission Vehicles & Low-Carbon Driving

The GM Learning Lab - Activity 3

ACTIVITY 3: Let's Make a Windmill!

Curriculum Connections

Sciences, Design & Technological Studies: Design, build, and test a device that produces electricity. Assess the short and long-term environmental effects of the different ways in which electricity is generated in Canada.

Intended Grade Levels: Grades 2-8

EcoSchool Resource Connection: The Environmental Impacts of Driving

Recommended Class Time: 2-3 periods

Key Considerations

- Safety first! Please ensure that there is adult supervision with proper safety precautions.
- It is strongly recommended that all students wear gloves and safety glasses throughout the activity.
- It is recommended that students work in small groups of 2-4 (depending on their age) to ensure equal participation.

Key Terms

The following terms can be found in bold.

They include: **wind energy, wind turbine, renewable energy source, greenhouse gases.**

Background Information

Using **wind energy** to create electricity is one of the fastest growing methods of electrical generation in the world! Electricity is generated by using **wind turbines** that convert the kinetic energy from moving air. Wind turbines are installed in locations with suitable wind flow patterns and speeds.

Wind energy is a beneficial **renewable energy source** that has a reduced environmental impact to traditional energy sources, as it does not require fuel and does not produce pollution or emit **greenhouse gases**.

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The GM Learning Lab - Activity 3

This activity will demonstrate the power of wind energy.

Materials

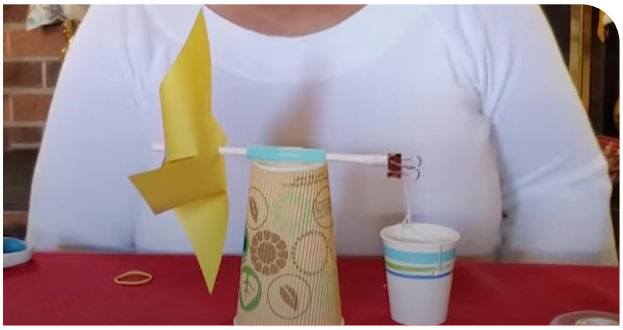
Per group:

- [ ] Cardstock or construction paper
- [ ] String
- [ ] Paper clips
- [ ] Rubber bands
- [ ] Scissors
- [ ] Tape
- [ ] Large and small disposable cup
- [ ] Large and small straw
- [ ] 5-10 pennies
- [ ] A ruler
- [ ] Pencil

Procedure

For a full explanation on how to make a windmill, watch this video created by GM Canada:

https://www.youtube.com/watch?v=D8CAab815CM
(NOTE: Instructions begin at “2:08”).



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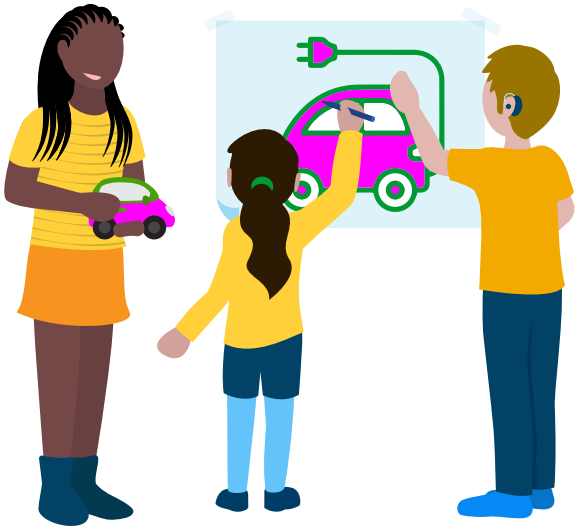
The GM Learning Lab - Activity 4

ACTIVITY 4: Let's Design an Electric Vehicle!

Curriculum Connections

Arts: Create two- and three-dimensional works of art that express ideas inspired by interests and experiences. Use a variety of materials, tools, and techniques to determine solutions to design challenges.

Intended Grade Levels:	**EcoSchool Resource Connection:**	**Recommended Class Time:**
Grades 2-8	Exploring Zero-Emission Vehicles Resource	2-3 periods



Key Considerations

This activity includes 4 different exercises. Consider setting up stations around the classroom for each exercise and have students rotate through each station.

Key Terms

The following terms can be found in bold.

They include: **internal-combustion engine vehicle, battery, electric motor, zero-emission vehicle.**

Background Information

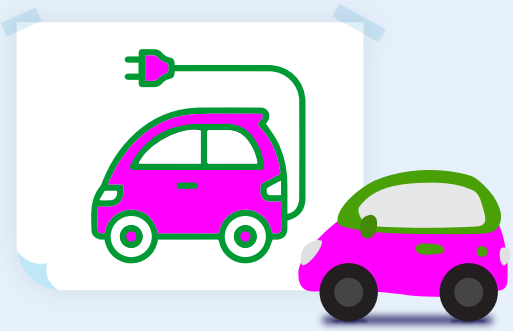
For the past one hundred years, the design of many **internal-combustion engine vehicles** has been quite similar, with the gasoline engine in the front of the car and seats facing forward.

However, with the substitution of **batteries** and **electric motors** there is more flexibility with the design and development of **zero-emission vehicles**. Moving forward, many vehicles will be able to drive themselves, which could even lead to the reimagining of the steering wheel and gas/brake pedals.

Zero-Emission Vehicles & Low-Carbon Driving

The GM Learning Lab - Activity 4

In this activity, explore how the cars of the future could look. Test out different designs from the inside out! This activity walks students through 4 different exercises that explore various stages of designing a car: determining seating layout, sketching a car, sculpting a small clay car model, creating a car model online.



Materials

Per group:

- [ ] 4 household chairs

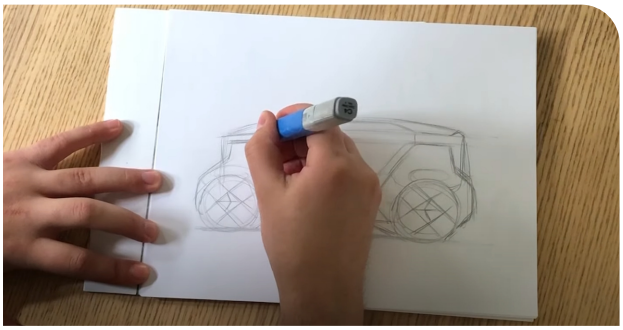
Per student:

- [ ] Plain paper or notebook
- [ ] Pencil or pen to sketch
- [ ] Play clay/sculpting clay
- [ ] Connecting blocks with wheels

Procedure

For a full explanation of the different exercises associated with designing a car, watch this video created by GM Canada:

https://www.youtube.com/watch?v=rzuemoK21EM
(NOTE: Instructions begin at “1:06”).



Sources

- How to Make an Electric Motor (General Motors)
- How Batteries Work (General Motors)
- How to Test Wind Energy at Home (General Motors)
- How to Design Your Own Car (General Motors)
- Battery (Brittanica Kids)
- How a Battery Works (Australian Academy of Science)