

# Electric Vehicles Teacher Guide

- 1: History of Electric Vehicles
- 2: Types of Electric Vehicles
- 3: Electric Vehicle Batteries
- 4: Electric Vehicle Emissions
- 5: How to Buy an Electric Vehicles

**Date: March 2020**

**Version 1.0**

## Summary of Activity

Grade: 7-12                      Subject: Math, Science, Social Studies

Time: 1-2 Hr  
per lesson                      Theme: Electric Vehicles

Description:                      There are five (5) backgrounders on Electric Vehicles (EV):

1. History of Electric Vehicles
2. Types of Electric Vehicles
3. Electric Vehicle Batteries
4. Electric Vehicle Emissions
5. How to Buy an Electric Vehicle

There are also four (4) activities on Electric Vehicles found in this lesson plan:

1. History of the Electric Vehicle
2. What EV Should You Buy?
3. Planning a Trip in Your EV
4. Build a Model Electric Vehicle

Lastly, there are two (2) take action activities that include rubrics:

1. Take Action Activity #1: Exploring Electric Vehicle Charging Stations in Your School or Community
2. Take Action Activity #2: How is Your Community Adapting for Electric Vehicles (Inquiry based)

What's included:                      Five PowerPoint presentations are available on the topics listed above, and four supplemental activities. These activities are intended to follow the PowerPoint presentations. Each activity contains instructions, a worksheet, and additional resources as necessary.

Each topic can be completed over one to two class periods. There are activities contained within the lessons that can be completed during the presentation to break up the lecture component.

## Overview

Electric vehicles have increased significantly in popularity in a few short years. Many individuals are making the transition to alternative fuel sources for transportation.

The electric vehicle lessons will teach students about the history of EVs, the types of EVs, the battery technology, the emissions, and how to buy one. By the end of the lessons, students should have an understanding of the growing trend and the direction the market is headed. Students should understand where the technology started, and where it is now.

In the circle of concern, these lessons fall under the circle of control and influence. These lessons may provide students with an idea of how they can contribute and make a difference to the climate change movement as their first car of will likely be an electric vehicle.

The Electric Vehicle Lesson is divided into five topics. There is one level for each available – some topics are more advanced than others. Lessons are best suited for junior high and high school students.

Fuel-Cell Cars were not discussed in this lesson. They are often discussed alongside electric cars in other sources because they have no tail-pipe emissions like conventional gasoline engines, and the fuel produces electricity locally rather than storing in a battery. As an extension, students can research fuel-cell cars and put together a presentation or poster illustrating how they work (i.e., what fuel is used and how this makes energy), the pros and cons, the feasibility in Alberta, etc. Fuel cell cars work very similar to fuel cell batteries (see energy storage lessons).

### Curriculum Links

The table below provides a guide to some of the curriculum links between this lesson plan and grades and subjects.

Table 1: Curriculum links to this lesson plan

Grade Level	SUBJECT			
	Science	Social Studies	Career & Technology Studies	Environment and Outdoor Education
7	Interactions and Ecosystems			
7	Structures and Forces			
8	Mechanical Systems			
9	Matter and Chemical Change	Issues for Canadians: Economic System in Canada and the United States	<ul style="list-style-type: none"> <li>Environmental Stewardship Occupational Area,</li> </ul>	<ul style="list-style-type: none"> <li>Part of a complex global environment</li> <li>Human life and lifestyles are dependent on environmental resources</li> <li>Humans influence environment through direct and indirect means.</li> <li>Principles of conservation</li> </ul>
9	Electrical Principles and Technologies		<ul style="list-style-type: none"> <li>Primary Resources Occupational area,</li> </ul>	
10	Energy and Matter in Chemical Change	10-1 To what extent should we embrace globalization?	<ul style="list-style-type: none"> <li>Agriculture Occupational Area</li> </ul>	
10	Energy Flow in Technological Systems	10-2 Living in a Globalizing World		
10	Energy Flow in Global Systems			
10	Stewardship			

	SUBJECT			
Grade Level	Science	Social Studies	Career & Technology Studies	Environment and Outdoor Education
11	Science Technology and Society	20-1 To what extent should we embrace nationalism?		
12	Chemistry and the Environment			
12	Energy and the Environment			

In addition to curriculum links, there are also direct links to the Alberta 21st Century Learner competencies.

<b>CRITICAL THINKING</b>	<b>COMMUNICATION</b>
<b>PROBLEM SOLVING</b>	<b>COLLABORATION</b>
<b>MANAGING INFORMATION</b>	<b>CULTURAL AND GLOBAL CITIZENSHIP</b>
<b>CREATIVITY AND INNOVATION</b>	<b>PERSONAL GROWTH AND WELL-BEING</b>

Figure 1: Alberta 21st Century Learner Competencies

This lesson focuses on the following learner competencies:

- Critical Thinking
- Problem Solving
- Managing Information
- Creativity and Innovation
- Collaboration

## Energy and Environmental Learning Outcomes

By the end of the lesson, students should be able to:

- Examine the differences in efficiency of transportation vehicle fuel types
- Identify the types of EVs in Alberta, suppliers, and charging stations, types of charging stations.
- Complete a calculation on the operating cost comparison between internal combustion engine (ICE) and electric vehicles.
- Determine an optimal charging strategy for a long-range EV (such as a Hyundai Kona, or Tesla) based on weather, EV charging equipment available en-route, and driving behaviour.
- Calculate the greenhouse gas emissions for a vehicle travelling from Edmonton to Calgary using different transportation vehicle fuel types (diesel, gasoline, electric vehicle, and hybrid vehicle).

## Planning Notes

### *Materials*

There are five presentations included in the Electric Vehicle lesson. These presentations can be taught in any order. There are three activities best taught at the end of the five presentations. The activities are designed to solidify the students' understanding. Students will apply their learnings with real world examples and have the opportunity to showcase their projects.

### ***Prior Learning***

A basic understanding of energy and electricity will make some concepts easier for students. All new concepts are explained in the presentations.

## **Teaching/Learning Strategies**

This lesson can be taught with the slide presentation, or with alternative research and analysis completed on your own.

## **Instructions**

### ***Pre-activity discussion***

To start off your discussion on electric vehicles, make a thought web. Include questions and comments on the thought web. This will help guide your lesson to understand what interests your students the most.

### ***Activity***

Start with the presentations. Go through each presentation with the students to provide the foundation for the activities. Refer to the notes section of the presentation for tips on how to use the lesson. Following the presentations, there are a series of lesson activities for the students to complete. These activities build on the learnings of the presentations. Each activity has a real-world application for the students to explore.

First is an activity on the *History of the Electric Vehicle*. The activity contains teacher instructions and tips on how to integrate the activities and PowerPoint presentations.

*What EV Should You Buy?* and *Planning a Trip in Your EV* activities teaches students the real-world applications of EVs. Students will play out a scenario and determine which electric vehicle is best suited for their lifestyle. Students will also plan a trip with an EV and determine how far they can travel, where they need to stop to recharge, how long the trip will take, etc. These activities are designed to take the learnings in the presentations beyond deskwork. Students will conduct their own research and make educated decisions relating to the use of EVs.

Following the above lesson activities are two take action activities. These activities are designed to encourage students to apply their learnings with the public. Lastly, as an appendix is the construction plan for the DIY Electric Vehicle, including a template to use.

## **Resources**

The following resources are credible websites, publications and videos students and teachers can reference to further their learnings.

## Websites

- Natural Resources Canada (NRCAN) has a page on their website titled *Buying an electric vehicle*. The page discusses in high-level the types of EVs (plug-in hybrid electric and battery electric) on the market and how they work. There are two videos on each technology discussed.
  - <https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-transportation-and-alternative-fuels/choosing-right-vehicle/buying-electric-vehicle/21034>
- Consumer Reports has some articles on electric vehicles. The two listed are great resources to answer all your questions regarding electric vehicles. Both articles were published July 2019.
  - *Electric Cars 101: The Answers to All Your EV Questions* – <https://www.consumerreports.org/hybrids-evs/electric-cars-101-the-answers-to-all-your-ev-questions/>
  - *Hybrid/EV Buying Guide* – <https://www.consumerreports.org/cro/cars/hybrids-evs/buying-guide/index.htm>

## Publications

- Plug-in BC offers this brochure illustrating the battery EV, plug-in hybrid EV, extended-range EV, and fuel cell vehicles available in British Columbia as of June 2019. Majority of the vehicles on the list are available in Alberta. Some of the pricing may differ.
  - [https://pluginbc.ca/wp/wp-content/uploads/2019/06/Electric-Car-Handout\\_190625.pdf](https://pluginbc.ca/wp/wp-content/uploads/2019/06/Electric-Car-Handout_190625.pdf)

## Videos

- This video by the Union of Concerned Scientists explains the life cycle analysis of EV and ICE vehicle emissions. This video is provided in the EV GHG presentation as well.
  - <https://www.youtube.com/watch?v=K9m9WDxmSN8#action=share>

## Data Reference

References are provided in each Electric Vehicle presentation in the notes section of the PowerPoint Document.

## Feedback

We are continuously interested in improving and updating this lesson plan. Please send your feedback to [info@greenlearning.ca](mailto:info@greenlearning.ca) .