

STEM SIT-DOWNS

MARK BRABY

Resourceful Vacation Planning with an Electric Vehicle

KEY LEARNING OBJECTIVES

Students will be able to:

- **Conduct** research on their electric vehicle to determine battery range and how much time and energy is required to fully charge the vehicle
- **Identify** the locations of charging stations on the way to their destination
- **Determine** total cost of ownership and emissions for their EV
- **Calculate** how many pounds of GHG and carbon emissions were saved by using their EV
- **Construct** a plan on where to charge their EV on the way to their vacation destination

OVERVIEW

In this STEM activity, students will work in small groups to conduct research on where to charge their electric vehicle while driving to a vacation destination. Groups will be assigned different scenarios that include a specific electric vehicle, vacation destination, and mileage total for the trip. Groups will present their plan to the class and share how many pounds of GHG and carbon emissions were saved by using their electric vehicle.

CONNECTION TO THE ENERGY-WATER NEXUS

- We can minimize the impact of global warming and decrease the use of fossil fuels by using all-electric vehicles that produce zero tailpipe emissions.
- Charging stations will need to be widely accessible and convenient to ensure that electricity is provided reliably and effectively to electric vehicles.

NATIONAL STANDARDS

Next Generation Science Standards

- HS-ESS3-4 Human Sustainability
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ESS3-3 Engineering Design
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Common Core English Language Arts

- Speaking and Listening:
SL.1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
SL.2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

BACKGROUND

According to the United States Department of Energy, electric vehicle sales in the United States grew by 85% from 2020 to 2021. With more consumers purchasing electric vehicles, infrastructure must be updated to accommodate these vehicles. The increased number of electric vehicles on the road creates a need for greater access to charging stations at workplaces, schools, and commonly visited locations in the community. Responding to the development of charging stations will present new challenges to our energy grid. Utility companies will be required to generate additional electricity to accommodate electric vehicles—they must also consider the impacts on the electric grid.

KEY VOCABULARY

- Infrastructure
- Commerce
- Combustion
- Clean energy
- Energy grid

MATERIALS

- Video—[STEM Sit-Down with Mark Braby](#)
- [3-2-1 Graphic Organizer](#)
- *Vacation Plan* student resource
- Charging Station Finder ([ChargePoint](#), [Tesla](#), [ChargeHub](#))
- [Vehicle Cost Calculator Tool](#)

TEACHER PREPARATION

- Copies of *3-2-1 graphic organizer* for each student
- Copies of *Vacation Plan* student resource for each student
- Organize students into small groups of 3

ACTIVITY OVERVIEW

Introduce

1. To make real-world connections, open the lesson by asking students to raise their hands if they own or know someone who owns an all-electric or hybrid car or an electric bike. Invite them to share types of vehicles they have seen on the road and any favorites they may have. If students in the class have these types of vehicles, invite them to share how and when they charge them.
2. Explain that students are about to watch a short video that features Mark Braby, the head of E-mobility for Itron, and how he is using his STEM skills and knowledge to help utility companies.

View and Reflect

1. Before the class watches the *STEM Sit-Down video*, provide a copy of the 3-2-1 graphic organizer to each student. Explain how they will use it as they summarize what they have learned from the video.
 - Bottom row—write one sentence to identify a need and a possible solution that was mentioned in the video
 - Middle row—write two ways the topic is significant or important
 - Top row—write three facts they have learned
2. After watching the video and reviewing the 3-2-1 graphic organizer, ask students to discuss with an elbow partner what they think each term means, then compare their thoughts with the explanations below.
 - *E-mobility*—The use of electrified vehicles for transportation purposes.
 - *Commerce*—The buying and selling of goods and service on a large scale.
 - *Infrastructure*—The basic systems and services, such as transportation and power supplies, that a country uses to work effectively.
 - *Emissions*—The chemicals in exhaust gases that are harmful to air quality.

CHALLENGE

1. Explain that the class will now be challenged to work in small teams to plan a trip between two locations with an EV. They will create a plan on when to charge, where to charge, and the time it takes to charge, and will present their plan to the class. Assign student groups one of the scenarios below.
 - **Scenario 1:** Your task is to plan a trip between Whitefish and Billings Montana in a Tesla model 3.
 - **Scenario 2:** Your task is to plan a trip between Boston, Massachusetts, and Washington, DC in a Nissan Leaf.
 - **Scenario 3:** Your task is to plan a trip between Jacksonville, Florida and New Orleans, in a Ford F-150 lightning.
 - **Scenario 4:** Your task is to plan a trip from your location and any place that is at least 500 miles away in a Volkswagen ID.4.
2. Share the *Vacation Plan* handout and review the instructions. Remind students that they will use their STEM skills of creativity, critical thinking, and collaboration to communicate their plan.

CONCLUDE

1. Once the *Challenge* activity is complete, invite students to share their presentations with the class and justify the reasoning behind their plan.
2. Wrap up by encouraging students to identify the need and propose solutions to the scenario below.
 - According to Kelly Blue Book, the average transaction price for an electric vehicle (EV) in 2021 was \$56,437.

EXTENSION

As an extension of this activity, students can conduct research on how much it would cost their school district to replace all the gasoline-powered school buses with electric school buses.

SOURCES

1. [New Plug-in Electric Vehicle Sales in the United States Nearly Doubled from 2020 to 2021 | Department of Energy.](#)
2. [Developing Infrastructure to Charge Electric Vehicles, US Department of Energy](#)
3. [Workplace Charging, US Department of Energy](#)
4. [Electric Vehicle Benefits and Considerations, US Department of Energy](#)

3			
2			
1			

Directions:

Work collaboratively with your group to create a vacation plan for your scenario.

What is your scenario?

1. What EV will you be driving?

2. Where will you be traveling?

Getting to Know Your EV

1. How much does your vehicle cost if purchased new?

2. How many people can accompany you on your vacation? Will there be enough room for your luggage?

3. What is the capacity (kWh) of your battery?

4. What is the range (miles) of your battery when fully charged?

5. How long does it take to fully charge your battery using the chargers below?
 - Level 1 (120V outlet)—
 - Level 2 (240V outlet)—
 - Level 3 (DC fast charging)—

Use the [Vehicle Cost Calculator](#) tool to compare the total cost of ownership and emissions between your EV and a gasoline-powered vehicle of your choice.

	Your EV	Vehicle # 2
Make & model		
Annual fuel use (gal)		
Annual electricity use (kWh)		
Annual fuel & electricity cost (\$)		
Annual operating cost (\$)		
Cost per mile (\$)		
Annual emissions (lbs. of CO ₂)		

Planning Your Trip

1. How many total miles is your trip?
2. How many times will you need to stop and charge your EV?
3. Use a charging station finder like [ChargePoint](#), [Tesla](#), [ChargeHub](#) to determine where you will stop and charge your EV. You can add more stops if needed.

Stop 1	
Stop 2	
Stop 3	
Stop 4	
Stop 5	

4. What were your total estimated fees for charging your EV on your trip?
5. Did you have to alter your route due to lack of charging infrastructure? If so, how many more miles did you have to drive?
6. How long will it take you to complete your trip? Make sure you plan enough time for charging, food, and restroom stops.
7. On average, cars in the United States can get 25 miles per gallon. If gas were \$3.50 (or use your local price) per gallon, how much would your trip have cost in a gasoline-powered vehicle? How does this compare to the total estimated fees you calculated for your trip?
8. Sketch or print a map of your planned route that identifies your charging station locations.

Sharing Your Plan

1. Your team will share their plan with the class by creating a presentation. You can use PowerPoint, Google Slides, or other online platforms.