



CLASSROOM ACTIVITY

Hybrid Vehicles

GRADE RANGE

6–8

OBJECTIVES

Students will be able to:

- **Identify** the correct sequence of steps for gasoline production.
- **Explain** how hybrid cars create power.
- **Create** a road trip for a hybrid vehicle and calculate miles driven as well as money spent on gasoline.

OVERVIEW

In this activity, students will learn how petroleum and electricity work together to create hybrid vehicles! After a review of how gasoline is created, students will read an article to understand the mechanics of hybrid cars. Students will then be given the fuel economy of a variety of hybrid vehicles, and they will select one with which to take a cross-country road trip. Using Google Maps, students will plan a trip from one coast to the other powered on gasoline and electricity—complete with planned fuel stops, calculations of how far they'll drive each day, and predictions of what they'll spend on gas!

MATERIALS

- Device with internet access and the ability to project, one for the educator
- **Gasoline Cards**, cut out in advance (one set per group of 6–7 students)
- **How Hybrid Cars Work** handout, one per student
- **Road Trip Planner Packet** (four pages), one per pair
- Devices with internet access, one per pair
- Crayons, markers, and colored pencils for students to share

NATIONAL STANDARDS

Mathematics Common Core Standards

- **CCSS.MATH.PRACTICE.MP1**: Make sense of problems and persevere in solving them.
- **CCSS.MATH.CONTENT.6.RP.A.3**: Use ratio and rate reasoning to solve real-world and mathematical problems.

PROCEDURE

Engage

- Tell the class that they are about to plan a cross-country road trip! But, before they do, they will learn *how* their car will be powered to make such a big trip.
- Divide students into groups of six and give each group a set of **Gasoline Cards**. (If necessary, groups of seven students are better than groups of five.) Explain that the cards outline how gasoline is created.
- Then instruct each student to take one card. (For groups of seven, a pair of students may take one card together.)
- Instruct students to read the card they selected. Explain that when you say “Go,” they should collaborate with their group to put their cards in the correct order. (For an added challenge, groups can do this *without* talking!)
- The first group who finishes and has their cards in the correct order* wins! Be sure to review the sequence aloud before moving on.

* Use the **Gasoline Cards** handout as your answer guide.

Explore

- Explain that technology now exists that combines gasoline-powered engines with electric motors to make cars more fuel efficient. The more energy a vehicle is able to extract from fuel, the more fuel-efficient it is.
- Pass out one **How Hybrid Cars Work** handout to each student, and ask students to read and annotate (highlight or underline) how electric motors and gasoline engines work together to create fuel-efficient hybrid vehicles!
- When students are done reading, recap what students read by discussing:

- **How do gasoline and electricity both contribute to powering hybrid cars?**

Answer: They work together! While regular cars have one engine, hybrid cars have two: a gas-powered engine and an electricity-charged motor, which both work together to power the car. In some hybrid vehicles, gasoline fuels the engine while batteries power the electric motor. In other hybrid vehicles, gasoline powers a generator. This generator can then either charge the car’s batteries *or* power the electric motor. Either way, both gasoline and electricity have an important role to play!

- **Which is more likely to be more fuel efficient: a regular car or a hybrid vehicle?**

Answer: Hybrid vehicles are likely to be more fuel efficient because they harness two different sources of power: gasoline and electricity!

Apply

- Divide students into pairs and pass out one **Road Trip Planner Packet** (4 pages) to each pair.
- Review the first four steps listed on the first page. Then project maps.google.com and give students a quick Google Maps tutorial. The three most important features to bring to students’ attention are the following:
 - The *Search Google Maps* box in the web page’s top left corner, where students will insert a city or town to use as their starting point.
 - The blue *Directions* button, which enables users to input a destination city/town in order to see the route, mileage, and how long the trip will take.
 - The grey + *Add destination* button, which enables the user to add additional destinations.

- Answer questions as needed, and then allow students to complete their road trip plans and maps until there are 5 minutes left in the session.
- Wrap up the class session by encouraging pairs to share their maps with their peers and reflect on the road trips that were made possible thanks to their gasoline and electricity-powered vehicles!



Millions of years ago, petroleum formed deep underground from the remains of ancient marine organisms like algae and plants.

Today, humans extract petroleum by using drilling machines that go deep into the Earth.

The drilling machines extract a form of petroleum called crude oil. The crude oil is then sent to a refinery where it is heated.

Once the crude oil is boiling at a very high temperature, it separates into different layers or *components*. One of these components is gasoline. Other components include natural gases and kerosene, as well as components used to make plastics and lubricants. This separation process is called fractional distillation.

The gasoline is sent from refineries through pipelines to storage areas. From here, it is sent to smaller blending terminals where it is mixed with other materials (like fuel ethanol) and is turned into gasoline that can power vehicles.

Tanker trucks deliver the gasoline to gas stations, so vehicles can use it for power!

Excerpts from: <https://auto.howstuffworks.com/hybrid-car.htm#pt2>

Gasoline Power vs. Electric Power

A gasoline-electric hybrid car is just what it sounds like—a cross between a gasoline-powered car and an electric car.

A gas-powered car has a fuel tank, which supplies gasoline to the engine. The engine then turns a transmission, which turns the wheels.

An electric car, on the other hand, has a set of batteries that provides electricity to an electric motor. The motor turns a transmission, and the transmission turns the wheels.

The hybrid is a compromise. It attempts to significantly increase the mileage and reduce the emissions of a gas-powered car while overcoming the shortcomings of an electric car.

Gasoline-Electric Hybrid Structure

Gasoline-electric hybrid cars contain the following parts:

- **Gasoline engine:** The hybrid car has a gasoline engine, much like the one you will find on most cars. However, the engine on a hybrid is smaller and uses advanced technologies to reduce emissions and increase efficiency.
- **Fuel tank:** The fuel tank in a hybrid is the energy storage device for the gasoline engine. Gasoline has a much higher energy density than batteries. For example, it takes about 1,000 pounds of batteries to store as much energy as 1 gallon (7 pounds) of gasoline.
- **Electric motor:** The electric motor on a hybrid car is very sophisticated. Advanced electronics allow it to act as a motor as well as a generator. For example, when it needs to, it can draw energy from the batteries to accelerate the car. But acting as a generator, it can slow the car down and return energy to the batteries.
- **Generator:** The generator is similar to an electric motor, but it acts only to produce electrical power. It is used mostly on series hybrids (see below).
- **Batteries:** The batteries in a hybrid car are the energy storage device for the electric motor. Unlike the gasoline in the fuel tank, which can only power the gasoline engine, the electric motor on a hybrid car can put energy into the batteries as well as draw energy from them.
- **Transmission:** The transmission on a hybrid car performs the same basic function as the transmission on a conventional car.

You can combine the two power sources found in a hybrid car in different ways.

One way, known as a *parallel hybrid*, has a fuel tank that supplies gasoline to the engine and a set of batteries that supplies power to the electric motor. Both the engine and the electric motor can turn the transmission at the same time, and the transmission then turns the wheels.

By contrast, in a *series hybrid*, the gasoline engine turns a generator, and the generator either charges the batteries or powers an electric motor that drives the transmission. Thus, the gasoline engine never directly powers the vehicle.

Hybrid Car Performance

The key to a hybrid car is that the gasoline engine can be much smaller than the one in a conventional car and, therefore, more efficient. Most cars require a relatively big engine to produce enough power to accelerate the car quickly. In a small engine, however, the efficiency can be improved by using smaller, lighter parts, reducing the number of cylinders, and operating the engine closer to its maximum load.

Ready to plan a cross-country road trip?

1. First, pick the hybrid vehicle you will drive! Your options are:

- Kia Niro Hybrid: 50 miles per gallon or mpg*
- Toyota RAV4 Hybrid: 40 mpg
- Honda Accord Hybrid: 47 mpg
- Lexus ES 300h: 44 mpg
- Hyundai Ioniq: 59 mpg

* Miles per gallon = the number of miles a car can travel on one gallon of gasoline

2. Next, access maps.google.com and choose where you will travel across the United States! Select a starting point on one coast and an ending point on the opposite coast. Then write your cities below:

Starting Point: _____ Ending Point: _____

3. Now use Google Maps *and* the template below to plan out your road trip. (It's fine if it takes you fewer than 14 days to reach your final destination!)

4. Then use your plan to create your **Road Trip Map!**

Day 1

Begin with a full tank of gas in: _____

How many miles will you drive? _____

Where will you stop for the night? _____

Day 2

Starting in: _____

If your tank holds about 13 gallons of gas, will you need to stop for gas? *Yes or No* (Circle one)

If so, where? _____

About how much* will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

* *To calculate how much you will pay for gas, use the internet to search for the average price of gas in the state you will be in. Then multiply this by the number of gallons you will need! (Tip: Think about how far you have driven!)*

Day 3

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one fun thing you can see today? _____

Where will you stop for the night? _____

Day 4

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

Day 5

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one interesting thing you can do today? _____

Where will you stop for the night? _____

Day 6

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one interesting thing you can do today? _____

Where will you stop for the night? _____

Day 7

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

Day 8

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one fun place you can visit today? _____

Where will you stop for the night? _____

Day 9

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

Day 10

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one song you can listen to while driving today? _____

Where will you stop for the night? _____

Day 11:

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

Day 12:

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

What is one unique thing you can eat today? _____

Where will you stop for the night? _____

Day 13:

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

How many miles will you drive in all? _____

Where will you stop for the night? _____

Day 14:

Starting in: _____

Will you need to stop for gas? *Yes or No* If so, where? _____

About how much will you pay for the gas? _____

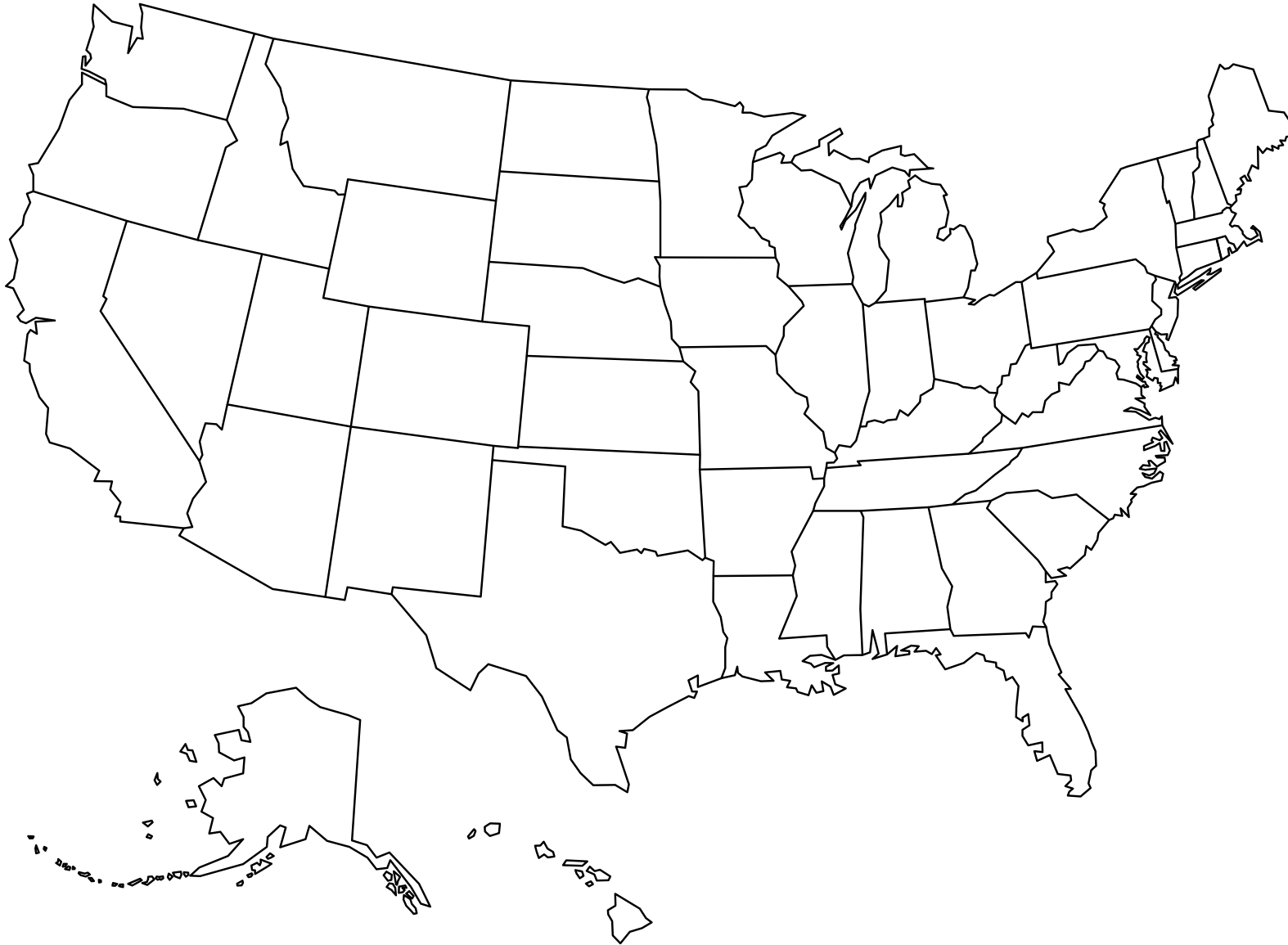
How many miles will you drive in all? _____

What is one interesting activity you can do today? _____

Final Destination reached: _____

ROAD TRIP MAP

Directions: Once your road trip plan is complete, map out your route! Fill in the key and choose different colors for your starting point, gas stops, sleeping stops, and your final destination. Then draw your route between the stops and fill-in-the-blanks for the Road Trip Quick Stats below!



Key

- Starting point
- Gas stops
- Sleeping stops
- Ending Destination

Road Trip Quick Stats

- _____ Miles Driven
- _____ Gas Stops
- _____ States Seen