

Electric Vehicles

Grade Level: 6th – 8th

Duration: 45 minutes

Lesson Overview: In this lesson students will learn about how we can take renewable sources and use them for energy. Students will start by making a wind turbine and charge it, then convert the turbine into an electric vehicle.

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Disciplinary Area:

**Earth
science**

Key Concepts:

- Renewable and nonrenewable
- Electric vehicle
- How do electric vehicles work?

Key Lesson Information

Materials List

- Wind turbine kit
- Rechargeable batteries
- Fan
- Model size traffic cones
- Worksheet

NGSS Performance Standards Addressed

NGSS Disciplinary Core Idea	MS-ESS3-5
Disciplinary Core Ideas	Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.
Performance Expectations	Ask questions to clarify evidence of the factors that have caused the rise of global temperatures over the past century.

NGSS Disciplinary Core Idea	MS-ESS3-4
Disciplinary Core Ideas	Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
Performance Expectations	Construct an argument supported by evidence for how increases in human population and per-capita consumption and natural resources impact Earth's systems.

Big Question:

What are advantages and disadvantages of using renewable resources? How can we use renewable resources to power electric vehicles?

Key Vocabulary:

1. **Renewable resource:** a resource that can be used more than once and there is an unlimited supply on Earth.
2. **Nonrenewable resource:** a resource that can only be used once and there is a limited supply on Earth.
3. **Greenhouse gases:** gases in the atmosphere that trap heat, which contributes to climate change.
4. **100% Electric vehicle:** a vehicle that can be powered by an electric motor and a battery. Rather than using fuel it uses 100% electricity from the grid.



5E model part 1: Engage

Introduction and Background – 5 minutes

This lesson focuses on using renewable energy to power electric vehicles. It begins with review of renewable and nonrenewable resources and then moves into how electric vehicles work as well as how they are better for the environment. The students will be able to build their own turbine and then turn that turbine into an electric vehicle.

Today we are going to be talking about renewable energy and how people can use renewable energy to power things in their homes and even their cars. Most importantly, we will be talking about why renewable energy is an eco-friendlier alternative to non-renewable energy.

So, to begin we are going to review renewable and nonrenewable resources. Starting with renewable, can someone give a definition or an example?

Give students time to think and then call on students to share.

Great. So, we have established that renewable resources can easily be replenished. They also don't emit greenhouse gases into the atmosphere which is important because those gases are what contribute to the planet heating up. Because of this, renewable resources are an environmentally friendly way to get energy.

We are now going to watch a short video about how electric vehicles work.

Play minutes 1:30-2:33.

https://www.youtube.com/watch?v=tJfERzrG-D8&embeds_euri=https%3A%2F%2Fhubblecontent.osi.office.net%2F&feature=emb_logo

As you watch take note of what you observe. This video uses some complicated terms but no worries if you don't understand, we are going to come back as a class and talk about what we observed.

- What did you find interesting in the video?
 - o Let students share
- Recap what was in the video:
 - o Talked about how EV batteries use the energy that has been stored
 - o EVs generate less air and noise pollution
 - o EVs gain energy when the brake is put on

5E model part 2: Explore

Introduce Activity

We are now going to work in our table groups to build a wind turbine!

Activity one: Building a turbine

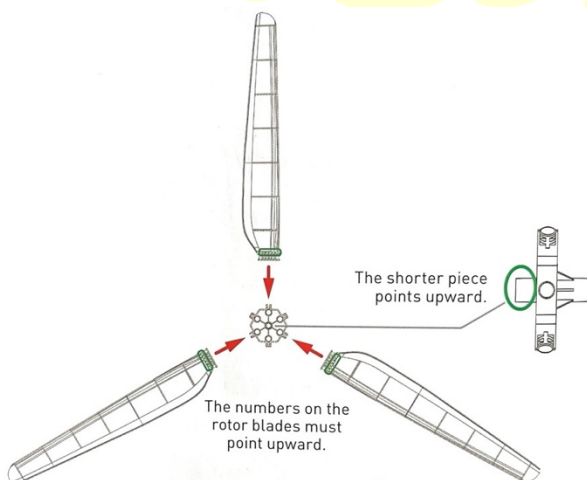
Students will follow along a demonstration and build their own wind turbine. They will then get the opportunity to charge its battery.

Essential Concepts

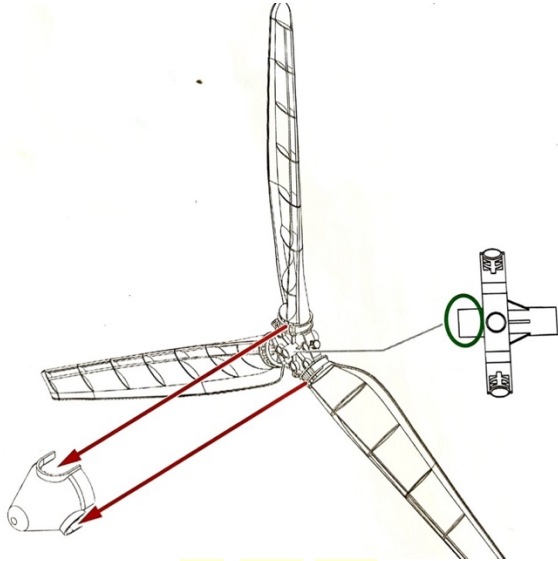
This activity helps to introduce students to how exactly renewable resources can be used as clean energy. Students will learn how electric vehicles work.

Activity One and Two Procedure – 12 minutes

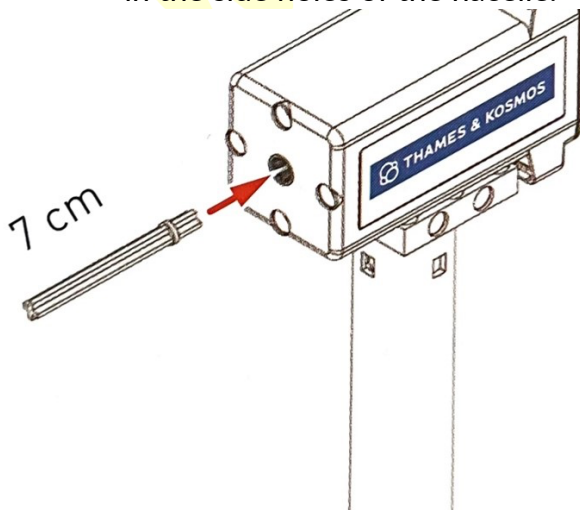
1. Teacher will demo up front step by step how to build the turbine. Students will work in groups of 2-5 students depending on the number of students in the class.
2. Before beginning the building process, tell the students that there is a battery in the nacelle (A nacelle is the battery and gear compartment where the wind energy is converted into usable energy and stored by the batteries in this turbine) and that it is rechargeable. So, as the blades turn, they are creating energy that is going into the battery and being stored.
3. Taking the center cog piece, students will attach the three blades. Place the first blade on the sideways peg, skip a peg, put on the next, and repeat for the third.



4. Once the blades are on have another student put the cone shaped cap over the cog.
5. Next, the blades will need to be aligned properly. There are small numbers on the edges of the blade. Line the number 3 up with the arrows on the cone cap.



6. Now it is time to attach the *nacelle* to the base. To attach the nacelle, just line the nubs on the bottom up with the holes on the top.
7. Put the black rod in the hole on the nacelle.
8. Put the white bar with two red studs onto the gray rod, attaching the studs in the side holes of the nacelle.



9. Attach the fan unit.
10. Once the turbines are put together, they will need to be placed in front of fans to create energy.
 - a. In order to cut down on the number of fans needed, half of the teams will put their turbines up to charge. This will take a total of 10 minutes. Once the time is halfway passed switch the turbines with the

other groups. While all of the fans are charging students will work on an alternate activity-- see activity 3 below to complete while the turbines charge.

11. Once the fans have charged, have students press the button on the back of the nacelle to the "in" position. This will use the charge from the batteries to start turning the blades on its own. Explain to the students that this is because the battery took and stored energy when the fan was "charging" that can now be used to power things (in this case, the fan).

Activity two: Wind turbine and electric vehicle worksheet

While students wait for groups to charge their turbines with the fans, they can fill out this worksheet.

Essential Concepts

Through this worksheet students will learn more about wind turbines and potential problems. Additionally, they will get the opportunity to take a look at the difference between hybrid electric vehicle, plug-in hybrid electric vehicles, and battery electric vehicles.

Activity Two Procedure

While students wait for fans to charge have them fill out this worksheet. If time allows, go over the worksheet. If not, write answers on the board. Have one teacher walk around the room to answer any questions.

Activity three: Building an electric vehicle

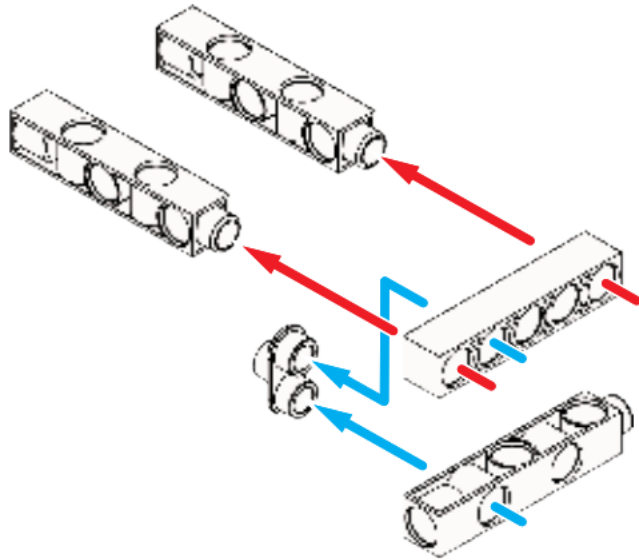
Students will follow along another demonstration of how to turn their wind turbine into an electric vehicle.

Essential Concepts

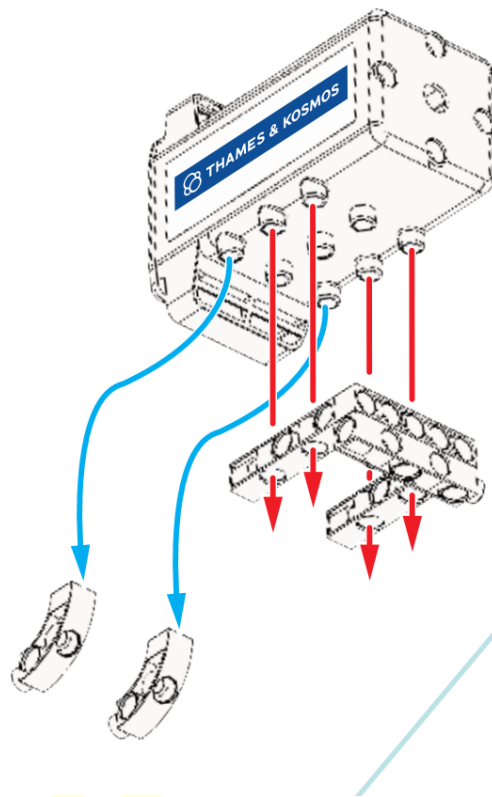
Students will make the connection between using stored renewable energy as a fuel source for vehicles.

Activity Three Procedure – 12 minutes

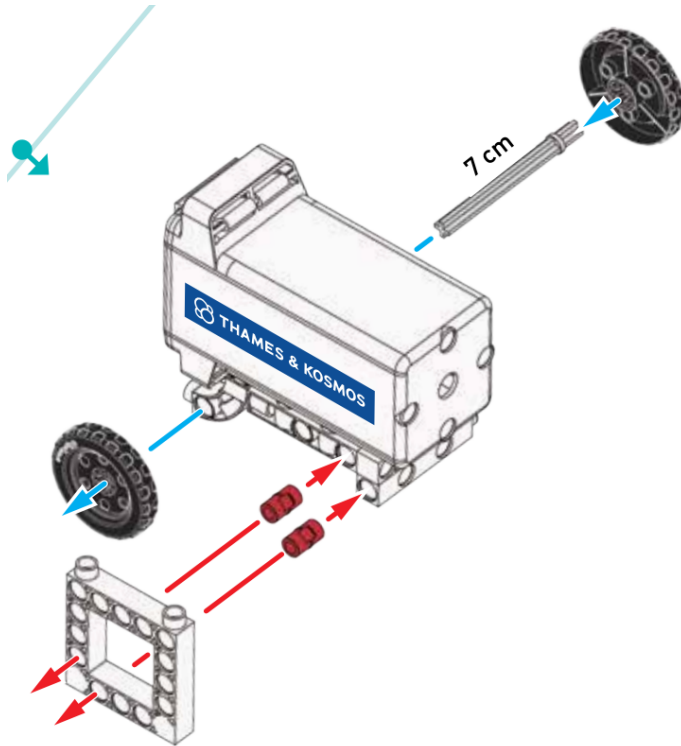
1. Insert two 5-hole dual rods into each end of 5-hole rod (with flat ends). Then in the second hole from the left place the two-to-one converter with the other end attached to another 5-hole dual rod.



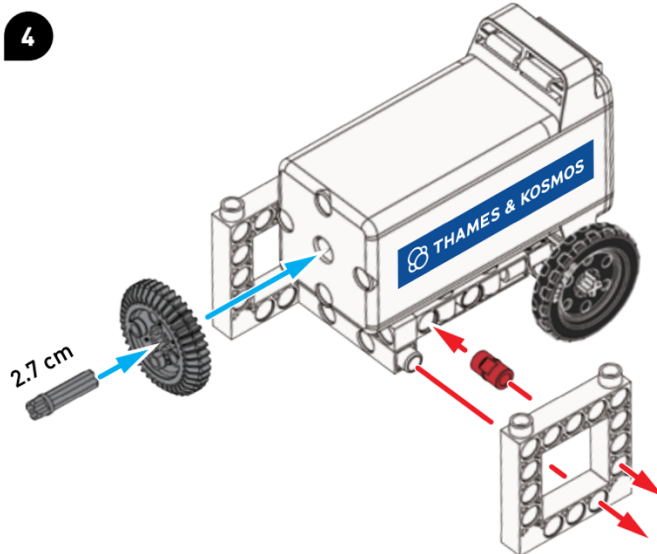
2. Place piece made in step 1 on generator/motor and housing on the last two holes on the base. On the front two holes place a curved rod so that the curve is faced outward.



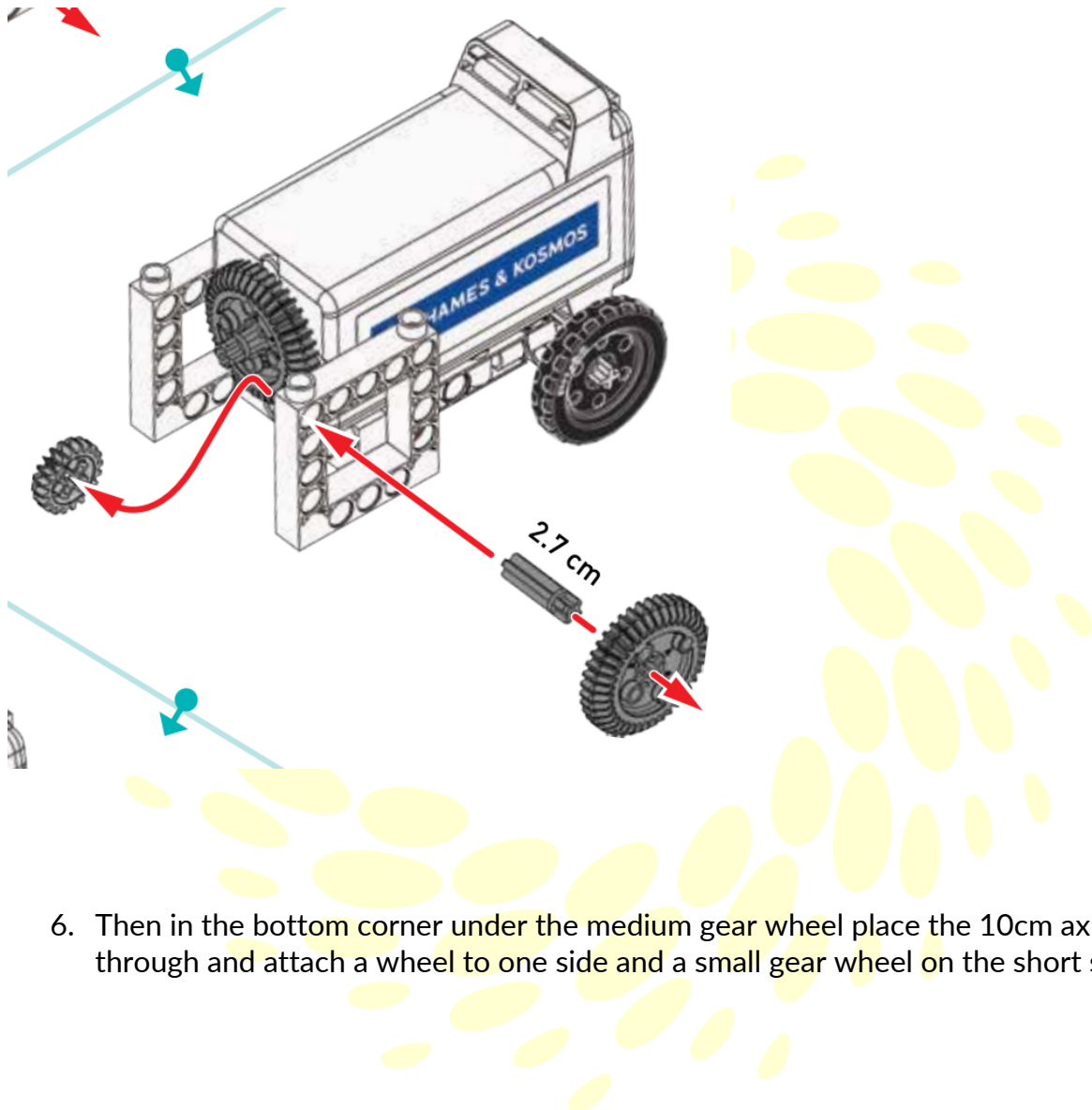
3. Then in the curved rod place the 7cm axle with a wheel attached to one end and attached the other wheel to the other end. Make sure the short end of the axle is on the back right side of the car. Then place two anchor pins into the front two holes on the piece made in step 1. Then attach the square frame to the anchor pins using the holes in the corner.



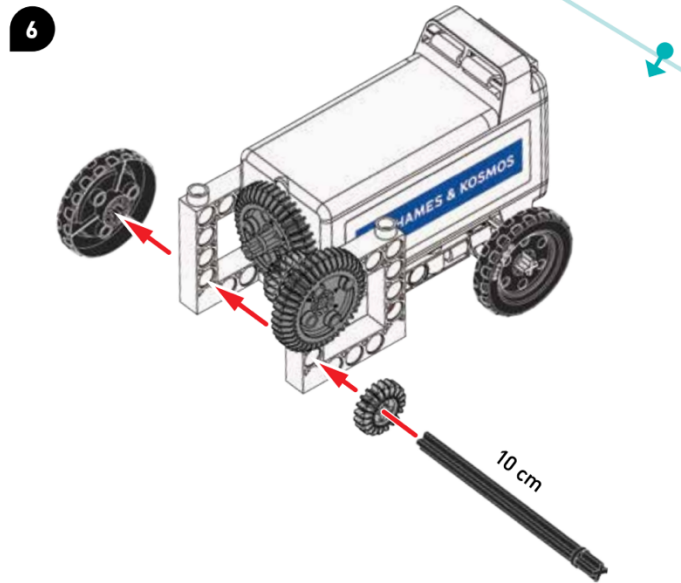
4. Use the 2.7cm axle to place the medium gear wheel into the front hole on the generator/motor and housing. Then place the anchor pin on the front left hole and then attach the other square frame.



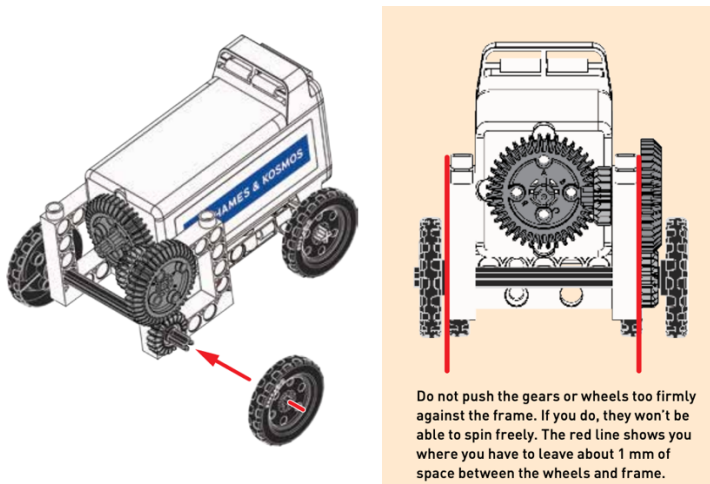
5. Next place the 2.7cm axle through the top left corner of the square frame with a small gear wheel on the inside and a medium gear wheel on the outside.



6. Then in the bottom corner under the medium gear wheel place the 10cm axle through and attach a wheel to one side and a small gear wheel on the short side.

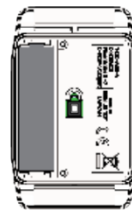
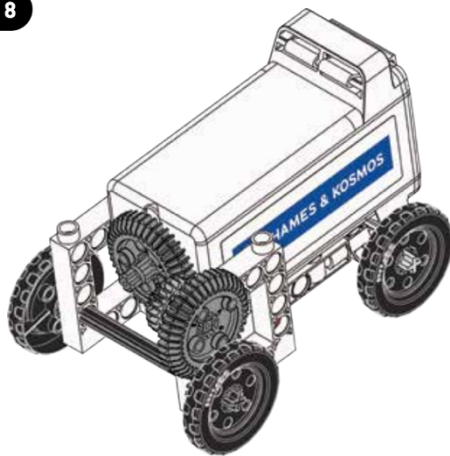


7. Next to the small gear wheel attach a wheel.



8. Click the button and switch the mode to out.

8



Keep the battery inserted during assembly.

Press the button and switch the mode to OUT. Watch as the stored energy from the battery is used to turn the car's wheels.

9. Have students test their cars by pushing the on button on the back of the nacelle. If cars are having difficulty make sure pieces aren't on too tight or else the gears and wheels will not spin. Now that the cars are built, pair teams up who will then compete in an electric vehicle race. Have teams find empty space in the classroom and then have them use the model toy cones so they are setup about 2 feet apart to act as the start and finish line for the cars. Once each group is set up and have their cars ready to race, set a countdown to when they can turn their car on. Once each car has crossed the finish line have students return to their seats and begin disassembling the cars.

5E model part 3 & 4: Elaborate

Discuss what the students learned – 2 minutes

Throughout the lesson today we learned about renewable energy and how we can use that energy to power electric vehicles. Electric vehicles utilize power from the grid instead of burning fuel. This allows for a reduction in greenhouse gas production and

thus it is more eco-friendly. Also, EVs emit less noise pollution making them an overall more sustainable choice.

5E model part 5: Evaluate

Students will be given an exit ticket to fill out and evaluate what they learned.

By the end of this Lesson

Concepts Learned:

- Renewable energy sources are a cleaner source of energy than nonrenewable energy. This helps reduce the impact on the planet.
- Energy can be stored to be used later.
- Electric vehicles can use the stored energy to operate. This is beneficial because electric vehicles don't produce air or noise pollution.
- Electric vehicles can get their energy from a grid which can utilize solar, hydroelectric or wind power.

Connection/Evidence Gathered:

- Renewable energy:
- Nonrenewable energy:
- Electric vehicles: Obtain power from the grid allowing them to never burn gasoline as a fuel source.

Potential resources:

1. How to build the turbine and the car
 - a. https://www.youtube.com/watch?time_continue=57&v=l836WD4laVI&feature=emb_logo
 - b. https://www.thamesandkosmos.co.uk/wp-content/uploads/2020/04/627929_WP4_Manual.pdf
2. Renewable energy
 - a. <https://www.youtube.com/watch?v=1kUEOBZtTRc>

Electric Vehicles



Renewable Resource

What is a
renewable
resource?

What is an
example?



Nonrenewable Resource

*What is a
nonrenewable
resource?*

*What is an
example?*





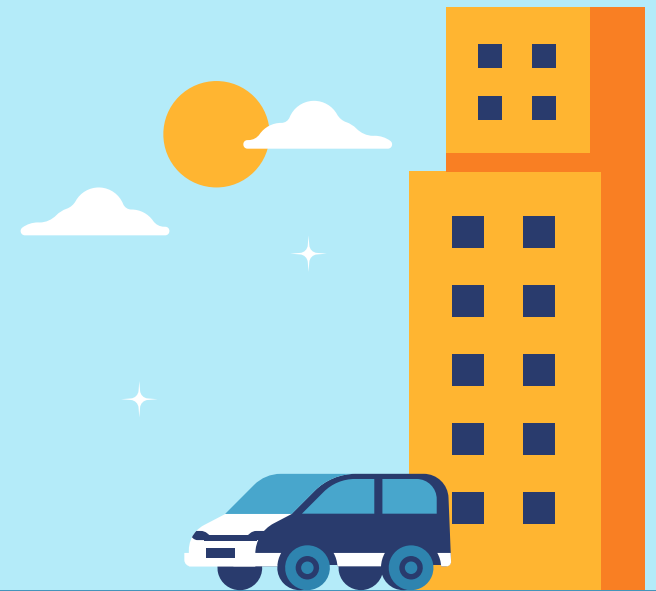
Using Renewable Resources for Transportation

Battery electric vehicles

- *100% electricity from the grid*

Advantages:

- *They don't produce harmful exhaust gas*
- *They are much quieter and can be helpful in reducing noise pollution*
- *You can charge an electric vehicle at home*



Using the Power of Wind!

*Follow along the teacher's demonstration
of how to build a turbine*

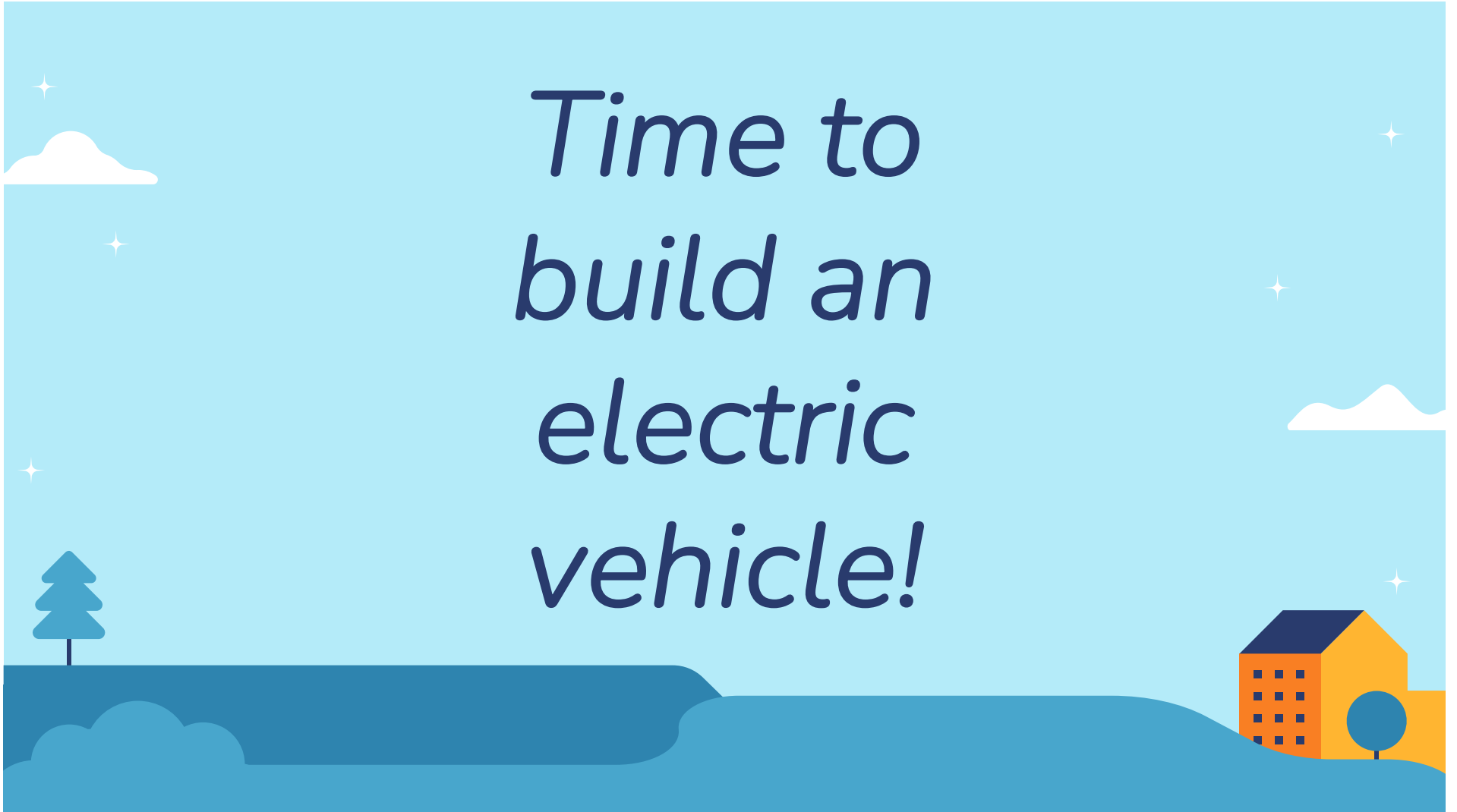


Charging Time

*While you wait for your group to be called,
complete the worksheet about Wind and
Electric Vehicles*



*Time to
build an
electric
vehicle!*



Wrap Up

- *Renewable energy sources are a cleaner source of energy than nonrenewable resources.*
- *We can use renewable energy (i.e. Wind, solar, hydroelectric) to power things like our cars.*
- *Electric vehicles can use stored renewable energy to operate. This allows them to be better for the planet as they don't produce greenhouse gases or noise pollution.*



Electric Vehicle Exit Ticket

1. In general, what are the benefits of renewable resources?
2. What are the benefits of electric vehicles?
3. What are potential drawbacks of renewable resources and electric vehicles?

4. What are you still wondering about or what do you want to learn more about?

5. Today I learned new concepts that I did not know before.

A. Yes, I learned many new concepts.

B. I learned a few.

C. I learned nothing new.

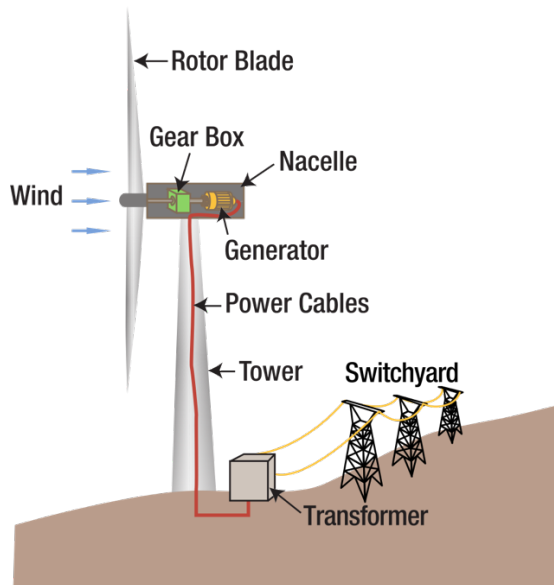
6. On a scale from 1-10, how much do you care about the environment?

I care a lot!				I kind of care				I do not care	
10	9	8	7	6	5	4	3	2	1



Name: _____

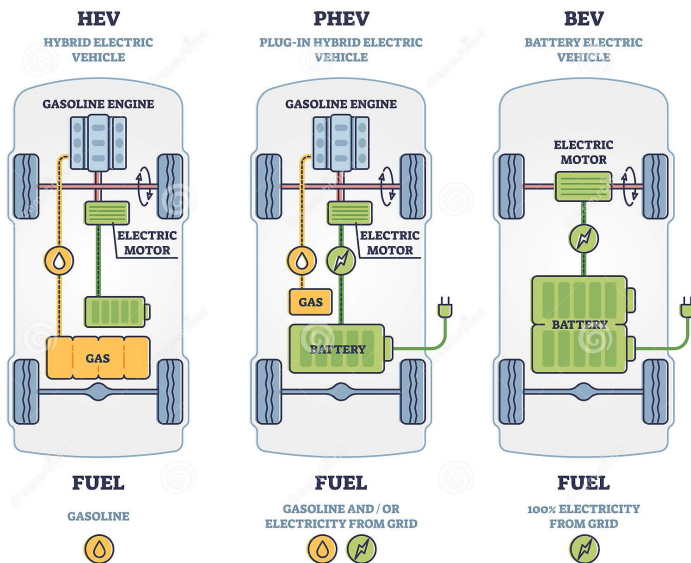
Wind turbine and Electric Vehicle Worksheet



1. Examples of renewable energy are:
 - a. Water, oil, wind
 - b. Water, coal, gas
 - c. Water, wind, solar
 - d. Coal, oil, gas
2. Wind turbine blades average _____ long.
 - a. 50 feet
 - b. 200 feet
 - c. 800 feet
 - d. 1,000 feet
3. Which of the following are TRUE statements about wind turbines:
 - a. Can impact animals such as birds that migrate.
 - b. Places that are good for wind turbines are usually remote locations.
 - c. Turbines make noise and alter the visual aesthetics of where they are located.
 - d. All of the above



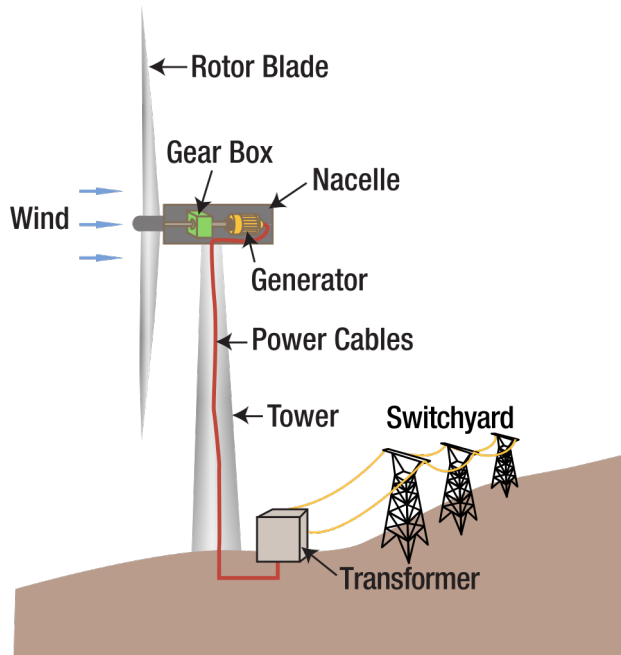
TYPES OF ELECTRIC VEHICLES



Using the graphic above answer the following questions:

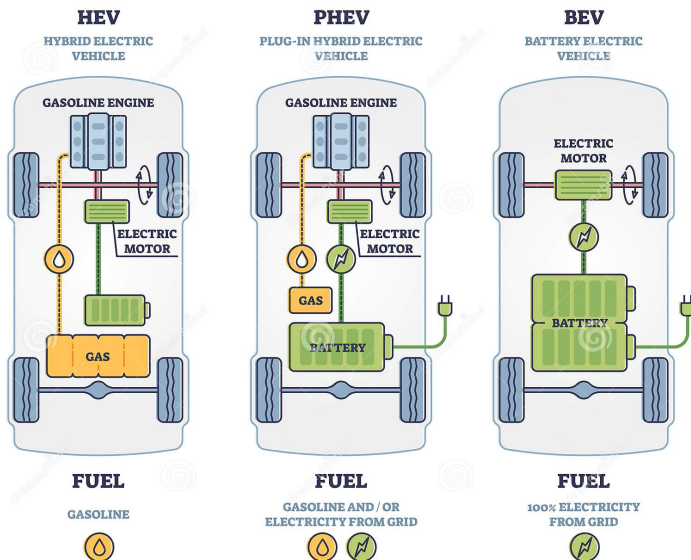
1. Which of the electric vehicles uses both gasoline and electricity from the grid as its fuel source?
 - a. HEV
 - b. PHEV
 - c. BEV
2. What is a similarity between all three vehicles?
 - a. They all use gasoline as a fuel source
 - b. They all can plug into an electricity source
 - c. They all have an electric motor
3. Which vehicle cannot be plugged into an electricity source?
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 - b. PHEV
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Wind turbine and Electric Vehicle Worksheet



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