Into the Outdoors

Educational Partners: Xcel Energy slipstream

TRANSPORTATION AND OUR CARBON FOOTPRINT

8th-10th Grade Discussion Guide

Teacher - Joseph Kanke

GRADE LEVEL: 8-10

TIMEFRAME: 5-7 class periods

MATERIALS: electronic devices for research, computers or classroom supplies to create infographics

KEY WORDS: Carbon Footprint, Electric Vehicle, Petroleum Product, Fossil Fuels, Carbon Dioxide, Greenhouse Gas, Vehicle Emissions, Hydroelectric Energy, Solar Energy, Wind Energy

SCIENCE CATEGORIES: Energy and Sustainable Science

LEARNING OBJECTIVES

Students will be able to:

- Investigate and engage in dialogue around ways to reduce your carbon footprint.
- Understand and explain how electric vehicles are better for the environment than traditional vehicles.
- Research and synthesize information in the form of an infographic.

ACTIVITY SUMMARY

Students will explore the concepts of carbon footprints, renewable energy and electric vehicles. For the introductory activity students will participate in the activity Hot Potato to activate prior knowledge. They will consider how you can reduce your carbon footprint for each of the categories: food, energy use and transportation.

Following the introduction students will work in dyads to explore how electric vehicles are more eco-friendly than traditional vehicles. Dyads should research and synthesize their findings into an infographic which will culminate in a gallery walk. Then, individually, students will choose from one of three activities on the topics of: their own carbon footprint, EV chargers in their community and renewable energy production from a local energy provider.

The unit will culminate with a final activity where students individually summarize their learning around the terms carbon footprint and electric vehicle.

BACKGROUND INFORMATION

There are many ways we can lower our carbon footprint. A carbon footprint is the amount of carbon emissions individuals contribute to the atmosphere. Some ways we contribute to our carbon footprint are through the food we eat, the energy we consume and the transportation we use. This episode focuses on lowering your carbon footprint by considering transportation options. A few ways you can lower your footprint are by walking, running and biking. Eventually, though, you will need to depend on a vehicle.

One way you can lower your footprint when considering a vehicle is considering an electric vehicle, or EVS. These vehicles use a combination of electricity, a battery and an electric motor to power the vehicle. Traditional vehicles use petroleum products like diesel or gasoline which burn fossil fuels and create emotions. Since EVS don't depend on fossil fuels, they don't create emissions and are considered better for the environment.

Fossil fuels are a nonrenewable resource, meaning once we use them up, we can't replace them. They also create energy by burning which gives off emissions of carbon dioxide. Carbon dioxide is found naturally in the environment, but when there is too much in the atmosphere it traps heat and changes our living conditions. According to the EPA, 27% of greenhouse gasses in the atmosphere come from the transportation sector.

Since EVS don't rely on fossil fuels, they have zero tailpipe emissions. EVS rely on EV charging stations which can be installed anywhere that electricity is available. Even though the EVS are directly using fossil fuels, the energy required to charge the vehicles may be produced by fossil fuels. For EVS to be truly green, energy must be produced by renewable resources such as wind, solar or hydroelectric sources. Electric companies have set goals to make the electricity we use cleaner. XCEL Energy, for example, has a goal to make its energy carbon free by 2050. There are already options for customers to request renewable energy through their providers.

It may be hard to notice EVS on the road because they look very similar to traditional vehicles and they aren't only commuter vehicles. Fire Trucks, school buses and delivery trucks are just a few examples of vehicles that may also be EVS. With the improving technology, many organizations are switching to these vehicles because of their cost-saving and environmental benefits.

VOCABULARY

CARBON FOOTPRINT: A measure of the amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person.

ELECTRIC VEHICLE: Also referred to as EVS. These vehicles use a combination of electricity, a battery and an electric motor to power the vehicle.

PETROLEUM PRODUCT: Petroleum products are materials derived from crude oil (petroleum) as it is processed in oil refineries.

FOSSIL FUELS: A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.

CARBON DIOXIDE: A chemical compound that is usually in the form of a gas. It is made up of one atom of carbon and two atoms of oxygen. Its chemical formula is CO 2 . It is naturally found in the atmosphere but too much of it contributes to climate change.

GREENHOUSE GAS: Greenhouse gasses are gasses in Earth's atmosphere that trap heat. They let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere.

VEHICLE EMISSIONS: Substances emitted from a vehicle as a result of internal combustion.

HYDROELECTRIC ENERGY: A form of renewable energy that uses the power of moving water to generate electricity.

SOLAR ENERGY: Any type of energy generated by the sun.

WIND ENERGY: Energy, such as electricity, that is generated directly from the wind.

LEARNING PROCEDURE

Instructor states, "In the video we were introduced to the term: carbon footprint. The video also explained that the three main ways we contribute to our carbon footprint is through food, energy use and transportation. We're going to activate our prior knowledge and see what we already know about reducing our footprint."

Hot Potato Activity

Instruct students to form groups of three.

Explain that each student will get a paper with one of the following questions on the top:

- How can you reduce your carbon footprint as related to food?
- How can you reduce your carbon footprint as related to energy use?
- How can you reduce your carbon footprint as related to transportation?

Provide students with five minutes to write down all the key points they can think of that are related to the topic before passing their paper on to the next person. Each time students receiv a new topic they read what is already written and add their statements. Key points cannot be repeated. The paper keeps getting passed around until it arrives back with its original owner.

Whole group: ask each group to share one creative response for each question. Consider posting the lists somewhere in the room for the duration of the unit of study.

ACTIVITY 1:

Instructor states, "For this activity, we are going to explore the question: What makes an electric vehicle more eco-friendly than a traditional car? We heard a few examples in the video clip we watched and now you'll have an opportunity to expand that knowledge base."

Instruct students to form dyads and review the website: Why Should You Drive Electric. Explain that they should see several infographics followed by links to broader information. Inform students that their task will be to research this site and pull information that supports the statement that electric vehicles are more eco-friendly than traditional vehicles. Using this research, they should create a unique infographic. It may be helpful to share a definition of infographic, such as the one below.

An infographic is a visual representation of information, data, or knowledge meant to present complex information quickly and clearly. Infographics use many different strategies to present information, including graphs, charts, maps, diagrams, and pictures (and often a mixture of several of these). (Definition from California Academy of Sciences)

Remind students there are some sample infographics to guide their thinking in the website provided. Encourage students to conduct research beyond the site provided and check the sources of their research for validity.

It may be helpful to co-create or provide a rubric to guide the infographic creation. Some questions to consider when developing a rubric are outlined below.

- Does the infographic have a main idea or thesis?
- Does the data support the main idea? (if applicable)
- Do the graphics enhance and support the data?
- Does the layout and design have a purpose
- Did you organize the graphics and text to communicate your ideas effectively? (from: Jeff Holiday, 2014)

As a culmination to the activity, post the infographics around the room for a gallery walk. As students tour the infographics, have them offer comments and questions by using sticky notes that they can paste to the side. At the end, allow the infographic creator to respond to any questions they received.

ACTIVITY 2:

For this activity, individual students will be given the opportunity to engage in one of three activities of their choice to further investigate renewable energy. An important component of this activity is building in time for students to share their projects so everyone is exposed to the content covered across the activities. Tell students that they have the opportunity to choose one of the three activities outlined below. They should engage in research to help support the development of their project and be prepared to share their findings with the class.

Activities

1) Track your carbon footprint over a week or month and set a goal to reduce it. There are several footprint calculators online to determine your starting place and plan. Calculator. At the end of the time, share your findings and reflect. Did you meet or exceed your goal? How did it feel? Was it difficult? If you didn't meet your goal, why?

2) Research EV charging stations in your community. You can use this website as a starting place. If you don't have any, where is the closest? If there are EV charging stations, are they equally distributed across your community? Write a letter to your local government or a business advocating for the installation of more charging stations. Be sure to include facts about how EVs are more environmentally responsible.

3) Determine which energy provider you use in your household or is used by your school/district. Research how much of the energy they provide comes from renewable sources. Is there a way individuals can opt into greener energy? If so, have your household or school/district. Is there a plan for your provider to increase the amount of renewable energy it produces? What is the plan and what is the time frame?

Provide students with an opportunity to present their findings. Instruct peers to complete the following sentence stems for each presentation:

One new thing I learned is...
One question I have is. . .

TRANSPORTATION AND OUR CARBON FOOTPRINT

Developed by: Dan Bertalan and Phyllis McKenzie

CONCLUSION

Tell students they will summarize their learning by creating Magnate Summaries. We will use two words.

1) Provide students with their magnet word. The two words will be carbon footprint and Electric Vehicles. You should provide these one at a time.

2) Ask students to copy the magnet word in the center of a notecard or page of their notebook.

3) Tell students the magnet word acts like a magnet and pulls other key information that is important to the topic.

4) Students should then pull keywords from their learning and arrange them around the magnet word.

5) Tell students to write a summary which must include the magnet word and some/all of the keywords.

6) Since students will be so focused on including the keywords, their first summary may not flow smoothly. Encourage students to edit a minimum of one time.

EXTENDING THE LESSON

(Options for extended/additional activities and lessons)

Visit a renewable energy source near your school (solar, wind, hydroelectric) and write a news article about the experience.

Create a visual presentation (such as a slide deck) on any of the topics covered.

Create a children's book appropriate for elementary that explains what a carbon footprint is and how anyone can shrink theirs.

Imagine you are the CEO of an energy company and develop a detailed plan of how you will get to zero carbon emissions. Consider what will need to be constructed and what time frame is realistic.

Develop an advertisement for EVS. Be sure to include research and data. Consider how you might compare an EVS to a traditional vehicle.

Research a company that is moving towards EVS vehicles that aren't considered commuter vehicles. What made them decide to switch to EVS?

RELATED LINKS

- **Renewable energy resources from Xcel:**

https://wi.my.xcelenergy.com/s/renewable

- **Environmental resources from Xcel:**

https://wi.my.xcelenergy.com/s/environment

- **Xcel's Carbon Reduction plan:**

https://wi.my.xcelenergy.com/s/our-commitment/carbon-reduction-plan

- **Why should you drive electric:**

https://ev.xcelenergy.com/ev-101#:~:text=All%2Delectric%20vehicles%20are%20also,as%20well%20as%20on%20gasoline

- **What is a carbon footprint and how to measure yours:**

https://www.nationalgeographic.com/environment/article/what-is-a-carbon-footprint-how-to-measure-yours

- **How EVs work:**

https://www.youtube.com/watch?v=tJfERzrG-D8

EDUCATIONAL STANDARDS

8TH GRADE:

CCSS.ELA-LITERACY.RI.8.1	Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.8.2	Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content..
CCSS.ELA-LITERACY.W.8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
CCSS.ELA-LITERACY.SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion
CCSS.ELA-LITERACY.SL.8.1.B	Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.
CCSS.ELA-LITERACY.SL.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
CCSS.ELA-LITERACY.SL.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.
8.4 4.	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation..
CCSS.ELA-LITERACY.SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

9TH-10TH GRADES

CCSS.ELA-LITERACY.RI.9-10.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.9-10.2	Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
CCSS.ELA-LITERACY.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
CCSS.ELA-LITERACY.W.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
9-10.8.8.	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of idea
CCSS.ELA-LITERACY.SL.9-10.1.B	Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed..
CCSS.ELA-LITERACY.SL.9-10.1.C	Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions..
CCSS.ELA-LITERACY.SL.9-10.1.D	Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
CCSS.ELA-LITERACY.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.

9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
CCSS.ELA-LITERACY.SL.9-10.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
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6-8th Grades

MS-ESS3-3 EARTH AND HUMAN ACTIVITY

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

Performance Expectation

Grade:

Middle School (6-8)

9-12th Grades

HS-ESS3-4 EARTH AND HUMAN ACTIVITY

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

Performance Expectation

Grade: High School (9-12)