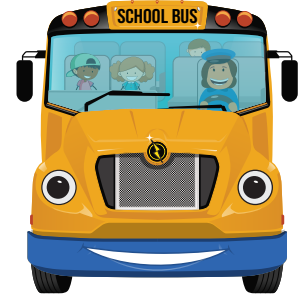


Instructional Materials for Elementary School

This lesson is intended for students in Grades 3–7 and explores our need for clean air and how transportation choices can contribute to cleaner air and healthier communities. This lesson begins with an exploration of the importance of clean air through discussion and a guided imagery exercise. Students will reflect on the various modes of transportation that emit little to no air pollution, including the electric school bus. Students will investigate school bus transportation and share their understanding in a format of their choice.



Overarching Inquiry Question:

What is the importance of clean air and what kinds of transportation emit little to no air pollution?

Educators can use and adapt the following framework to guide student discovery and learning:

THINK:

Students will discuss our need for clean air and engage in a mindful breathing exercise.

LEARN:

Students will consider various modes of transportation and determine which ways of travel emit little to no air pollution, including the electric school bus. A Know-Wonder-Learn activity will help learners access prior knowledge of electric school buses and foster curiosity for further investigation.

APPLY:

Students will learn more about electric school buses and choose options from the School Bus Transportation Choice Board to communicate their understanding.

Target Age Group: Grades 3–7

Curricular Competencies:

- Demonstrate a personal awareness of and ability to recognize factors that affect well-being — at a personal level as well as within their community
- Examine solutions to improve air quality, including low-carbon/zero-emissions commuting
- Communicate, in various creative formats, an understanding of the relationship between school buses and air quality
- Demonstrate a sense of curiosity

Key vocabulary

Air pollution: contamination of the indoor or outdoor environment by any chemical, physical, or biological agent that changes the natural characteristics of the atmosphere ([World Health Organization 2023](#))

Non-renewable energy: energy derived from sources that will eventually run out, such as oil and coal ([National Geographic 2022](#))

Renewable energy: energy derived from natural sources that are replenished at a higher rate than they are consumed (Sunlight and wind, for example, are such sources that are constantly being replenished.) ([United Nations](#))

Traffic-related air pollution (TRAP): a mix of gases and particles that includes many different harmful chemicals emitted by cars, trucks, and buses ([Government of Canada 2022](#))

Opening: Clean Air Breathing Exercise

Instructions

- Share this question with the class verbally or write it on the board. *Why do you think it is important to breathe clean air?*
- Ask students their thoughts on this question, inviting them to first turn and talk with someone beside them; then share out ideas as a whole group. Some prompt questions to encourage students to share more detail may include the following: *What does clean air do for our body? What kinds of things can our body do when we are breathing air that is clean? What does clean air do for plants, animals, ocean, soil, etc.?*
- Move on to the following breathing exercise. The script below offers a template for how to guide students through this. Read slowly and take moments to pause where appropriate.

Our bodies need oxygen, and we get this from breathing. The respiratory system brings oxygen-filled fresh air in through our nose and mouth. It then travels down the windpipe before entering our lungs. From the lungs, the oxygen is transferred to the bloodstream and then throughout the body.

We are going to spend some time just breathing for a few minutes. Begin by imagining that you are in a beautiful forest. It is quiet and calm. The air around you is clear and feels refreshing. If helpful, you may close your eyes or lower your gaze, to better visualize the setting of this forest. Take a moment to picture what is around you. When you feel ready, breathe in that clear, refreshing air through your nose and mouth. Practice inhaling (breathing in) and exhaling (breathing out) slowly — for maybe a count of 3 in and 3 out. As you take in this oxygen-filled breath, feel it pass through your nose or mouth; feel it travel down the windpipe and fill your lungs. Let's try this three more times, slowly breathing in and back out.

Now this time as you take the next breath, perhaps place your hands on the area where your lungs are. As you breathe in, feel the lungs and the chest rise with air. Then feel the lungs contract as you breathe out. As you take in this next breath, feel your lungs expand to take in that oxygen-filled fresh air. Now picture your body sending the oxygen out to all of the parts of your body and brain. Imagine the oxygen from this breath moving from your lungs (then transferring to the bloodstream) and then throughout your body. Take a few more breaths like this. When you are ready, open your eyes.



Activities:

1. Transportation Brainstorm and Cross-the-Floor Game

Instructions

- Explain that breathing clean air is good for our bodies and so it is important to keep our air as clean as possible. There are many ways that we make choices that emit little to no air pollution, including the ways that we travel from place to place.
- Ask students what are the different ways we travel from place to place. What are some modes of transportation?
- Give students a set amount of time to list as many examples as possible of modes of transportation, using pictures or words. Have students share their list with a classmate before sharing out with the whole class.
- Review students' lists and explain that some of these ways of travel are powered using non-renewable energy and some are powered using renewable energy sources. Review what non-renewable energy and renewable energy mean, writing their definitions and examples of each for students to see. Non-renewable energy sources contribute to air pollution. Renewable energy sources promote cleaner air.

NOTE: *The use of the terms non-renewable energy and renewable energy are simplified in this lesson. For older students, a more critical lens on these terms could be considered. At-the-source energy production from renewable sources like wind and solar are emissions-free; however there are indirect emissions created during the production of the renewable energy (e.g., transporting heavy wind turbine parts by gasoline-powered vehicles,). Consider including this additional information for students in older grades, emphasizing that an energy system powered by renewables generates significantly less air pollution than one powered by non-renewables. Another option to address this is to initially split the two groups into “combustion at the source” and “no combustion at the source” to focus the discussion more specifically. This should also include a discussion on what combustion means. After building this understanding, an examination of renewables and non-renewables could then follow, including why combustion means it is non-renewable.*

- Cross-the-floor game:

Designate one side of the classroom space as “renewable energy” and the other side as “non-renewable energy” (or combustion at the source and no combustion at the source). This can be done verbally or with a sign. Based on the mode of transportation that is called out, students will cross the floor to the side that represents the energy source used by the given mode of transportation.

Examples:

Truck: non-renewable (uses gasoline or diesel) / combustion at the source

Sailboat: renewable (uses wind power) / no combustion at the source

Motorcycle: non-renewable (uses gasoline) / combustion at the source

Canoe: renewable (uses human power) / no combustion at the source

Diesel-powered school bus: non-renewable (uses diesel) / combustion at the source

Electric school bus: renewable (uses electricity) / no combustion at the source



2. Know-Wonder-Learned (KWL) Chart

Suggested materials:

- Appendix A: KWL worksheet

Instructions:

- a. One type of transportation powered by renewable / no combustion at the source energy is the electric bus. Electric buses are making their way to schools in communities across Canada, the United States, and around the world. Electric school buses emit little to no air pollution and use electricity derived from a battery.
- b. Show examples of electric school buses in communities across Canada from the [Healthy Environment for Learning Day Video Series \(link to follow\)](#).
- c. Ask students to begin by thinking about what they already know about electric school buses. Prompts can be used to encourage students to make connections to what they know or think about electric vehicles in general.
- d. Using the KWL Chart Worksheet, have students write what they know. This can be completed by students on their own, in small groups, or as a whole class.
- e. Next, students can move on to recording what they want to know and what they wonder similarly, on their own, in small groups, or as a whole class.
- f. Leave the “What have I learned...” section blank to be filled out after the final activity.

KNOW: What do I know about electric school buses?	WONDER: What do I wonder about electric school buses?	LEARN: What have I learned about electric school buses?

3. Electric School Bus Choice Board

Suggested materials:

- For younger grades:
 - For Our Kids: Electric School Buses — here is why they are better or [Electric School Buses — 4 reasons](#)
- For older grades and teacher resources:
 - Appendix B: About Electric School Buses
 - CPCHE: [Healthy Environment for Learning Day Graphic](#)
- Appendix C: School Bus Transportation Choice Board
- Appendix D: Choice Board Interview Templates
- Access to digital technology



Instructions:

- a. Share the most age-appropriate electric school bus materials listed above with students and have student form small groups to discuss the following:
 - i. *What did you already know?*
 - ii. *What did you learn?*
 - iii. *What do you think is most important? Why?*

After some discussion in small groups, return as a whole class for everyone to share their thoughts on the above questions collectively.

- b. Review the School Bus Transportation Choice Board and explain that students can choose one or more of the ideas from the choice board to complete. If possible, students should have access to digital technology to reference the suggested materials, videos, and graphics listed above to further their investigation on electric school buses and to support their completion of the choice board activities.

Note: Lithium is discussed in Appendix B: About Electric School Buses. The batteries used in electric vehicles, including electric school buses, require lithium, which is a non-renewable resource like fossil fuels. It is important, then, for the lithium in batteries to be reused or repurposed as part of a circular economy.

School Bus Transportation Choice Board		
Make a comic strip about a ride on an electric school bus.	Interview your teacher, principal, or vice principal to find out about school bus transportation where you live. (see template Appendix D for questions or create your own).	Design a poster or infographic about electric school buses.
Create a short video on electric school buses.	Create a survey to find out how students in your class, your grade, or your school travel to school.	Write a speech about how transportation to school could be changed.

Closing:

Students share one idea with the class about what they have learned about electric school buses or transportation to school in general. Add this to the Learned portion of the Know-Wonder-Learned chart that was started earlier.

Extensions:

- Further investigate any of the questions or curiosities that emerged from the Wonder part of the K-W-L chart that were not yet answered.
- Find a community in another part of Canada with electric school buses and virtually connect with some of their residents (maybe another class) or write them letters. Have students prepare questions in advance.
- This could lead into a possible inquiry into what is environmental health. What does this mean? What can we do about it and how do electric school buses fit in?
- Further investigate the relationship between school bus emissions and climate change.





K-W-L Chart

What I Know About Electric School Buses:

K

What I Want to Know About Electric School Buses:

W

What I Have Learned About Electric School Buses:

L

About Electric School Buses



Economics

- Electric school buses cost more than diesel to buy. ~\$220 000 more than diesel without subsidies, add \$15 000 for a charging station.
- In BC, the Pembina Institute estimates that a school district will save \$17 000 per bus annually compared to a diesel bus due to lower fuel cost (electricity) and lower maintenance costs. After 4-5 years, when some subsidies are included, the electric bus outperforms the diesel bus. Over 12 years that is ~\$165 000 in savings!

Environmental Impacts

- Lithium-ion batteries need to be replaced every 8-15 years. Lithium is mined and there is an environmental impact to mining (see example of impacts from the Thacker Pass Lithium Mine Project in Nevada).
- It is a 'critical mineral' (essential to our technological world yet may be in short supply). There is a lot of research in Canada and in the world going into finding solutions for recycling lithium from batteries.

Safety & Performance

- There is evidence that because electric school buses do not have a heavy engine on board, they have a more equal distribution of weight. This allows for better performance on icy and snowy conditions.
- Batteries operate at lower range when temperatures are below zero (~55-58% of normal). Also, battery & bus technology geared for colder conditions is improving.
- Fueling time can take 3hrs (fast charge) or between 5-8hrs (slow charge).

Greenhouse Gas (GHG) Emissions and Climate Change

- Electric buses, sourced by a clean energy grid, reduce operational GHG emissions, over an average bus lifetime of 12 years, by 92% compared to diesel school buses.
- Overall GHG emissions depends on the manufacturing process of electric school buses and the electrical grid (i.e. coal powered vs hydroelectric powered).

Health Benefits

- Switching to electric school buses improves local air quality and related health outcomes.
- There are multiple physical and mental health benefits from improved air quality in the short term, and the reduction in GHG emissions will help reduce the health impacts of climate change for children today and future generations.

Social Impacts

Electric school buses allow, if implemented well, opportunities to provide environmental justice to communities suffering from the effects of diesel emissions. Reports from both The World Resources Institute & CleanTechnica suggest embedding equity into the rollout of electric school buses programs. One example would be to make sure that lower income neighbourhoods receive electric bus service first.

School Bus Transportation Choice Board

Make a comic strip about a ride on an electric school bus

Interview your teacher, principal or vice principal to find out about school bus transportation where you live

Design a poster or infographic about electric school buses

Create a short video on electric school buses

Create a survey to find out how students in your class, your grade or your school travel to school

Write a speech about how transportation to school could be changed



School Bus Interview

1. What kinds of school buses do we have?
2. How many school buses are used in our district?
3. How many students take the school bus?
4. Do we have any electric school buses?
5. What do you think our district could do to promote cleaner school bus transportation?



School Bus Interview

1.

2.

3.

4.

5.

