EPA Clean School Bus Program Electric School Bus Activity Book:

GUIDE FOR K–5 EDUCATORS

Introduction

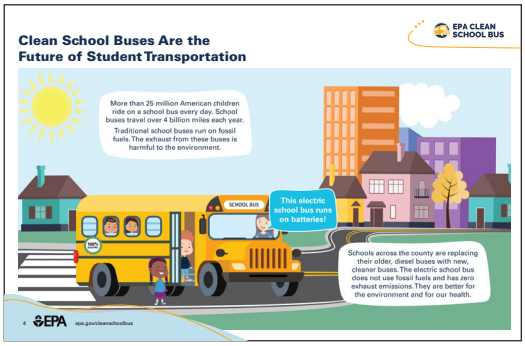
This activity book was created by the United States Environmental Protection Agency (EPA) as a teaching aid on clean transportation, electric school buses, public health, and climate change. **The goal of this educational activity book is to channel the students' excitement about your school's new, clean school buses so they can share what they've learned with their families.** Activities within this book align with the Next Generation Science Standards (NGSS) in the table below. These alignments are not intended to imply that the activities include all content needed to satisfy the specified NGSS performance expectations. Rather, they are intended to guide how the activities may supplement other materials for fully addressing the expectations. Activities may also meet specific state standards for literacy, mathematics, or other content.

For each activity, this guide presents a learning objective, NGSS performance expectation, key vocabulary, discussion questions, and general comments on activity design. The activities were created for kindergarten through fifth grade, with an emphasis on grades 3–5. Teachers may modify the activities and/or choose to present the information in any way they deem appropriate for their classroom and learners.

Next Generation Science Standards (See Appendix A for Performance Expectations)

K	1	2	3	4	5
K-ESS2-2: Earth's Systems	K-2-ETS1-1: Engineering Design	K-2-ETS1-1: Engineering Design	3-5-ETS1-1: Engineering Design	4-ESS3-1: Earth and Human Activity	5-ESS3-1: Earth and Human Activity
K-ESS3-1: Earth and Human Activity	K-2-ETS1-3: Engineering Design	K-2-ETS1-3: Engineering Design	3-5-ETS1-2: Engineering Design	4-ESS3-2: Earth and Human Activity	3-5-ETS1-1: Engineering Design
K-ESS3-3: Earth and Human Activity				3-5-ETS1-1: Engineering Design	3-5-ETS1-2: Engineering Design
K-LS1-1: From Molecules to Organisms: Structures and Processes				3-5-ETS1-2: Engineering Design	
K-PS3-1: Energy					
K-2-ETS1-1: Engineering Design					
K-2-ETS1-3: Engineering Design					

Infographic: Clean School Buses Are the Future of Student Transportation



Learning objective:

- Provide an overview of the types of school buses.
- Compare traditional diesel buses to clean school buses.
- Define low- and zero-emission school buses.

NGSS: K-ESS3-3, K-2-ETS1-1, K-2-ETS1-3, 4-ESS3-1, 3-5-ETS1-2

Key vocabulary: fossil fuel, exhaust, alternative fuel, emissions

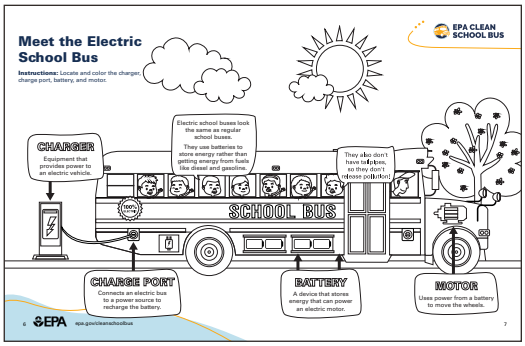
Discussion questions:

- What are the different types of school buses?
- What does it mean to have zero tailpipe emissions?
- What types of school buses do you think are best for the environment and why?

Comments on the activity:

- Match bus type with the level of exhaust emissions. For example, diesel school bus = has tailpipe emissions; electric school bus = zero tailpipe emissions.
- Introduce the concept of nonrenewable and renewable resources and identify which category each bus belongs to.

Activity: Meet the Electric School Bus



Learning objective:

- Become familiar with the external and internal parts of an electric school bus.
- Understand what makes an electric bus different from a bus that uses fossil fuel.

NGSS: K-2-ETS1-2, K-2-ETS1-3, 3-5-ETS1-1, 3-5-ETS1-2

Key vocabulary: charger, charge port, battery, motor

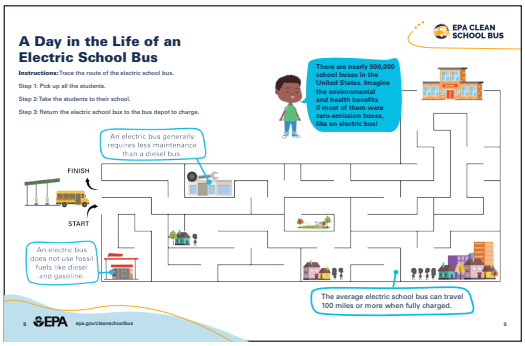
Discussion questions:

- What features are unique to an electric school bus?
- Where are the unique features on the school bus (outside/external vs. inside/internal)?

Comments on the activity:

- Younger students can practice colors and identifying vocabulary. For example, color the charger green.
- Older students can discuss the order of transferring energy from a charger to the motor to move the bus.
- Make a list of similarities and differences. For example, all buses have wheels. An electric school bus has a charge port rather than a gas tank.

Activity: A Day in the Life of an Electric School Bus



Learning objective:

- Highlight the infrastructure associated with an electric school bus. (Specifically, electric buses rely on electric vehicle chargers rather than gasoline.)
- Identify different maintenance requirements among the different types of school buses.
- Visualize and discuss the difference between rural and city school bus routes.

NGSS: K-2-ETS1-2, K-2-ETS1-3, 3-5-ETS1-1, 3-5-ETS1-2

Key vocabulary: diesel, gasoline, maintenance

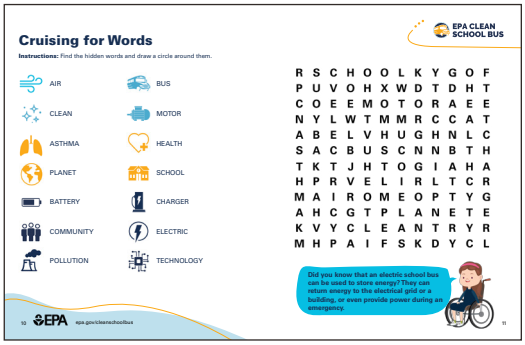
Discussion questions:

- How do drivers take care of their buses?
- Do electric buses need to stop at a gas station for fuel? Why or why not?
- Have you seen any electric vehicle chargers in your community? If so, where?
- How many of your classmates ride a school bus?

Comments on the activity:

- Compare and contrast the maintenance requirements for the different types of school buses. For example, all buses will need to rotate/replace tires. Unlike a diesel bus, an electric bus does not require oil changes.
- Have students compare school bus routes. Collect the following information from students and make a table and/or graph(s).
    - How far away do you live from your school?
    - How many minutes do you spend on a school bus each day?
    - What types of roads does your school bus drive on (e.g., pavement, dirt, gravel)?
    - How many stops does your school bus make?
    - How many students get on at each stop?

Activity: Cruising for Words



Learning objective:

- Identify and link concepts and vocabulary words.
- Introduce students to vehicle-2-grid and vehicle-2-building technology.

NGSS: L-LS1-1, K-2-ETS1-1, 3-5-ETS1-1, 3-5-ETS1-2

Key vocabulary: technology, electric, electrical grid

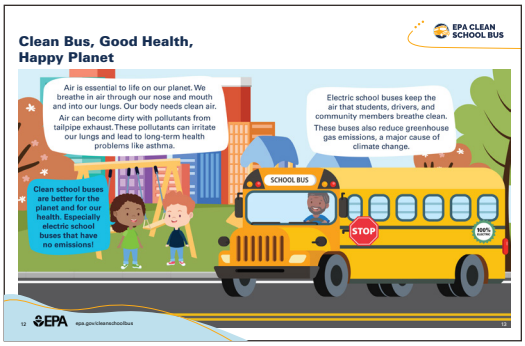
Discussion questions:

- How are these words related to one another?
- If an electric school bus is like a giant battery, what could it power?
- Identify situations when an electric school bus could power your school or community.

Comments on the activity:

- Word search level of difficulty:
    - Light blue words are for beginner readers and run horizontally in the word search.
    - Yellow words are for mid-level readers and run horizontally and vertically in the word search.
    - Dark blue words are for advanced readers and run diagonally in the word search.
- Use the word list to create a concept map.
- Additional information about vehicle-2-grid technology is located in the EPA's Green Vehicle Guide.

Infographic: Clean Bus, Good Health, Happy Planet



Learning objective:

- Identify the resources that living things need.
- Define the term "health."
- Associate air quality with health.
- Highlight the health benefits of clean school buses.

NGSS: K-ESS3-1, K-ESS3-3, K-LS1-1, 4-ESS3-2, 5-ESS3-1

Key vocabulary: air, health, asthma, community

Discussion questions:

- Why is it important to have clean air?
- Besides humans, what other living things need clean air?
- What does the word "health" mean to you?
- What actions do you take to have good health and/or a healthy lifestyle?
- What role do clean school buses play in clean air?

Comments on the activity:

- Create a concept map to help students make the connection between clean school buses, cleaner air, and better health.

Activity: Moving Toward a Cleaner Planet

Learning objective:

- Visualize and discuss an unhealthy environment vs. a healthy environment.
- Highlight the environmental benefits of clean school buses.

NGSS: K-ESS2-2, K-ESS3-1, K-ESS3-3, K-LS1-1, 4-ESS3-2, 5-ESS3-1

Key vocabulary: planet, pollutant, pollution

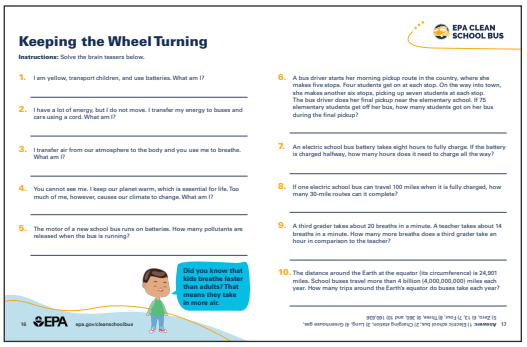
Discussion questions:

- Which of the two images (top vs. bottom) represents a healthy environment?
- Does it matter if our environment is healthy? Why or why not?
- Identify other types of pollution besides air pollution.
- What do you do to keep your community and planet healthy?

Comments on the activity:

- Have students draw their own picture of a healthy vs. unhealthy environment.

Activity: Keeping the Wheel Turning


Keeping the Wheel Turning

Instructions: Solve the brain teasers below.

1. I am yellow, transport children, and use batteries. What am I?
2. I have a lot of energy, but I do not move. I transfer my energy to buses and cars using a cord. What am I?
3. I transfer air from our atmosphere to the body and you use me to breathe. What am I?
4. You cannot see me. I keep our planet warm, which is essential for life. Too much of me, however, causes our climate to change. What am I?
5. The motor of a new school bus runs on batteries. How many pollutants are released when the bus is running?
6. A bus driver starts her morning pickup route in the country, where she makes five stops. Four students get on at each stop. On the way into town, she makes another six stops, picking up seven students at each stop. The bus driver does her first pickup near the elementary school. If 75 elementary students get off her bus, how many students got on her bus during the final pickup?
7. An electric school bus battery takes eight hours to fully charge. If the battery is charged halfway, how many hours does it need to charge all the way?
8. If one electric school bus can travel 100 miles when it is fully charged, how many 30-mile routes can it complete?
9. A third grader takes about 20 breaths in a minute. A teacher takes about 14 breaths in a minute. How many more breaths does a third grader take an hour in comparison to the teacher?
10. The distance around the Earth at the equator (its circumference) is 24,901 miles. School buses travel more than 4 billion (4,000,000,000) miles each year. How many trips around the Earth's equator do buses take each year?

Did you know that kids breathe faster than adults? That means they take in more air.

EPA CLEAN SCHOOL BUS

EPA epa.gov/cleanschoolbus

Learning objective:

- Practice critical thinking skills.
- Review vocabulary.
- Define greenhouse gases and identify their role in sustaining life and climate change.
- Use math calculations to highlight the capabilities of electric school buses.

NGSS: K-PS3-1, K-2-ETS1-1, K-2-ETS1-3, 3-5-ETS1-1, 3-5-ETS1-2

Key vocabulary: atmosphere, greenhouse gases, charge

Discussion questions:

- What are greenhouse gases and what do they do to our planet?
- What role do greenhouse gases play in climate change?
- How do clean school buses reduce greenhouse gases?
- How can you reduce the amount of greenhouse gases in our environment?
- Does a shorter route or longer route require more or less time to recharge a battery?

Comments on the activity:

- Questions 1–5 are riddles to review vocabulary and concepts.
- Questions 6–10 are math-based.
- Using the data gathered from the "A Day in the Life of an Electric School Bus" activity, determine how many routes an electric school bus can complete before needing to recharge.
- Have students research and compare miles/gallon of diesel school buses vs. miles/charge of electric school buses. Students can also factor in the cost of fuel vs. electricity.
- Discuss climate change and the effects it has on the planet.

Activity: Tickle Me Green Fill in the Blank


Tickle Me Green Fill in the Blank

Instructions: Choose your own words to complete the story below. Be as silly and creative as you would like.

Jayden's New School Bus

Jayden is ready to start his school day. Before heading to the bus stop, he double checks to make sure his _____ (school subject) homework is in his _____ (color/pattern) backpack. At the bus stop, Jayden says hi to his four friends. Jayden and his friends see the bus coming around the corner.

"_____ (expression of excitement)," says _____ (name of friend 1), "I have never seen a _____ (color) bus before." "Neither have I!" says Jayden. "This must be our new electric bus."

"_____ (greeting)," says the bus driver. "Welcome aboard our new electric school bus! Do you know what makes an electric bus different from a diesel bus?" asks the bus driver. Everyone shakes their heads no. "This bus is different because it uses batteries rather than diesel or gasoline," says the bus driver. "Rather than stopping at _____ (name of gas station) for fuel, we recharge our bus at a charging station." "Does that mean it's faster than a regular bus?" asks _____ (name of friend 2). "No," says the bus driver. "It's not faster, but it is much quieter."

"Is it true that some school buses can power a(n) _____ (electronic device)?" asks Jayden. The bus driver smiles and says, "You are correct that some electric school buses can store energy. That energy can be returned to the power grid or a building, or even provide power during an emergency."

"The most important benefit of an electric school bus is that it is much better for our planet because it does not emit pollution," says the bus driver. "Does pollution cause _____ (illness)?" asks _____ (name of friend 3). "Pollution can irritate our lungs, which can make us cough or lead to conditions such as asthma," explains the driver. "My grandpa sounds like a/an _____ (animal) when he coughs!" says Jayden. "Clean technology helps everyone breathe clean air," says the bus driver. "This bus is so _____ (expression of excitement)!" says _____ (name of friend 4).

EPA CLEAN SCHOOL BUS

EPA epa.gov/cleanschoolbus

Learning objective:

- To use storytelling to synthesize information about the electric school bus.

NGSS: K-ESS3-3, 4-ESS3-2, 5-ESS3-1

Key vocabulary: Vehicle

Discussion questions:

- This story is about Jayden's school bus. There are other types of vehicles that transport people and goods/supplies. Identify other types of vehicles.
- Do other vehicles use fossil fuels or do they use clean technology like batteries?

Comments on the activity:

- Beginner and mid-level readers will need assistance from their teachers. Stronger readers can work in small groups or independently.
- Have students draw and/or write their own stories about an electric vehicle.

Review Activity: Charging Your Knowledge

Learning objective:

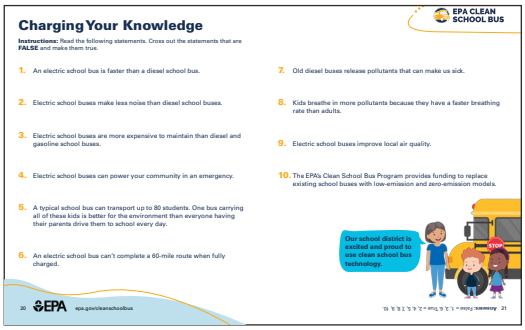
- Use critical thinking skills to assess if the information in the statement is correct or incorrect.

Discussion questions:

- What is something new that you learned?

Comments on the activity:

- This is a series of true/false questions that informally test understanding of the content.
- The slogan for the Clean School Bus Program is "Tomorrow's Buses for Today's Children." Have students create their own slogan or hashtag for clean school buses.



Charging Your Knowledge

EPA CLEAN SCHOOL BUS

Instructions: Read the following statements. Cross out the statements that are **FALSE** and make them true.

1. An electric school bus is faster than a diesel school bus.
2. Electric school buses make less noise than diesel school buses.
3. Electric school buses are more expensive to maintain than diesel and gasoline school buses.
4. Electric school buses can power your community in an emergency.
5. A typical school bus can transport up to 80 students. One bus carrying all of these kids is better for the environment than everyone having their parents drive them to school every day.
6. An electric school bus can't complete a 60-mile route when fully charged.
7. Old diesel buses release pollutants that can make us sick.
8. Kids breathe in more pollutants because they have a faster breathing rate than adults.
9. Electric school buses improve local air quality.
10. The EPA's Clean School Bus Program provides funding to replace existing school buses with low-emission and zero-emission models.

Our school district is excited and proud to use clean school bus technology.

STOP

20 EPA epa.gov/cleanschoolbus

Answers: 1, 3, 6, 7, 8, 10 21

Appendix A: Next Generation Science Standards Performance Expectations

Disciplinary Code	Performance Expectation
K-ESS2-2: Earth's Systems	Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
K-ESS3-1: Earth and Human Activity	Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.
K-ESS3-3: Earth and Human Activity	Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
K-LS1-1: From Molecules to Organisms: Structures and Processes	Use observations to describe patterns of what plants and animals (including humans) need to survive.
K-PS3-1: Energy	Make observations to determine the effect of sunlight on Earth's surface.
K-2-ETS1-1: Engineering Design	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2-ETS1-2: Engineering Design	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2-ETS1-3: Engineering Design	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
4-ESS3-1: Earth and Human Activity	Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.
4-ESS3-2: Earth and Human Activity	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
5-ESS3-1: Earth and Human Activity	Obtain and combine information about ways individual communities use scientific ideas to protect the Earth's resources and environment.
3-5-ETS1-1: Engineering Design	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2: Engineering Design	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

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