CONSERVATION STATION

ENERGY-WATER NEXUS STEM INVESTIGATIONS
Smart Schools

OBJECTIVES

Students will be able to:

- **Determine** the number of miles driven, gasoline consumed, and carbon emitted by the buses used in the school district.

- **Develop** a hybrid school schedule with a mix of online and face-to-face instruction.

- **Calculate** the total savings in gasoline using their hybrid schedule.

- **Organize** a plan to use the yearly savings of their hybrid schedule to implement green infrastructure in their schools.

OVERVIEW

In this activity, students will work in small innovative teams to develop a hybrid school schedule to decrease the school district's carbon footprint. Students will calculate how much money the school district will save in the cost of gasoline used by school buses and identify ways to spend the yearly savings to implement green infrastructure in their schools. Teams will summarize and communicate their plan by creating a video to "pitch" their hybrid schedule to their superintendent.

CONNECTION TO THE ENERGY-WATER NEXUS

- Decreasing our carbon footprint by reducing the amount of gasoline used in public school transportation will decrease our dependence on nonrenewable energy sources.

- Incorporating green infrastructure in schools can provide water quality benefits, create wildlife habitats, manage stormwater, and educate future generations about the importance of responsible management of resources through sustainable practices.

NATIONAL STANDARDS

Next Generation Science Standards

- **MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics**
  Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organism in an ecosystem.

- **MS-ESS3-4 Earth and Human Activity**
  Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

- **MS-ESS3-3 Earth and Human Impact**
  Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

BACKGROUND

Have you ever thought about the impact of traveling to school every day has on the environment? The school bus system is the largest mass transportation system in the nation. Each day, 480,000 school buses travel the nation's roads. According to the United States Department of Education, the U.S. spends $17.5 billion per year on school bus transportation. School buses, depending upon the type of fuel that is used, get only 4-6 miles per gallon. What if we could develop a hybrid master schedule that would decrease the need for transportation to school by one day a week or even a month? Not only would we save money, we would greatly reduce our dependence on fossil fuels and CO_2 emissions. The money saved could be used to identify and improve water and energy inefficiencies within school buildings and incorporate sustainable practices.

KEY VOCABULARY

- Ecological footprint
- Emissions
- Sustainability

MATERIALS

- Sticky notes
- School District Commute Log capture sheet
- Hybrid School Schedule capture sheet
- Computer or smart phone
- Internet access
- Calculator

TEACHER PREPARATION

- Have copies of *Hybrid School Schedule* capture sheet ready for each group
- Determine the number of buses used in the school district
- Have ready a copy of *School District Commute Log* for each student
- Prepare printed images on poster paper for the gallery walk (green roof, composting bins, water bottle filling station, waterless urinal, solar panels, electric vehicle charging stations, landscaping, pervious sidewalks, and stormwater management techniques)

PROCEDURE

1. Open the lesson by asking students to walk around the room and examine the images of the sustainable, green practices. Working in pairs, students should discuss their ideas of how these practices could be implemented in their school. Have them write their ideas on sticky notes and attach them to the images.

2. When the students are finished with the gallery walk, invite them to explain how these practices could reduce waste, prevent pollution, and reduce energy use in their school. Ask students why they think these practices are not implemented currently in their school. The answer to this question will most likely be lack of resources or money.

3. Share with the students that their job today is to find the money to implement these practices. They will work in groups of three to develop a master school schedule that is a hybrid of online learning and face-to-face instruction. Their schedule must include at least one day of online learning a week. Their ideas should be recorded on the *Hybrid School Schedule* capture sheet.

4. Once they have completed their hybrid schedules, students will calculate fleet mileage, fleet fuel consumption, and fleet carbon footprint and record the information on the School District Commute Log. Students may research the number of buses used in their school district or this information may be provided by the teacher.

5. Based on the hybrid schedule they created, students will work together to complete the *School District Hybrid Schedule Plan* sections that include Decreasing Our Carbon Footprint, Decreasing Our Mileage, and Savings In Gasoline.

6. Students will select green practices to incorporate in their school with the money saved in gasoline. They can select the practices from the gallery walk or research and develop their own. They will need to use the Internet to determine the cost of certain items.

7. To close the activity, have each group create a video to "pitch" their hybrid schedule to the superintendent. They should present their hybrid school schedule, discuss environmental and cost benefits, and describe the green practices they would implement with the money saved.

EXTENSION

As an extension of this activity, students can form a "green team" in their school. They could break into smaller teams that focus on communication, environmental problems, technology, paper reduction, and waste reduction. Each team could coordinate activities like waste-free lunches, going paperless for a day, student recycling pledges, and trash audits after lunch.

Sources

https://afdc.energy.gov/data/
https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_m.htm
https://thomasbuiltbuses.com/bus-advisor/articles/co2-emissions/

Considerations

1. What type of activities can be done at home?

2. What type of activities would be more effective with face-to-face instruction?

3. What courses would be better suited for face-to-face instruction?

4. What courses could be completed entirely at home?

5. How would the buses operate?

6. How will your schedule decrease bus transportation?

Possible Schedules

- Morning vs. Afternoon
- Alternate Days—Group A, Group B

Monday	Tuesday	Wednesday	Thursday	Friday

FLEET MILEAGE

School Buses (Number)	x	Daily Bus Average (Miles)	=	Total Miles (Daily)	x	School Year (Days)	=	Total Miles (Yearly)
	x	66.7	=		x	180	=	

FLEET FUEL CONSUMPTION

Total Miles (Daily)	x	Average Fuel Efficiency (Miles/Gallon)	=	Total Gas (Gallons / Day)	x	School Year (Days)	=	Total Gas (Gallons / Year)
	x	6.20	=		x	180	=	

FLEET CARBON FOOTPRINT

Total Gas (Gallons / Day)	x	Average CO_2 Emission (Pounds/Gallon)	=	Total Daily CO_2 (Pounds)	x	School Year (Days)	=	Total Yearly CO_2 (Pounds)
	x	21	=		x	180	=	

DECREASING OUR CARBON FOOTPRINT

Total Gas (Gallons / Day)	x	Average CO_2 Emission (Pounds/Gallon)	=	**Total Daily CO_2 (Pounds)**	x	School Year (Days)	=	**Total Yearly CO_2 (Pounds)**
	x	21	=		x		=	
						TOTAL SAVINGS:		

DECREASING OUR MILEAGE

School Buses (Number)	x	Daily Average (Miles)	=	**Total Miles (Daily)**	x	School Year (Days)	=	**Total Miles (Yearly)**
	x	66.7	=		x		=	
						TOTAL SAVINGS:		

SAVINGS IN GASOLINE

Total Miles *Not* Driven (Yearly)	÷	Avg. Bus Fuel Efficiency (Miles / Gallon)	=	Gasoline Saved (Gallons)	x	Average Price of Gasoline	=	**Total Saved (Yearly)**
	÷	6.20	=		x	$2.94	=	

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