



## Exploration Summary

Students will select a type of vehicle and its average weekly driving distance. Then they will observe the results of that vehicle's emissions test.

## Student Learning Objectives

- Recognize that carbon dioxide (CO<sub>2</sub>) and other air pollution that has collected in the atmosphere traps the sun's heat and causes the Earth to warm up. This process is called global warming.
- Distinguish the amounts of CO<sub>2</sub> produced by various types of vehicles.

## Student Worksheet

The student worksheet includes questions to check understanding, instructions for how to use the Exploration, and a section for recording Exploration data. Why do the questions come first? In following best practices for teaching science, students are asked to review questions before participating in an activity. When the questions come first, students are more focused on the intended content of the activity. Then they can respond to the questions during the activity or after completion of the activity.

## Exploration Procedure

Explain that the purpose of this Exploration is to learn about the impact gasoline-powered vehicles can have on global warming. Follow the appropriate procedure below.

## Student Performs Exploration

1. Tell students how much time they will have to complete the Exploration and the student worksheet.
2. Explain how students should proceed:
  - Read the questions before starting the Exploration.
  - Follow the instructions on the worksheet to perform the Exploration.
  - Take notes or record data as necessary.
  - Respond to the questions in writing.
3. Explain that you will be available to help any students who raise their hands.
4. Tell students to begin the Exploration.
5. When time is up, ask students to share their answers.
6. Talk about the Discussion Question below.



## Teacher Performs Exploration

1. Draw the Data Chart from the student worksheet on the board.
2. Display the questions from the student worksheet and ask students to tell you what they think they will learn from the Exploration based on its questions. Highlight key words.
3. Read the Introduction and click the Continue button.
4. Identify the Exploration components.
5. Select a vehicle and an average weekly distance. Click the Play button.
6. Watch as the vehicle takes the emissions test. Note the test results and read the explanation.
7. Record your observations in the Data Chart below. (Use the emissions specified in the explanation. If the explanation doesn't include emissions, use the higher number from the vehicle's Annual Emissions range.)
8. Repeat for other combinations of vehicles and driving distances.
9. Pose each of the questions below and ask for answers from the class. Replay parts of the Exploration as necessary to illustrate the answers.
10. Talk about the Discussion Question below.

**Optional:** Use this Exploration as a small-group activity at a computer station. Assign it to students who need specific reinforcement of the concept.

## Questions

1. List the vehicles in order from lowest-to-highest carbon dioxide (CO<sub>2</sub>) emissions at all distances.  
**Answer:** gas-electric hybrid car → gas-engine car → gas-engine SUV → diesel-electric hybrid bus
2. Let's assume that the cars carry two passengers each, the SUV carries four passengers, and the bus carries 24 passengers. Which vehicle would have the highest per-person CO<sub>2</sub> emissions for an average weekly distance of 640 km?  
**Answer:** gas-engine SUV
3. Based on your observations, how would the CO<sub>2</sub> emissions from a diesel-engine bus compare to those from the diesel-electric hybrid bus?  
**Answer:** The diesel-engine bus would have higher CO<sub>2</sub> emissions.

## Discussion Questions

**What are some possible ways to reduce the CO<sub>2</sub> emissions produced by our day-to-day transportation methods?**

Possible answers

- Purchase low-emissions vehicles
- Use public transportation
- Car pool
- Ride a bike
- Walk
- Stock up on supplies to reduce the number of trips to the store
- Shop at multi-purpose stores to avoid driving from store to store