

UNIT 7 | PEOPLE AND WASTE

CATCHING POLLUTION

METHOD

Students “catch” pollution (particulate matter) on prepared cards to see the environmental and health-related consequences of our transportation habits and then visualize how much carbon is being put into the atmosphere per driver each day.

MATERIALS

Part 1:

- Blank, white index cards
- Vaseline
- Swabs
- Construction paper
- Tape
- Magnifying glasses
- Student Worksheet

Part 2:

- 5 pound bag of charcoal briquettes
- White trash bag
- Hand wipes

INTRODUCTION

Air pollution is the presence of harmful substances in the air. It is comprised of gases and particles that can be harmful in high concentrations. Gas-powered vehicles (cars, trucks, buses) are one of the leading culprits of air pollution. Gasoline is burned in the vehicles’ combustion engines and then waste products come out the exhaust pipes and fill the air. Some of this pollution can be seen when it’s emitted (like from a big rig truck). Other pollution can’t be seen until after the particles have stuck to buildings, roads, and us. Air pollution can create more than just dirt, though. It can be harmful for people and other living things to breathe. In this activity, students will “catch” pollution on sticky cards around the school (inside and outside) to easily see the results of fuel combustion. They will then learn about unseen pollution, specifically carbon that becomes carbon dioxide in the air and acts as a greenhouse gas. Greenhouse gases cause heat to be trapped within the earth’s atmosphere, adding to global climate change.



CONCEPT

Much of our air pollution comes from gas-powered vehicles. The more we drive cars, the more pollution we create. Some of this pollution is visible while some is not.

GRADE LEVEL

Upper elementary

SUBJECTS

Science, Math

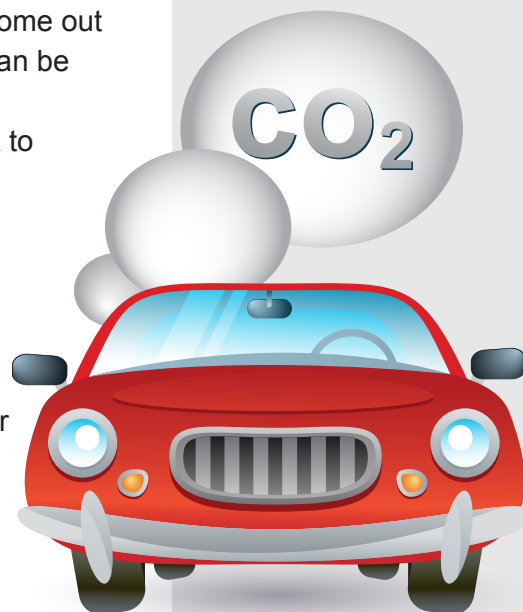
OBJECTIVES

Students will be able to:

- Observe, identify, and list visible and invisible air pollutants around the school and in the community.
- Identify at least three solutions to prevent air pollution.
- Explain the connection between driving and carbon emissions.

SKILLS

Observing, collecting and analyzing data, solving word problems



PART 1: NOW YOU SEE IT . . .

PROCEDURE

Day 1

1. Ask students, “Where do you think man-made pollution comes from?” Write answers on the board.
(*Cars, trucks, motorcycles, power plants, industry, trains, planes, fireplaces, etc.*)
2. Explain that over the next several days they’ll be looking at air pollution, where it comes from, and some different things we can do to reduce air pollution.
3. Darken the classroom and shine a flashlight. Have students observe the particles seen in the light. Explain that they’ll be preparing cards to “catch” visible pollution. Ask them, “Where do you think we could place a card that might show air pollution?” (*Near the bus turnaround, by an open window, near a heating vent.*) “Where would be some places that might not show air pollution?” (*Undisturbed spot in the classroom, principal’s office.*)
4. Divide students into pairs. Provide each pair with an index card, Vaseline, a swab, and a sheet of construction paper. Provide the following instructions:
 - Staple or glue the index card to the center of the construction paper.
 - Write the names of the students in your group above the card.
 - Decide on your sampling location and write that above the card.
 - Write “Experiment in progress. Please do not disturb.” below the card.
 - Swab a thin layer of Vaseline on the index card.
5. Distribute a copy of the Student Worksheet to each pair and ask them to read the questions for Day 1 so that they know what they have to record about their sites.
6. Have students tape their cards in test areas, one card per area, with the Vaseline side facing out.
7. Once all groups have placed their cards, return to class and have pairs complete the questions in the Day 1 section of the Student Worksheet.

Day 3 or 4

8. Air pollution collector cards should remain in the test areas for at least two whole days, but preferably over several days. You may want to have groups check their cards daily and report back to the class on their observations. Any cards placed outdoors should be taken down in rainy weather.
9. Bring cards back to class for comparison. Have students look at their cards under magnification if magnifying glasses or microscopes are available.
10. Observe and rank the cards from the one with the most visible pollutants to the one with the least. You can do this by placing cards side by side on a table.

DISCUSSION QUESTIONS

1. Which card was the dirtiest? The cleanest? Why do you think that's so?

The cards which were posted near high traffic areas are likely to be the dirtiest from the exhaust of cars and other vehicles, especially buses and trucks which burn diesel fuel.

2. Think about the cards you taped to areas where cars go by. What would happen to the card if twice as many cars went by?

The card would be twice as dirty.

3. What sorts of things get dirty as a result of pollution from cars? For living things, how might this affect their health?

Answers will vary but may include: buildings, statues, animals, plants, trees, people, etc.

4. How could we reduce car usage? Is there a way for you to ride your bike or walk to school?

Instead of using cars, walk and ride our bicycles, carpool, take public transportation whenever possible, use more fuel-efficient cars, etc.

5. If the world population continues to grow, how might that affect air pollution?

As the number of people and cars increases, it is likely that the amount of air pollution will increase as well.

PART 2: . . . NOW YOU DON'T (OR DO YOU?)

PROCEDURE

1. Introduce students to the basics of carbon dioxide. Perhaps they are already familiar with this gas if you've studied photosynthesis. Explain to them the presence of carbon dioxide in our air as both a natural and man-made phenomenon.

Not all air pollution can be seen. One of the byproducts of fuel combustion is **carbon dioxide** or CO₂, a colorless, odorless gas. Carbon dioxide is not dangerous by itself. In fact, it's a natural, vital part of our atmosphere as a gas that people and animals breathe out and plants breathe in. In the atmosphere, carbon dioxide functions as a **greenhouse gas**, trapping in the warmth of the sun so that the earth's surface doesn't get too cold at night – just like the glass of a greenhouse traps in the sun's heat to keep the plants warm. Too much carbon dioxide, though, can warm the earth and oceans too much and create problems for our climate and the well-being of plants, animals, and people. Lots of carbon dioxide is released into the air when we burn fuel – wood, oil, gas, and coal – in our homes, cars, factories, and power plants. Over the past 50 years, scientists have measured an increasing amount of carbon dioxide in our atmosphere and have linked this trend to rising global temperatures that are already affecting our ecosystems. It will be critical for the world's people to reduce our man-made emissions of carbon dioxide to prevent this trend from continuing.

2. Ask students if they think carbon dioxide has weight. They will probably think that it doesn't since it is a gas that they can't see. Now ask if any of them have ever seen dry ice (like as a special effect at Halloween). Explain that dry ice is frozen carbon dioxide (a solid). When it melts, it turns into a gas again. Now ask again whether they think carbon dioxide has a weight.
3. Ask students to feel their breath on their hands. It would take them about a day of breathing to exhale enough carbon dioxide to weigh one pound. Tell them that by comparison, the same amount of carbon dioxide is released in less than two minutes by the average car and in just nine seconds to keep one passenger aloft in a commercial jet.
4. Show students the bag of charcoal briquettes and ask them if they know what makes up the briquettes. (*Carbon*) Ask if they know what charcoal briquettes are used for. (*Grilling food in an outdoor grill.*) So, the briquettes act as fuel for the fire you light in your grill and when burned, it gives off carbon dioxide.
5. Explain the following:
 - Charcoal briquettes are made almost entirely of carbon.
 - There are about 100 briquettes in a 5 lb bag.
 - There are just over 5 lbs of carbon in each gallon of gasoline, which combines with O₂ (oxygen) in the atmosphere to produce almost 20 lbs of CO₂.
 - This means that these 100 briquettes are a good visual representation of the approximately 5 lbs of carbon that make up one gallon of gasoline.
 - If a car travels at 25 miles/gallon, it is using about four charcoal briquettes worth of carbon per mile.
6. Lay down the white trash bag on a table. Ask students to help you create a visual of what gets burned and emitted into the air when cars are driven. Select a few students to pile up briquettes onto the table covered with the white trash bag. Have the class solve these simple math problems to determine the amount of briquettes to count out. Provide hand wipes to the students who handled the briquettes.
 - a. If four briquettes represent the amount of carbon released into the atmosphere when driving one mile in a car, how many briquettes represent the carbon emitted in a 10-mile drive? (*40 briquettes*) How about in a 20-mile drive (10-miles each way)? (*80 briquettes*)
Note: Provide your students with a frame of reference in your community so they have an idea of a 10 mile distance (ex. distance from the school to other area landmarks students would know).
 - b. The average driver in the U.S. drives 30 miles each day. How many briquettes of carbon would you need to represent that? (*120 briquettes*) Can you show this with a 5 lb bag of briquettes? (*No, you'd need 20 extra briquettes.*)

Bonus Problem

- c. The average household drives about 20,000 miles each year. If each household could reduce its driving by just 10 percent, how much less carbon would be emitted into the atmosphere per household, in terms of briquettes and bags of briquettes?

By driving 10 percent less, the average household would drive 2,000 fewer miles. Each mile driven = 4 briquettes of carbon emitted for a total of 8,000 briquettes. There are 100 briquettes in each bag for a total of 80 bags. Each bag = 5 lbs for a total of 400 lbs.

7. Lead a discussion with students on ways households could reduce their “carbon footprints” by reducing the amount of carbon dioxide emitted by the driving directly, and by the indirect transportation costs of transporting goods that households use.

MEASURING LEARNING

Review students’ observations of their “Catching Pollution” assignment on their worksheets. To gauge students’ understanding of the linkages between driving and air pollution, have them explain this connection on an exit slip, along with three ways to prevent air pollution.

FOLLOW-UP ACTIVITY

Now that students understand that many CO₂ emissions could be prevented by changing our transportation habits, have them take one of the several online carbon footprint quizzes. These quizzes calculate their annual emissions based on their energy use habits and also show simple ways to reduce their emissions. Here are two to kid-friendly quizzes for them to try: www.footprintnetwork.org and <http://calc.zerofootprint.net/youth>.

Part 1 based on “Studying Air Pollution,” Protect Your Climate, Bay Area Air Quality Management District, San Francisco, CA; Part 2 based on “Seeing CO₂,” Chicago Conservation Corps, City of Chicago, 2008.

CATCHING POLLUTION

STUDENT WORKSHEET

Name: _____

Date: _____

Day 1: Find a place to put your index card with the sticky side facing out. Then answer the following questions.

1. Where did you put your card? _____

2. Are there any nearby sources of air pollution that you can see or that you know about?

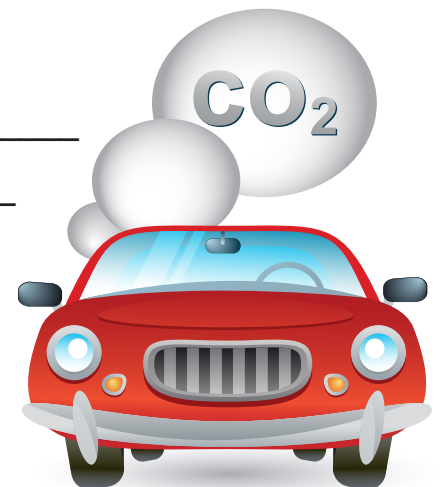
If so, where are they? _____

3. What kinds of air pollution do you think you'll collect? _____

4. What do you think the card will look like after a few days? _____

Day 3 or 4: Collect your card from the location where it was hanging and describe what you observe.

1. Did your card change color? If so, what color is it now? _____



2. What do you see in the Vaseline? List what you see. _____

3. What do you think are the sources of the air pollution? _____

4. Do you think your card would look different at a different time of year?

Why or why not? _____
