Key Messages: Grades 3-5

(Adapted from EPA's Air Now Curriculum)

Breathing dirty air is not good for people. For example: You might feel like it's harder to breathe, you might cough, or your chest might feel tight.

You can help protect your health when the air is dirty. Here are three things you can do.

1. Find out how clean your air is each day.

• You can do this by checking the AQI, just like checking the weather report. The AQI (or the Air Quality Index) uses colors to tell you how clean or dirty the air is. For example, green means the air is clean. Red means the air is unhealthy.

• Check the AQI at www.airnow.gov, download the AirNow App, or sign up for air quality emails at www.airnow.gov/enviroflash. Many local newspapers and television and radio stations also present the AQI.

• Tell your parents about the AQI so they can check how clean or dirty the air is.

2. If you play outside when you know the air is polluted, you can protect your health by taking it a little easier. For example, walk instead of run, take breaks often, or play outside when the air is cleaner.

3. If you notice any signs when you are playing outside like coughing, pain when you take a deep breath, chest tightness, or wheezing, stop playing and tell an adult.

• If you have asthma, pay special attention on polluted days. If you think you or a friend may be having an asthma attack, tell an adult.

Traffic Tally

Learning Objectives

Students will:

- Design and conduct a traffic survey to explore traffic volume on key local roads.
- Collect and analyze observational data.
- Understand the connection between traffic volume, modes of transportation, air pollution, and health.

Grade Level: Grades 3–5

Estimated Time: 1.5–2 hours (2–3 sessions)

Background Summary

Increased traffic is an ongoing problem in many local communities, for several reasons. An increase in traffic often increases accidents, safety problems, traffic jams, and the time it takes to get places. Increased traffic is also a health and environmental concern: more vehicles on the road means more air pollution, since gasoline-powered vehicles release, or emit, several air pollutants (called vehicle emissions). Increased air pollution can cause people to have breathing problems and aggravate heart and lung disease.

Also, driving more, instead of walking or bicycling, means we get less exercise, which can potentially contribute to health problems such as obesity, heart disease, and diabetes. Traffic is an environmental and economic concern for another reason as well: more cars on the road means more gasoline is used to run those cars. Gasoline is made from oil, of which there is a limited amount in the world.

This activity is a mini-field trip (that you can do from a window or your own back yard!) that provides students with hands-on experience in conducting a traffic survey in their own community, analyzing their data, and exploring the connection between traffic and air pollution. If time permits, students can create presentations of their data.

Next Generation Science Standards

Energy
Interdependent Relationships in Ecosystems
Engineering Design

Materials Needed

- Pencils and erasers
- Watches with minute/second hands, stopwatches, or clicker counters

• Clipboards (if available)

• Student Worksheets (included)

• Additional staff support (classroom assistants or parent volunteers)

• Signed parental consent forms (if taking students off school premises)

Key Questions

• Do you think there is too much traffic along the main (2-lane) roads in your community? If so, how many vehicles do you think travel along these roads during morning rush-hour traffic? How many people do you think are typically in each vehicle?

• How might the amount of traffic be reduced? (*Possible answers:* People could walk, bicycle, carpool, and take subways, trains, and buses more often.)

• How might the amount of air pollution from traffic be reduced? (*Possible answers:* Having fewer vehicles on the road; more people walking, bicycling, carpooling, and taking subways, trains, and buses; driving low-emission vehicles.)

• What might some of the benefits be of reducing traffic and air pollution from vehicles? (*Possible answers:* Fewer traffic jams; safer streets to walk and bike on; fewer health problems from air pollution, such as breathing problems [e.g., asthma], and heart disease, and possibly healthier people because more people might be walking and get-ting exercise.)

• What things might affect the accuracy of a traffic survey's results? (*Possible answers:* If on the day of the survey there was bad weather or the day was a holiday, the amount of traffic would not represent the usual traffic. Also, the traffic survey results would not be as accurate if:

(1) different groups started counting traffic at different times;

(2) some people missed counting some vehicles;

(3) some people put some vehicles into the wrong categories;

(4) some people "double-counted" some of the vehicles.)

• What vehicles produce the most pollution per person? *(Possible answer:* Cars and trucks with just one person in them.) What vehicles produce the least pollution per person? (*Possible answer:* Bicycles. OR buses & trains that carry a lot of people.)

Vocabulary

Tally—Counting using marks rather than names or numbers.

Emissions—Substances discharged into the air. Releases of pollutants from a variety of sources and activities, including vehicles, factories, power plants that make electricity, and wood-burning stoves and fireplaces, among others.

Steps

1. **Preparation**.

• Make important arrangements, such as obtaining parental permission slips to go to off-school premises, and getting commitments from adult classroom assistants and/or parent volunteers to accompany the class groups.

(Note: If going offsite is problematic, you can instead conduct the traffic survey on school premises, near the driveway to the school, on your front porch/driveway, or even a window at home.)

• Choose the roads on which the class will survey traffic volume and vehicle types. Choose a minimum of two roads, for comparison purposes. Choose roads that are within easy walking distance of the school and are busy two-lane (one travel lane each direction) roadways. Select a time of day when the roads have moderately busy traffic, such as morning rush hour.

The number of roads chosen will depend on how many groups you want to divide the class into (which in turn will depend in part on how many adult assistants/volunteers you have, and the size of your class). (Note: The class will not be surveying major four-lane or larger highways; the purpose is to determine local/community traffic impacts.)

• Give students an overview of the traffic survey. Inform students that the class will conduct a traffic survey to explore traffic volume on key local roads, and the connection between vehicle traffic and air pollution. Discuss the "Key Questions" above with the class if you have not already done so. Tell the class that they will divide up into groups of at least 8 students(if possible to coordinate with neighbors) per group, and will stand safely by the sides of different busy roads. For a fifteen-minute period (e.g., during morning rush hour), some students will count the number of vehicles driving by, while other students will identify the type of each vehicle (e.g., car, truck, etc.), or the number of people in each vehicle.

• Explain a tally chart. Tell students that to conduct the survey, they will make tally charts that keep track of the number and types of vehicles and the number of people in each vehicle, and that the class is first going to practice making these charts. On the chalkboard, illustrate tally marks.

2. Practice a traffic tally in class. Tell students to use the back of their Student Worksheets to practice recording the number and types of vehicles that you will be calling out to them. For simplicity, tell students to consider SUVs and vans as "trucks" and to ignore motorcycles. Then call out the names of the vehicle types listed below; do it quickly to

simulate rapid traffic flow so that students can practice performing quick tallies, which they will need to do by the roadside.

Car	Car	Car	Truck	Bicycle
Truck	Car	Truck	Car	Truck
Car	Car	Truck	Bus	Truck
Bicycle	Car	Car	Car	Car
Car	Car	Bicycle	Truck	Car
Car	Car	Bicycle	Truck	Car
Truck	Car	Car	Car	Truck
Car	Car	Bicycle	Truck	Truck
Car	Car	Car	Car	Truck
Truck	Bus	Bus	Car	Car
Car	Truck	Car	Bicycle	Truck
Car	Car	Car	Car	Truck
Bus	Car	Truck	Bicycle	Car
Car	Car	Car	Car	Car

Tell students to swap tally sheets and check for correct answers for each type of vehicle as you read aloud the totals listed below:

Totals: Bicycle = 7, Car = 41, Truck = 18, Bus = 4

3. Explain to students that they will conduct the traffic survey in four pairs. The first and second pairs will focus on the number and types of vehicles; the third and fourth pairs will focus on the number of people in each type of vehicle:

- **1st Pair:** One person will call out loud to their partner the type of the vehicle (e.g., "car," "truck") each time a vehicle passes in *one direction* (one side of the street), while the other partner will record the data on Student Worksheet #1.
- **2nd Pair:** One person will count vehicles passing in *the other direction* (on the other side of the street), while the other partner records the data (as described in "1st Pair" above).
- **3rd Pair:** One person will call out the number of people in each vehicle in *one direction* and identify the type of vehicle, while the other partner will record the number of persons per vehicle and the vehicle type. Tell students that it may be difficult to identify the number of people, and to do the best they can. For buses, have the students discuss and agree on an estimate of the number of people they will use (e.g., average of 15 people per bus) and make sure all students are using the same number.
- **4th Pair:** One person will call out the number of people in each vehicle in *the other direction* and the vehicle type, while the other partner will record the number of persons per vehicle and the type of vehicle. Again, tell students that it may be difficult to identify the number of people, and to do the best they can. For buses, use the same estimated average number of people as discussed in "3rd Pair" above, and make sure all students are using the same number.

4. Explain ways that conducting the survey can help make it more accurate. That is, it is important for each group and each pair of students to do things exactly the same way. For example, each group must start the survey at the same time, and each group must conduct the survey for exactly 15 minutes—not longer and not shorter.

5. Assign the students to survey groups, and assign an adult assistant to each group. Have students in each group divide up into pairs; help them decide who will be an "announcer" (calling out the type of each vehicle that passes, or the number of people in each vehicle) and who will be the "recorder" in each pair. Assign one person (e.g., the adult assistant) to be the timekeeper, who will tell students when to begin and end the survey and record the exact starting and ending times.

6. Conduct the traffic survey at the designated locations, using Student Worksheet #1. If possible, have students stand in locations where they do not have to cross any streets. Be sure to remind students to practice safety: stand back from the roadway; if crossing a street is necessary, do so carefully when the adult assistant says it is safe to do so. Make sure students are standing in such a way that allows other pedestrians to pass easily, and that they are polite to people. Have adult assistants help students as needed as they count vehicles and people in them.

7. After the survey has been conducted, in class (on the same day or another day), have the student groups compile their survey results, and discuss and analyze the results as a class.

- **Calculate totals**. Back in the classroom, in the top half of Student Worksheet #2, have each group add up the totals for their group, including the total number of each type of vehicle and the grand total number of vehicles. Ask a spokesperson from each group to read aloud the totals for their group, write these on the chalkboard, and add up the totals for the entire class.

- **Calculate data for different vehicle types**. Of the total traffic, have the class calculate the portion of each vehicle type (e.g., cars, trucks, buses, bicycles). For younger students, this might be calculated as fractions. For older students, this might be calculated as fractions and percentages.

- **Discuss results thus far**. Which roadway had the most traffic? Why does the class think this is so? Compare and contrast the numbers of different types of vehicles for each group.

8. Explain the Air Pollution Values table on Student Worksheet #2 to the class. Tell students that you have assigned an "air pollution value" number to each type of vehicle. The number is an estimate of the degree of air pollution each type of vehicle releases for every person it carries, compared to the other vehicle types—the higher the number, the more air pollution. On Student Worksheet #2, in the Air Pollution Values table, tell students to look at the numbers in the "Air Pollution Value Per Person" column.

Explain the rationale behind these numbers: Trucks with one or two people in them release the most pollution per person, so they are assigned the highest pollution value of "10." Cars with one or two people in them release the next most pollution per person, so they are assigned the next highest pollution value of "9." Cars and trucks with three or more people can be considered carpools (sharing rides) for this exercise; because more people are in the vehicle, it releases less air pollution per person, and is assigned a lower value

of "3"—about one-third the pollution values of 9 or 10. (This is because a vehicle with three people in it would release about one-third of the pollution compared to three separate vehicles each carrying one person in it). Because buses can carry many more people than cars and trucks, the pollution value per person for buses is much lower ("0.2") than for cars and trucks. Bicycles don't release any air pollution, so their air pollution value is "0".

9. Tell students to fill in the "Total Number of People" column in the Air Pollution Values table in Student Worksheet #2. Ask students if they know where to get this information. If no one offers the correct answer, tell students they recorded this information on the bottom of Student Worksheet #1 during the traffic survey, in the "Number of People in Each Vehicle" box. Assist students as needed in adding up the data in Student Worksheet #1 and transferring it to the Total Number of People column of the Air Pollution Values table in Student Worksheet #2 (e.g., placing the numbers in the correct "Vehicle Type" rows in the table).

10. Next, demonstrate on the board how to calculate numbers for the "Estimated Air Pollution Value" column in the Air Pollution Value table. For one of the vehicle types listed, ask a student to give you his or her answer for the "Total Number of People" for that vehicle type. Multiply the total number of people for that type of vehicle by the "Pollution Value Per Person" number assigned to that vehicle type. Have students enter this answer in the "Estimated Air Pollution Value" column of the table. Have students work in groups to calculate the Estimated Air Pollution Value for the other vehicle type categories and record these numbers in the Air Pollution Values column in the table.

11. Discuss the results of the Air Pollution Values table. Which vehicle type had the highest air pollution value? Which vehicle type had the lowest air pollution value? Discuss the results for the other categories, and compare the numbers for all five vehicle types. If no buses were identified in the traffic survey, provide a hypothetical scenario for comparison purposes (e.g., two buses, each with 15 people in them, would result in an Estimated Air Pollution Value of 6: Total Number of People [30] x Air Pollution Value Per Person [0.2] = Estimated Air Pollution Value [6]).

12. Discuss the relationship between traffic volume, air pollution, and health.

Ask: If the number of vehicles on the road were reduced, might this reduce air pollution? (*Correct answer:* Yes). Why? (*Correct answer:* Because gas-powered vehicles release air pollutants, and fewer vehicles would mean less pollution.)

Ask: How might the number of vehicles on the road be reduced? (*Correct answers:* Carpooling and using public transportation [buses, trains, subways] would reduce the number of vehicles on the road, which would reduce air pollution. Walking and bicycling would also reduce air pollution. You can also mention that new laws requiring vehicles to release fewer emissions would also help vehicles reduce the amount of air pollution.

Ask: What are some benefits from reducing air pollution? (*Correct answer:* Less breathing problems and fewer asthma attacks and heart problems. People might also be healthier because they might get more exercise by walking or bicycling instead of driving. Also, trees and plants would be healthier if there was less air pollution.

13. Discuss the accuracy of the traffic survey methodology and results. Identify any potential problems regarding the data collection methods: Did one group collect data for 20 minutes instead of 15? Did some people miss counting some vehicles (e.g., because they weren't paying attention, because they sneezed, etc.)? Did some people "double-count" one or more vehicles? Could students really see the number of passengers inside vehicles? Did some people put certain types of vehicles in the wrong categories (e.g., did they remember to count SUVs and vans as trucks)? Did one group start earlier or later than another group? Did the weather suddenly change during the tally? Inform the class that any of these or other factors can affect the accuracy of the survey results. Ask the class if they have any ideas about how the survey could have been done more accurately. (Then tell students they did a great job, given the many things that can affect the accuracy of survey results.)

14. If time permits, have students create a presentation of the traffic survey and air pollution results. Depending on time available, either assign how the class should present the data, or, if more time is available, have the class discuss different ways of presenting the data and determine the best way to present the information (e.g., line graph, pie chart, pictogram, and/or bar graph). If time permits, you may want to have different groups present their data results in different ways.

Building on prior classroom experience with different graphic presentation formats, explain to the class how to develop the type of presentation format you choose. Decide what units, scales, colors, symbols, spacing, etc. to use, as appropriate. If computers are available, consider having students use the Internet or relevant software to create charts or graphs.

Discuss which type(s) of chart or graph conveys the information most effectively and why.

Adaptation

For Grades K-2, conduct the traffic survey as a whole class instead of dividing up into groups (with enough adult classroom assistants). Have the teacher and adult assistants, rather than the students, count the number of vehicles and people in the vehicles. Back in class, the teacher can call out the totals for the students to record. The teacher can calculate the estimated air pollution values and tell students that the higher the number, the more air pollution that type of vehicle produces. For presentation purposes, help the students develop pictograms and/or pie charts (instead of more complex bar graphs, etc.).

For Further Exploration

• Have students explore the mean and range of the different groups' data sets and of the grand totals.

• Have students develop a database, computerized if possible, of the data collected.

• Share data in the name of citizen science with RideWise on social media.

• Conduct an in-class simulation instead of, or in addition to, a traffic survey field trip. See the Traffic Jams lesson at Web site: www.cleanaircampaign.org/Your-Schools/Resourc-

es/Air-Quality-Lesson-Plans/Elementary-School. (Step 7 of the Traffic Jams lesson on pollution values was adapted and incorporated into this Traffic Tally lesson).

Acknowledgments/Resources

UK Department of Transport Primary School Teaching Resource – Numeracy: Local Traffic Survey.

The Beacon School Interactive Website—Geography Department at: www.geogweb.com

Traffic Jams. The Clean Air Campaign, Georgia Learning Connections at: http://www.cleanaircampaign.org/Your-Schools/Resources/Air-Quality-Lesson-Plans/Elementary-School

Walking for Health and the Environment Curriculum. WalkBoston and ERG at: http://walkboston.org/resources/maps

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Student Worksheet #1: Tally Sheet for Traffic Survey

Location (name of road, and main intersection if appropriate):

_____

_____

Number of Each Vehicle Type

Type	Tally	Totals
Cars		
Trucks		
Buses		
Bicycles		

Number of People in Each Vehicle (keep separate results for each individual vehicle)

Cars	Trucks	Bicycles	Buses (estimate)

Student Worksheet #2: Survey Results and Air Pollution Values

Location (name of road, and main intersection if appropriate):

_____

_____

Using your results in Student Worksheet #1, fill out the following information in the classroom after conducting the survey:

Total number of cars: _____

Total number of trucks: _____

Total number of buses: _____

Total number of bicycles: _____

Total number of all types of vehicles: _____

After your teacher discusses the Air Pollution Values table below with the class, complete the table.

Air Pollution Values

Vehicle Type	Total Number of People	Air Pollution Value Per Person	Estimated Air Pollution Value
Trucks with 1 or 2 people		10	
Cars with 1 or 2 people		9	
Cars and Trucks with 3 or more people (Carpool)		3	
Bus		0.2	
Bicycle		0	

If your teacher instructs you to do so, present your survey results (as a line graph, pie chart, bar graph, and/or pictogram, as your teacher tells you).