



A PROGRAM OF GEORGIA COMMUTE OPTIONS

Air Pollution 101

Georgia Commute Schools 9th - 10th Lesson Plan

Lesson Background

Grades: 9th-10th

Length of Lesson: Three class periods, each approximately 45 minutes

Materials:

- ➔ Clear plastic cups or recycled glass jars – one per student.
- ➔ Liquid food coloring – one set for each group/table/student. For this lesson, we used red, green, yellow, and blue.
- ➔ Ground charcoal (from pet store, or ground substance that will not dissolve in water, e.g. coffee grounds)
- ➔ Cocoa mix and
- ➔ Lemonade drink mix
- ➔ Clean water
- ➔ Large container (to hold all of students' water once they have completed the demonstration)

Student Handouts:

- ➔ Handout 1: Air Pollution Worksheet
- ➔ Handout 2: Georgia Air Quality Trends 2010-2022
- ➔ Handout 3: Georgia Asthma Data Analysis

Throughout this document, you will see items highlighted in various colors to indicate alignment to specific standards. Each color corresponds to a different framework component—**Disciplinary Core Ideas (DCIs)**, **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, or **Georgia Health Standards**. Highlighted text may appear in directions, prompts, or other instructional text to help quickly identify where these standards connections occur throughout the lesson.



EDUCATION STANDARDS

Anchoring Phenomenon

Local air pollution

Georgia Standards of Excellence

[SEV2:](#) Obtain, evaluate, and communicate information to construct explanations of stability and change in Earth's ecosystems.

[SEV4:](#) Obtain, evaluate, and communicate information to analyze human impact on natural resources.

[SEC5:](#) Obtain, evaluate, and communicate information on the impact of natural and anthropogenic activities on ecological systems.

[SM5:](#) Obtain, evaluate, and communicate information about climate and climate change.

[Performance Expectation: HS-LS2-7](#)

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Next Generation Science Standards

Science and Engineering Practices (SEPs): Constructing Explanations and Designing Solutions

Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

[Appendix F Science and Engineering Practices in the NGSS, page 11](#)

Disciplinary Core Ideas (DCIs): LS2.C Ecosystem Dynamics, Functioning, and Resilience

Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem.

[Appendix E - Progressions within the Next Generation Science Standards, page 5](#)

Crosscutting Concepts (CCCs): Stability and Change

Much of science deals with constructing explanations of how things change and how they remain stable.

[Appendix G - Crosscutting Concepts, pages 10 & 17](#)



Reading & Writing Skills	<p>Reading Skills:</p> <ul style="list-style-type: none">➔ Cite textual and graphical evidence from data tables, air quality maps, and research sources.➔ Analyze arguments and claims in scientific media.➔ Compare multiple data representations—such as pollutant trends, asthma rates, and regional maps—to identify cause-and-effect patterns.➔ Synthesize information from local and national datasets to evaluate human impacts on air quality. <p>Writing Skills:</p> <ul style="list-style-type: none">➔ Construct evidence-based explanations linking human activities to environmental change.➔ Compose brief analytical summaries interpreting graphs and identifying pollutant trends.➔ Develop a short public health or policy proposal with claims supported by quantitative and qualitative data.➔ Reflect in writing on ethical and community-level tradeoffs involved in environmental decisions.
Health and Physical Education Standards	<p>HEHS.5.d: Describe evidence-based choices to health-related issues or problems.</p> <p>HEHS.5.e: Analyze the potential short-term and long-term impact of each decision on self and others.</p> <p>HEHS.5.f: Explain how decisions can negatively and positively impact personal health and well-being.</p> <p>HEHS.5.g: Compare and contrast the short- and long-term outcomes of health-related decisions.</p>

Big Idea: Basics of Air Pollution

Overview

Students will gain background knowledge of the basic sources of air pollution, along with an overview of how air pollution affects our health, our environment, and our economy. They will then participate in a hands-on demonstration to understand visually that everyone has an impact on air pollution. Students will also complete a worksheet detailing a description of each pollutant, as well as listing three interesting facts about each pollutant.

Vocabulary

The vocabulary section of a lesson plan provides key terms and definitions that support student comprehension and engagement with the lesson content. Teachers can reference this section to introduce new words during instruction, reinforce understanding through activities, or provide background information to support differentiated learning.

- ➔ **US Environmental Protection Agency (EPA):** An agency of the federal government tasked with protecting human health and the environment by researching pollutants, monitoring pollutant levels, developing permits, and enforcing environmental protection laws.
- ➔ **Criteria Air Pollutants:** The Environmental Protection Agency (EPA) monitors six common air pollutants known as “criteria air pollutants.” The criteria air pollutants are particulate matter, ground level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.
- ➔ **Sulfur Dioxide (SO₂):** Chemical compound released by the burning of fossil fuels by power plants and other industrial facilities. Harmful to human respiratory health and can contribute to acid rain. One of the six criteria air pollutants.
- ➔ **Nitrogen Dioxide (NO₂):** Chemical compound released by burning fuel from cars, trucks, and power plants. Harmful to human respiratory health and can contribute to acid rain. One of the six criteria air pollutants.
- ➔ **Carbon Monoxide (CO):** Chemical compound released by burning fossil fuels, mainly by cars and trucks. Harmful to human health by reducing the amount of oxygen that can be transported in the blood stream. One of the six criteria air pollutants.
- ➔ **Lead (Pb):** Chemical released by ore and metal processing plants, airplanes using leaded aviation fuel, and waste incinerators. High exposure of lead can adversely affect the human nervous system, immune system, and cardiovascular system. One of the six criteria air pollutants.
- ➔ **Particulate Matter (PM_{2.5} or PM₁₀):** A mixture of solid particles and liquid droplets found in the air, which can be found in diameters of either 2.5 or 10 micrometers. Emitted from construction sites, smokestacks, fires, or from chemical reactions of chemicals such as SO₂ or NO₂. Harmful to human respiratory health. One of the six criteria air pollutants.
- ➔ **Ground-Level Ozone (O₃):** Chemical compound created when pollutants released by cars, powerplants, and chemical plants (oxides of Nitrogen and VOCs) react in the presence of sunlight. It is the main ingredient in “smog” and can harm human respiratory health. One of the six criteria air pollutants. Ozone occurs naturally in the upper atmosphere, where it is beneficial for humans by forming a protective layer that shields us from the sun’s harmful ultraviolet rays.
- ➔ **Volatile Organic Compounds (VOCs):** Emitted gases from human-made chemicals used in paints, cleaning supplies, pesticide, and building materials. The variety of chemicals in VOCs may have short- and long-term health effects. VOCs are not a criteria air pollutant but included in this lesson.
- ➔ **National Ambient Air Quality Standards (NAAQS):** Limits set by the EPA for how many of the six criteria air pollutants can be released to protect public health and the environment.

Engage: Air Pollution 101 Introduction (20 minutes)

1. Tell students that the issue of air quality – how good or bad the air is – during the May to Sept. months are often in the GA news. Play the video “Atlanta air quality receives failing grade.”



Video hyperlink: <https://www.youtube.com/watch?v=v4tLH-BuqCA>

Video length: 2 minutes and 05 seconds



LIVED EXPERIENCES

Connect to students' lived experiences by facilitating conversation as a class about air quality indicators in your local community. **Ask students to compare how local air quality compares to the air quality in Atlanta (as shown in the video).** Consider using the following prompts:

- How would you describe the air quality in your community? What do you notice about the air when you're outside compared to when you've visited or heard about Atlanta?
- In what ways does air quality affect your daily life (walking, biking, sports, or just being outdoors)? How might that be different for someone living in a big city like Atlanta?
- What kinds of transportation do you see most often in your area (cars, buses, trucks, etc.)? How might that be similar to or different from Atlanta, and how could it change air quality?
- Have you or someone you know experienced asthma, allergies, or breathing problems? How might those experiences be influenced by air quality where you live compared to Atlanta?

2. Write the words Air Quality on the board and ask students the following questions:

- Do you think the quality of the air in your area is good or bad? How do you know? What evidence is there of air pollution?
 - » Answer: Answers will vary. Some students will have noticed while others probably have not. Evidence of air pollution may include smog, EPA Air Quality Index warnings, etc.



- ➔ Have you ever experienced burning eyes, an itchy throat, or shortness of breath on polluted days?
 - » *Answer: Answers will vary depending on whether students live in or go to school in areas with higher levels of air pollution.*
- ➔ What time of the year does the air seem dirtiest?
 - » *Answer: Typically, the air will seem the dirtiest during the summer (May-Sept.) because air pollution is highest in the summer. Hotter temperatures and increased sunlight speed up the chemical processes associated with producing ground-level ozone which increases the likelihood of smog.*

3. Ask students why there is so much talk about air quality.

- ➔ *Answer: Poor air quality is extremely bad for our health. As the video discussed, poor air quality can be particularly bad for people who are active outside during the summer, as people who are physically active outside are potentially ingesting as much as 5 times more air pollution than those just sitting outside.*



HEALTH AND PHYSICAL EDUCATION CONNECTION

This would be an excellent opportunity to have students discuss the prevalence of air quality across the country due to wildfires and natural sources of pollution that have been in the news and on social media platforms. Consider using the example of the BioLab, Inc. chemical fire in Rockdale County, GA in 2024. You can find information at the following link: <https://gema.georgia.gov/rockdale-county-biolab-fire-1>. **Ask students to describe what evidence they are familiar with that relates to the connection between health issues and air quality in various communities across the country and compare them to their local community or areas in and around Georgia.**

4. Guide students to identify the importance of air for living things. **Ask students why having clean air is important to living organisms and how poor air quality can impact health outcomes in people. Extend the conversation to emphasize how air pollution also disrupts ecosystems, affecting plants, animals, and long-term ecosystem resilience.**
- ➔ *Answer: All living organisms need air to breathe. Air pollutants can lead to a host of human health issues, including the development of respiratory, cardiac, and cancer issues. Such issues include emphysema, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, increased risk of stroke and heart attack, and increased risk of breast and lung cancers.*
5. Provide information and write on the board the six pollutants they will be exploring. Explain that we also sometimes include Volatile Organic Compounds (VOCs) as a pollutant. Show the students the slide that lists them.



Air Pollutant
Sulfur Dioxide (SO ₂)
Nitrogen Dioxide (NO ₂)
Carbon Monoxide (CO)
Lead (Pb)
Particulate Matter (PM _{2.5} or PM ₁₀)
Ozone (O ₃)
Volatile Organic Compounds (VOCs)

6. Facilitate conversation about how our everyday activities contribute to air pollution. Write the following on the board: Getting Around, Energy Use, Small Choices. **With an elbow partner, ask students to discuss how their choices related to these categories might impact air pollution.** Listen for choosing to ride a bike vs. taking a car, not using air conditioning, recycling, etc. **Bring students to the conclusion that we are often unaware of how our everyday activities contribute to air pollution.**



STUDENT SUPPORT

Encouraging Student Conversation

For students who need support engaging in conversation with their peers, consider asking questions about each of the topic areas directly. Here are some example prompts to use:

- ➔ How might walking, biking, riding the bus, or driving impact the air we all breathe?
- ➔ What's one way you or your family use energy every day (like heating, cooling, or electronics)? How could that connect to air pollution?
- ➔ What's a small choice you make daily (like idling in the car, recycling, or turning off lights) that might make air cleaner—or dirtier—for your community?

Provide students with sentence starters so they can engage in conversation with a partner:

- ➔ "When I ____, it might cause more pollution because ____."
- ➔ "A choice we make about energy is _____. This affects air quality by ____."
- ➔ "One small choice that helps/hurts air quality is ____ because ____."

Explore: Personal Air Pollution Demonstration (25 minutes)

- Divide your class into small groups. Give each student a clear plastic cup or jar that is $\frac{3}{4}$ full of clean water. Give each group a set of supplies (food coloring, ground charcoal, cocoa mix, and drink mix).
- Write on the board the corresponding food coloring or drink mix (below) and explain to the students that these colors/mixes will illustrate a particular pollutant that was discussed. Show the slide that lists them.

Air Pollutant	Corresponding Color/Mix
Sulfur Dioxide (SO₂)	Pinch of lemonade mix
Nitrogen Dioxide (NO₂)	Pinch of cocoa drink mix
Carbon Monoxide (CO)	One drop of red food coloring
Lead (Pb)	One drop of green food coloring
Particulate Matter (PM_{2.5} or PM₁₀)	Pinch of ground charcoal
Ozone (O₃)	One drop of yellow food coloring
Volatile Organic Compounds (VOCs)	One drop of blue food coloring

- Tell the students that a series of “activities” will be read. If the student has participated in the “activity” within the past week, they are to add one drop/pinch of the corresponding pollutant into their cup of water. All activities will not apply to every student (for example, applying nail polish or mowing the lawn).



STUDENT SUPPORT

Using a Model

Explain that this cup is functioning as a model, helping us visualize how everyday actions contribute to cumulative air pollution. One of the goals of using models is to help scientists represent and study systems that are too large, small, or invisible to observe directly. **Give students time to think about how this activity serves as a model demonstrating air pollution.**

Here are the activities to read to students. Feel free to add or remove activities as they relate to the school or community.

A. You drove or were a passenger in a car/truck.

- 1 drop of red coloring represents Carbon Monoxide (CO) in motor vehicle exhaust.
- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) produced by the engine when gasoline or oil is burned.
- 1 pinch of lemonade mix represents Sulfur Dioxide (SO₂) in auto exhaust.
- 1 pinch of cocoa represents Nitrogen Dioxide (NO₂) from vehicle exhaust.

**B. You enjoyed heat, air conditioning, or a warm shower.**

- 1 drop of green food coloring represents Lead (Pb) in electricity generation.
- 1 pinch lemonade mix represents Sulfur Dioxide (SO₂) released from electric utilities.
- 1 pinch of cocoa represents Nitrogen Dioxide (NO₂) emitted by combustions used to generate electricity and heat water.

C. You got ready for school or work and used nail polish or hairspray.

- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) in indoor air.

D. You used your computer, tablet, mobile phone, video game console.

- 1 pinch of ground charcoal represents Particulate Matter (PM_{2.5} or PM₁₀) resulting from power plants burning coal to produce electricity.
- 1 drop of green food coloring represents Lead (Pb) as a station source providing utilities.
- 1 pinch of lemonade mix represents Sulfur Dioxide (SO₂) from burning fossil fuels to create electricity.

E. You or your family burned firewood or yard debris.

- 1 drop of red coloring represents the Carbon Monoxide (CO) in wood burning.
- 1 pinch of ground charcoal represents Particulate Matter (PM_{2.5} or PM₁₀) in the burning, leaving ash and soot.

F. You or your family used paint or some type of solvent, like nail polish remover or cleaning supplies.

- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) when chemicals evaporate.
- 1 drop of yellow food coloring represents Ozone (O₃) evaporation.

G. You travel down a dirt or gravel road.

- 1 pinch of ground charcoal represents Particulate Matter (PM_{2.5} or PM₁₀) from dust.

H. You or your family used gasoline-powered equipment to mow the lawn, blow yard clippings, or whack the weeds.

- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) in exhaust and gas vapors.
- 1 pinch of lemonade mix represents Sulfur Dioxide (SO₂) emitted by the equipment's engine.
- 1 pinch of cocoa represents Nitrogen Dioxide (NO₂) in exhaust from burning fuel.
- 1 drop of yellow food coloring represents Ozone (O₃) from fuel combustions and evaporation.

I. You or your family purchased gasoline at the gas station.

- 1 drop of yellow food coloring represents Ozone (O₃) from evaporation while filling the tank (mostly occurs on hot, sunny days).



- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) when chemicals evaporate.

J. You put on your favorite shirt, which your parents had dry-cleaned for you.

- 1 drop of blue food coloring represents Volatile Organic Compounds (VOCs) emitted by the dry-cleaning process.

K. A car was idling outside of your home for almost 10 minutes.

- 1 drop of red coloring represents Carbon Monoxide (CO) from vehicle exhaust.
- 1 pinch of lemonade mix represents Sulfur Dioxide (SO₂) gas from industrial emissions.
- 1 pinch of cocoa represents traces of Nitrogen Dioxide (NO₂) from traffic pollution.

L. You used office equipment such as a printer or copier.

- 1 drop of blue food coloring represents the Volatile Organic Compounds (VOCs) released when equipment is used.



LIVED EXPERIENCES

Consider taking the activities above and modifying them to represent more localized activities in your community.

Remind students that the way we live our daily lives can add “invisible pollutants” to the air and environment around us. Riding in a car, mowing the lawn, or even using certain household products all give off small amounts of pollution. Ask students to think about their own week:

- What activities did you do that might have added pollutants to the air?
- How often do those activities happen in your family or community?
- Do people in different places (cities, suburbs, rural areas) have the same kinds of pollution sources, or are they different?

10. At the end of the activity, ask all students to put their cups together in the center of their group. Give them time to compare them to one another and make general observations about their appearance. Allow students to engage in conversation about their results using the following prompts:

- How does your cup look compared to your partner's?
- What might explain the differences in how many “pollutants” you added?
- **Which human activities are causing the changes in your cup? What effects did you see?**
- **How might the activities in your cup connect to air quality in your neighborhood or town?**
- If this cup represented the air we breathe, what health effects might result from the pollutants inside?
- **What's one small change you or your community could make to reduce the “pollutants” in the cup if we did this again next week?**



Explain: Researching Pollutants (30 minutes)

11. Divide the students into seven groups. Assign each group one of the six pollutants, plus a group for VOCs.
12. Have each group research their pollutant, using the following websites. Have the groups research what causes their pollutant to be produced and the effects of their air pollutant on human health and the environment.
Air Topics - US EPA: <https://www.epa.gov/environmental-topics/air-topics>
Air Pollution: <https://scied.ucar.edu/learning-zone/air-quality/air-pollution>
Learn About Air Pollution: <https://epd.georgia.gov/outreach/outreach-educational-programs/learn-about-air-pollution>
Air Quality, Energy, and Health - WHO: <https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants>
13. **Ask each group to report out and share their findings to the class.** In their report out of their findings, they should provide a description of the pollutant and include at least 3 facts about it.
14. While each group shares their findings, have the rest of the class take notes using Student Handout 1: Air Pollution Worksheet.

Elaborate: Discussion and Data Analysis (25 minutes)

15. Ask your students the following questions:
 - ➔ Look inside your cups. If the air pollution around you were this apparent, would you want to breathe the air?
 - » *Answer: Definitely not!*
 - ➔ What other sources of air pollution, beyond those mentioned in this demonstration, could you think of as being produced in a single day?
 - » *Possible Answers: Keeping the lights on in the house when not using them; turning on the air conditioner or heat in a home/apartment; dust from construction, demolition, and agricultural activities; and factory emissions.*
16. Pour each student's "polluted water" into the larger container and explain how this represents some of what people breathe every day. Of course, much is diluted in the huge volume of the atmosphere, but it is getting more concentrated daily with more people increasing their activities, which contributes to air pollution.
 - ➔ What could you do to reduce the number of pollutants released each day? Help students come up with a list of things they can do to reduce their impacts.
 - » *Possible Answers: Drive less; use different modes of travel (bike, walk, etc.); buy smart (energy efficient and better quality for longer use); save energy; and reduce, reuse, recycle.*



17. Give students **Student Handout 2: Georgia Air Quality Trends 2010-2022**. **Invite students to observe and discuss each of the graphs and how pollutant levels have changed over time.**



STUDENT SUPPORT

Formative Assessment Opportunity

As a potential formative assessment opportunity, have students write down their initial observations and prompt responses indicating how pollutant levels have changed over time and the relationship of these trends to activity habits. Collect these responses or have students share in a whole-class discussion to assess student understandings.

18. Ask students what they think has helped reduce these emissions so much since 1990. Use the following prompts to facilitate whole-class discussion about the local and regional trends:
- Thinking about your activity cup, what kinds of habits might help drive those kinds of improvements?
 - Even though overall air quality is improving, Atlanta still has some of the worst air pollution days in the state. Why do you think that is?
 - Do you see a connection between what we pour into our ‘pollutant cups’ and the air quality trends in Georgia or in cities like Atlanta?”



LIVED EXPERIENCES

Prompt students to compare activities from their “pollutant cups” (like driving or lawn mowing) with broader state-level reductions. Ask students if our individual habits are part of this bigger change. Why or why not?

Air quality data isn’t just numbers on a chart—it affects real people every day. In Georgia, some communities experience more unhealthy air days than others, especially in bigger cities like Atlanta. Students can think about their own experiences:

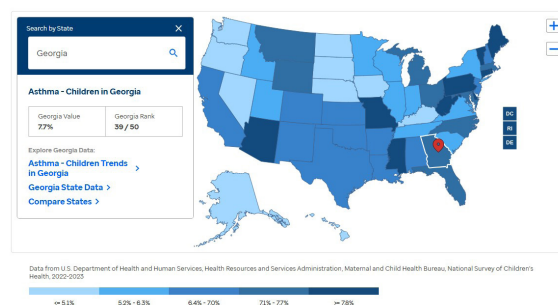
- Have you ever noticed hazy skies or smog alerts?
- Do people in your community talk about air quality on hot summer days?
- Have you or someone you know had breathing trouble (like asthma) that feels worse during certain times of year?

Looking at the state-level data, students can compare whether their lived experiences match the trends.

19. Have students examine the Asthma - Children by State map from the **Student Handout 3: Georgia Asthma Data Analysis** and identify at least two noticeable patterns or trends.

Asthma - Children by State

Percentage of children ages 0-17 who currently have asthma (2-year estimate)



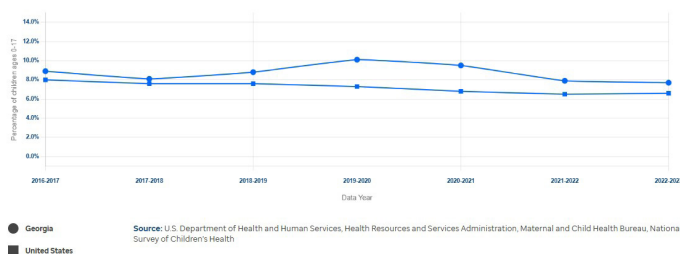
Source: https://www.americashealthrankings.org/explore/measures/asthma_overall/GA

After a brief peer discussion, students should write a short paragraph summarizing the patterns they observed and any regional differences they noticed.

20. Facilitate a class brainstorm or small group conversation about possible contributing factors. Students should then write a response identifying one or more factors and explaining how they might influence asthma rates in different regions.
21. Encourage students to think creatively about solutions and share ideas with a partner. Students should write a brief proposal for a public health initiative, including what it would target and how it could help reduce asthma disparities.
22. Using the Asthma - Children Trends map, have students closely examine both lines on the graph and identify key similarities and differences.

Asthma - Children Trends

Percentage of children ages 0-17 who currently have asthma (2-year estimate)



Source: https://www.americashealthrankings.org/explore/measures/asthma_overall/GA

After a brief peer discussion, students should write a paragraph comparing the trends and suggesting possible reasons for any differences they observe.

23. Facilitate a class brainstorm or small group conversation about events or changes that could have impacted asthma rates (e.g., air quality regulations, healthcare access). Students should then write a response explaining one initiative or environmental factor and how it may have affected the data.
24. **Optional Extension:** Encourage students to think about how this data could influence decisions made by health officials or lawmakers. Students should write a short proposal or reflection on how healthcare resources could be better allocated based on the trends shown in the graph.



HEALTH AND PHYSICAL EDUCATION CONNECTION

This activity connects to health education standards that focus on analyzing how environmental factors influence personal and community health. For example, in high school health standards, students are asked to:

- Analyze the relationship between environmental factors and community health (e.g., air quality and asthma rates).
- Describe how individual and collective actions can reduce health risks (e.g., reducing car trips can cut both emissions and pollution-related illnesses).
- Evaluate the impact of social and cultural influences on health (e.g., where you live—urban, suburban, or rural—can change your transportation options and exposure to pollution).

By analyzing Georgia's air quality trends, students are not just studying climate solutions, but also learning how the air you breathe connects directly to human health outcomes like asthma, heart disease, and stress and the impact of air pollution over time.

Evaluate: What is the Air Quality in Your Neighborhood? (20 minutes)

25. Tell students about the Atlanta Regional Commission's Atlanta Roadside Emissions Exposure Study (AREES). AREES spatially depicts air quality throughout the 20-county Atlanta region, focusing on particulate matter concentrations resulting from the transportation system.
26. Have students visit the AREES Interactive Mapping Tool website at <https://atlregional.github.io/DASH/arees.html>. Challenge students to zoom into their neighborhood and identify the amount of particulate matter in their community. Guide them to notice how patterns at different scales (e.g. neighborhood, city, state) reveal different aspects of air quality, and how individual actions combine to affect larger-scale pollution trends.



STUDENT SUPPORT

Thoughtful Prompts for Guiding Data Analysis

For students who need more guided support in distinguishing characteristics and determining trends in the data on the map, consider using the following guided prompts to elicit engaging responses:

- ➔ Find your community (or the closest city you know). What does the color show for your area? How does it compare to other parts of the state?
- ➔ Choose two different regions (for example, metro Atlanta vs. rural areas). What differences do you notice in the color patterns? Why might those differences exist?
- ➔ Where are the highest roadway emissions located—near big cities, highways, rural areas, or somewhere else? Why do you think those spots show up that way?
- ➔ If you live in or near one of the high-color areas, what might that mean for people's health? What conditions could get worse with higher PM_{2.5} exposure?
- ➔ What part of the map surprised you the most? Why? What new questions do you have after seeing those colors?

27. Ask students what areas in Georgia seem to have the most air pollution. Answers will vary, but listen for any that include that typically areas near highways or areas lacking vegetation and tree cover will have higher pollution.
28. Given what they've learned in the unit's previous activities and their own experiences in their neighborhood, what are some potential solutions to improving air quality? Encourage students to design and refine these solutions using criteria (e.g., effectiveness, cost, feasibility) and to discuss possible trade-offs; mirroring how scientists and engineers address real-world problems. While answers will vary, listen for responses such as drive less; use different modes of travel (bike, walk, etc.); buy smart (energy efficient and better quality for longer use); save energy; and reduce, reuse, recycle.



HEALTH AND PHYSICAL EDUCATION CONNECTION

Having students look at the connection between different Georgia locations can help students focus on the impact of decisions on personal health and well-being and long-term outcomes of health and wellness. **Ask students to consider how areas with higher pollution might require more creative solutions to mitigate negative impacts to human health over time.**

29. Before you go, ask students to share one thing they learned about how air pollution and health are connected. Ask students to continue thinking about how their choices can change the systems they are a part of.

Optional Assessment Questions

The optional assessment questions section offers suggested prompts that can be used to check for understanding, guide student reflection, or spark class discussion. Teachers may choose to use these questions during whole-group conversations, small-group work, or as formative checks throughout the lesson.

Assessment Questions

- Q** What are the seven main pollutants monitored by the EPA?
- A** Answer: Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Lead (Pb), Particulate Matter ($\text{PM}_{2.5}$ or PM_{10}), Ground-Level Ozone (O_3), and Volatile Organic Compounds (VOCs).
- Q** How can air pollutants affect human health?
- A** Answer: Air pollutants can lead to a host of human health issues including the development of respiratory, cardiac, and cancer issues. Such issues include emphysema, asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, increased risk of stroke and heart attack, and increased risk of breast and lung cancers.
- Q** How can air pollutants affect the environment?
- A** Possible Answers: Air pollutants can lead to smog, exasperate global warming and climate change trends, negatively impact crops and vegetation, and contribute to acid rain.
- Q** List three ways you or your family emit pollutants in your everyday lives.
- A** Possible Answers: Driving a car, using the air conditioner, heat or taking a warm shower, using nail polish or hair spray, using electronics, burning fire wood or leaves, using paint or some other solvent, driving down a dirt or gravel road, using gasoline-powered equipment to mow the lawn, blow yard clippings, or whack the weeds, purchasing gas at a gas station, dry cleaning a shirt, smoking cigarettes, and using a printer or copier.
- Q** List three ways you can reduce your or your family's environmental impact in your everyday lives.
- A** Possible Answers: Drive less; use different modes of travel (bike, walk, etc.); buy smart (energy efficient and better quality for longer use); save energy; and reduce, reuse, recycle.



Potential Local Field Trip Ideas

Volunteer with Trees Atlanta

<https://www.treesatlanta.org/>

Trees Atlanta seeks to increase and maintain Atlanta's tree canopy, an important resource in the fight against air pollution. Trees are also a natural carbon sink for excess carbon dioxide. Trees Atlanta welcomes school groups to assist during planting season (October-March) and maintenance season (April-September).

West Atlanta Watershed Alliance Outdoor Activity Center

<https://wawa-online.org/about/>

The West Atlanta Watershed Alliance Outdoor Activity Center hosts environmental education programming, a nature preserve, and outdoor activity center. Students can learn about the organization's origins as a community environmental justice organization and what they can do to advocate and protect their local environment.

Additional Teacher Resources

The Additional Teacher Resources section includes optional materials that can support lesson delivery, extend learning, or provide enrichment opportunities. Teachers may use these resources to deepen content knowledge, adapt instruction for diverse learners, or enhance classroom engagement.

EPA Air Topics

<https://www.epa.gov/environmental-topics/air-topics>

This page on the EPA website has resources to learn more about air pollution, climate change, air research, and what you can do.

CDC Air Pollutants

https://www.cdc.gov/air-quality/pollutants/?CDC_AAref_Val=https://www.cdc.gov/air/pollutants.htm

This resource is from the Centers for Disease Control and Prevention and provides further information on the six criteria air pollutants: carbon monoxide, lead, nitrogen oxides, ground-level ozone, particle pollution, and sulfur oxides.

Atlanta Regional Commission (ARC) Air Quality Page

<https://atlantaregional.org/natural-resources/air-quality/air-quality/>

This resource is written for adults and provides background information on air quality and air quality standards in Atlanta.

ARC AREES Interactive Map

<https://atlregional.github.io/DASH/arees.html>

The Atlanta Regional Commission's Atlanta Roadside Emissions Exposure Study (AREES) has a goal of understanding how local-scale air quality is impacted by changes to the transportation system. This interactive map uses AREES data to spatially depict air quality throughout the 20-county Atlanta region, focusing on particulate matter (one of the six pollutants) concentrations resulting from the transportation system.

This lesson plan was adapted from a lesson plan from the Clean Air Campaign accessed from the National Jewish Health Clean Air Projects website.

This lesson was designed as a part of K-12 curriculum focusing on the relationship between human activity, transportation, air pollution, and health by Georgia Commute Schools. If you liked the curriculum, please leave a rating and review on [our Teachers Pay Teachers page](#).

For more information about our programs, visit gacommuteroptions.com/schools