



## Monitoring Air Pollution

In this lesson, students learn how scientists monitor air pollution. Working in teams as environmental scientists, students construct particulate matter collectors and conduct an experiment to monitor particulate matter around their own school. Through the experiment, students learn about making predictions, data collection techniques, controlled experiments, and using data to form explanations and make real-life recommendations. This is the second lesson in the “Air Pollution and Visibility” unit. (Environmental Education)

<i>Education Committee</i>	<i>The Clean Air Campaign</i>	<i>Fulton</i>	<i>EEinGEORGIA.org</i>
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### Primary Learning Outcomes

How is air quality monitored in Georgia?

How can I conduct an experiment to learn more about particulate matter at my school?

What are controls and variables in an experiment?

How do I make predictions, collect data, and then use data to form explanations and make recommendations?

### Additional Learning Outcomes

How can I share information about particulate matter at my school?

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### Assessed GPS Standards:

**Grade: 4**

### Science Standards

**S4CS1:** Students will be aware of the importance of curiosity, honesty, openness and skepticism in science and will exhibit these traits in their own efforts to understand how the world works. Students will:

- Keep records of investigations and observations and not alter records later
- Carefully distinguish observations from ideas and speculation about those observations
- Offer reasons for findings and consider reasons suggested by others

- d. Take responsibility for understanding the importance of being safety conscious

**S4CS5:** Students will communicate scientific ideas and activities clearly. Students will:

- a. Write instructions that others can follow in carrying out a scientific procedure
- b. Make sketches to aid in explaining scientific procedures or ideas
- c. Use numerical data in describing and comparing objects and events experiments
- d. Locate scientific information in reference books, back issues of newspapers and magazines, CD-ROMs and computer databases

**S4CS8:** Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

- a. Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis and doing experiments
- b. Clear and active communication is an essential part of doing science. It enables scientific discoveries around the world.
- c. Scientists use technology to increase their power to observe things and to measure and compare things accurately.
- d. Science involves many different kinds of work and engages men and women of all ages and backgrounds.

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## **Non-Assessed GPS Standards:**

**Grade: 4**

### **Social Studies Standards *Information Processing Skills***

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## **Procedures/Activities**

*Step: 1      Duration: Teacher Preparation*

**Review the Teacher Resource Manual.** The Teacher Resource Manual provides background information on the lesson topic and other lesson resources. Review all steps in this lesson prior to beginning so that you will know what to prepare in advance for your class. Be sure to collect all the items listed in the materials section, and to make handouts (as indicated throughout the lesson)

ahead of time. This lesson is the second in a unit focusing on air pollution and visibility.

### **Web Resources for Step 1**

**Title:** Teacher Resource Manual

**URL:** [http://eeingeorgia.org/content/ee/docs/4th\\_CAC\\_Manual.doc](http://eeingeorgia.org/content/ee/docs/4th_CAC_Manual.doc)

**Annotation:** The Teacher Resource Manual provides background information on the lesson topic and other lesson resources.

#### *Step: 2      Duration: 10 minutes*

Prepare a plastic bag containing vanilla-soaked cotton balls prior to the start of class in another room. At the beginning of the class, ask students to close their eyes. Then open the sealed plastic bag containing vanilla-soaked cotton balls. Ask students to raise their hands when they first begin to notice something. When most students' hands are up, have them identify what they noticed and how they knew what it was. Note that even though they could not see the vanilla, they knew it was there because their noses told them. Explain that in this situation their nose acted like a monitor. Write the word "monitor" on the board and discuss the definition of the verb "to monitor" (to check, watch, or keep track of). In the case of the vanilla, our noses kept track of what smells were in the air. Explain that for scientists studying air pollution, like the scientists at the EPA, monitoring what's in the air is very important. Ask students to suggest reasons why monitoring air pollution might be important. Tell students that over the next few days they will be working as environmental scientists to monitor air pollution around their school and it will be their job to let others know what they have found.

#### *Step: 3      Duration: 10 minutes*

Tell students that they are going to conduct an experiment that will monitor the amount of particulate matter in four places around the school. These places are called "data collection sites" (explain the word "data" if students are unfamiliar with the term). Hand out the "Monitoring Particulate Matter Experiment" (attached) to each student. Review the procedures step by step. You may need to explain further about "cluster sampling" and controlled experiments and variables depending on how familiar your class is with conducting experiments. Explain that they will be working in teams of four, but each "environmental scientist" will be responsible for filling out his/her own experiment report.

### **Attachments for Step 3**

**Title:** Monitoring Particulate Matter Experiment **FileName:**

[Monitoring Particulate Matter Experiment.doc](#)

**Description:** A student hand-out with step-by-step procedures for conducting the Monitoring Particulate Matter experiment. Includes

diagrams, charts, calculations, and questions for the student to complete.

*Step: 4      Duration: 30 minutes*

Divide the class into teams of four and assign each team a number, letter, or other name, or have each team choose its name. Distribute materials for making the particulate matter collectors: index cards, rulers, red markers, double-sided tape, plastic bags. Circulate and assist teams as they make the grids; as you do, ask them to explain why we are making the grid instead of using the whole card (cluster sampling). As the teams complete Experiment Step 1, guide them to go on to Step 2 and 3 to choose their data collection sites as a group and record their predictions individually on the Experiment report. Discuss with them the importance of the control and variable in an experiment. For teacher background: More information on controls and conducting experiments can be found on the Experimental Science Projects Web site, attached.

#### **Web Resources for Step 4**

**Title:** Experimental Science Projects: An Intermediate Level Guide

**URL:** <http://www.isd77.k12.mn.us/resources/cf/SciProjInter.html>

**Annotation:** This site can be used by teachers for additional information about the scientific method. Provided as teacher background.

*Step: 5      Duration: 20 minutes*

When teams have completed steps 1 and 2 on the Monitoring Particulate Matter Experiment handout, go outdoors with the class and assist them to place two particulate matter collectors at each site – one with tape exposed to the air, one in the sealed plastic bag. Be sure that the collectors are secured with tape or thumbtacks and out of the way of other students or passersby.

*Step: 6      Duration: Optional 10 minutes daily over 3 days*

Allow collectors to remain in place for the next three days. Optional: Have students observe – but not touch! – collectors on a daily basis.

*Step: 7      Duration: 30 minutes*

During the three-day experiment wait period, have students work in pairs to visit the AQI section of EPA's AirNow Web site. Explain there are air quality monitoring stations around the state of Georgia. State that while most of the haze and particulate matter problems are around cities, this isn't just a big city problem. Have students suggest why (PM can blow in the wind and travel to other areas). In fact, the EPA has placed 29 counties in Georgia on a "dirty air" list because of high amounts of particulate matter in the air. Using the EPA map of Georgia (attached), have students identify whether their county is on the list. If

so, have students track your area's air quality through the EPA's Air Quality Index. Place a color chart (see sample attached) on the wall of the classroom or in the hallway and have students indicate daily what the code is. (Note: Greatest variation will occur between May and September.) You might also have them read Particulate Matter data from air quality monitoring stations. Charts are found on the Georgia Environmental Protections Division's Ambient Particulate Matter Web site.

### **Web Resources for Step 7**

**Title:** Current Ambient Particulate Matter (FINE) Concentrations around Georgia

**URL:**

[http://www.air.dnr.state.ga.us/tmp/today/amp\\_1hrPM25.html#atlanta](http://www.air.dnr.state.ga.us/tmp/today/amp_1hrPM25.html#atlanta)

**Annotation:** Contains data updated hourly from air quality monitoring stations around Georgia.

### **Attachments for Step 7**

**Title:** EPA PM2.5 Map of Georgia **FileName:** [4th PM25 Map.ppt](#)

**Description:** Color map of PM2.5 (PM-FINE) nonattainment areas in Georgia.

**Title:** AQI Color Chart **FileName:** [AQI Color Chart.doc](#)

**Description:** A sample color chart illustrating the EPA's Air Quality Index.

*Step: 8      Duration: 45 minutes*

On the fourth day, have students finish the experiment and complete the experiment report.

*Step: 9      Duration: 20 minutes*

In a whole group, have each team share their results. Have each group share their "per square centimeter" count and explain that finding "per square centimeter" averages helps scientists compare one place to another; compare counts and locations. On a map of the school, have each team mark the place with the highest particulate matter count. (Note that some of the teams may not have useful counts, since often particulate matter is quite microscopic. If this is the case, rely on their observations and drawings.) Discuss why collectors hung in certain areas had more particles on them than others. Are the particles necessarily from high up in the sky? Did someone use a leaf blower nearby? Is pollen being released by nearby trees and plants? Did neighborhood children kick dirt on the collector? Did dust from the classroom contaminate the card while

the team was making its observations? Have the students list as many possible sources of particles as they can and record on the board or a flip chart. Discuss what might be done to reduce the levels of particulate matter in areas that rated high in the students' findings. Also discuss how they would change their experiment and where they would place their collectors if they were to repeat the experiment.

*Step: 10      Duration: 30 minutes + time to complete chosen activity*

Ask students how they, as environmental scientists, might let others know about air quality around their school – how can they let students, teachers, parents and visitors know where air quality might be a challenge for some people? You may have each team display their findings in a particular way or the whole class may work together to display the findings. (Ideas may include: a map of the school with high PM ratings marked; a display of the particulate matter collector cards with an informative written explanation; a report to the principal; an article in the school newsletter; posters displays; publication of a small pamphlet about PM at your school; inclusion of report findings in Hazy Days Storybook presentations.) Be sure to have students include information about what can be done to reduce PM in areas of the school that had high levels.

*Step: 11      Duration: Teacher Feedback*

The Clean Air Campaign is pleased to provide standards-based air quality lesson plans for 4th through 8th grades. Please offer your feedback after implementing this lesson plan, as there is no substitute for real classroom experience. Send teacher name, school name and address, grade level, lesson name, comments or suggestions, and the number of students who completed the lesson to: [school@cleanaircampaign.com](mailto:school@cleanaircampaign.com). Each teacher who responds will receive a Clean Air Campaign goody bag as a 'thank you.'

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### **Materials and Equipment**

1. 1 or 2 vanilla soaked cotton balls inside a plastic sandwich bag
2. 4x6 inch white unlined index card, 8 per team of 4 students
3. Cm ruler, 1 per team of 4 students
4. Resealable plastic sandwich bags, 8 per team of 4 students
5. Double-sided tape
6. Thumb tacks, 8 per team OR strong packing tape
7. Red markers, 2 per of 4 students
8. "Monitoring Particulate Matter Experiment Report" (attached), 1 per student
9. Magnifying lenses, 1 per student
10. Computer with Internet access, 1 per 2 students
11. EPA PM2.5 Map of Georgia (attached)
12. Air Quality Index Color Chart (attached)
13. Map of school

14. Flip chart (optional)
15. Other materials as needed for information displays

**Total Duration**

195 minutes (over three or four days) + additional time for optional activities

**Technology Connection**

Students will use a computer with Internet access to monitor the EPA's Air Quality Index for their area.

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**Assessment**

Use the attached rubric to assess student completion of the Monitoring Particulate Matter Experiment Report.

**Attachments**

**Title:** Monitoring Air Pollution Assessment Rubric

**FileName:** [Monitoring Air Pollution Assessment Rubric.doc](#)

**Description:** A rubric for assessing student understanding of experiment concepts and procedures.

**Extension**

Invite someone from the EPA; Air Protection Branch of Georgia DNR Environmental Protection Division; a metropolitan planning organization; The Clean Air Campaign; or a local chapter of the American Lung Association to visit the class and discuss the importance of air quality issues.

**Remediation****Accommodation**

For students with exceptional needs, what changes can be made in instruction and teaching delivery to enhance student participation and learning? Each area below is a direct link to general classroom accommodations.

[Non-readers](#)   [Physical Impairments](#)   [Sensory Impairments](#)  
[Attention/Behavior](#)   [Gifted](#)

Each disability below is a direct link to general classroom accommodations specific for that disability.

[Autism](#)  
[Deaf - Blind](#)  
[Deaf/Hard of Hearing](#)  
[Emotional and Behavioral Disorder](#)

[Mild Intellectual Disability](#)

[Orthopedic Impairment](#)

Other Health Impairments:

[Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder](#)

[Tourette Syndrome](#)

[Significant Development Delay](#)

[Specific Learning Disability](#)

[Speech - Language Impairment](#)

[Traumatic Brain Injury](#)

[Visual Impairment](#)

### **Modification**

For students with significant disabilities, what changes can be made in instruction and teaching delivery to allow students to participate in classroom instruction while working on IEP objectives and off grade level GPS standards. Below are suggested modifications correlated to the procedures of this lesson plan.