



Weather and Ground-Level Ozone

In this lesson, students will query a Web-based data system to compare ground level ozone readings during different seasons and weather conditions, graph the results for three dates, and analyze the graphs to identify possible correlations. Students will also design ad campaigns to educate the public about causes of air pollution and what can be done to mitigate it. This is the second lesson in the “Ground Level Ozone” unit. A Teacher Resource Manual, PowerPoint presentations, and other lesson resources are included. (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

Does weather affect air pollution? How can I collect, graph and analyze data to draw conclusions about the relationship between certain weather conditions and the formation of ground-level ozone? What can be done to help prevent the formation of ground-level ozone?

Additional Learning Outcomes

How can I use an interactive database on the Internet to collect information for the investigation of air pollution?

Assessed GPS Standards:

Grade: 6

Science Standards:

S6E5i: Students will investigate the scientific view of how the earth's surface is formed.

- i. Explain the effects of human activity on the erosion of the earth's surface

Math Standards:

M6D1b-d: Students will pose questions, collect data, represent and analyze the data, and interpret results.

- b. Using data, construct frequency distributions, frequency tables, and graphs.
- c. Choose appropriate graphs to be consistent with the nature of the data (categorical or numerical). Graphs should include pictographs, histograms, bar graphs, line graphs, circle graphs, and line plots.
- d. Use tables and graphs to examine variation that occurs within a group and variation that occurs between groups.

Non-Assessed GPS Standards:**Grade: 6****Math Standards:**

M6D1: Students will pose questions, collect data, represent and analyze the data, and interpret results.

- a. Formulate questions that can be answered by data. Students should collect data by using samples from a larger population (surveys), or by conducting experiments.
- b. Using data, construct frequency distributions, frequency tables, and graphs.
- c. Choose appropriate graphs to be consistent with the nature of the data (categorical or numerical). Graphs should include pictographs, histograms, bar graphs, line graphs, circle graphs, and line plots.
- d. Use tables and graphs to examine variation that occurs within a group and variation that occurs between groups.
- e. Relate the data analysis to the context of the questions posed.

M6P4: Students will make connections among mathematical ideas and to other disciplines.

- a. Recognize and use connections among mathematical ideas.
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- c. Recognize and apply mathematics in contexts outside of mathematics.

M6P5: Students will represent mathematics in multiple ways.

- a. Create and use representations to organize, record, and communicate mathematical ideas.
- b. Select, apply, and translate among mathematical representations to solve problems.
- c. Use representations to model and interpret physical, social, and mathematical phenomena.

Procedures/Activities

Step: 1 Duration: Teacher Preparation

Introduction

The Clean Air Campaign is pleased to provide Georgia standards-based air quality unit plans for the 4th through 8th grades. We hope that you will implement the following 8th grade lesson plan and offer your feedback. Teacher input and suggestions will be reviewed and incorporated into future updates of this lesson plan. We look forward to hearing from you at schools@cleanaircampaign.com

Review the Teacher Resource Manual

The Teacher Resource Manual provides background information on the lesson topic and other lesson resources which may be used to answer students' question and facilitate class discussions. 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 transparencies and hand-outs (as attached throughout the lesson) ahead of time.

Note: This lesson is the second in a 8th grade unit focusing on air pollution. In the unit, students will investigate the role that humans play in causing air pollution, the components that make up smog, and the correlation between weather and ground-level ozone. Lesson 1, "Air Pollution in Metro Atlanta and Georgia," should be completed prior to beginning this lesson. If that is not possible, use the attached Power Point presentation, "Metro Atlanta's Air Quality," to review the causes of air pollution in metro Atlanta with the class. (As an alternative, this presentation may be viewed on an overhead projector, with transparencies made from the PowerPoint slides). Have students take notes and/or give each student printed copies of the presentation.

Web Resources for Step 1

Title: 8th Grade Teacher Resource Manual

URL: http://eeingorgia.org/content/ee/docs/8th_CAC_Manual.doc

Annotation: The Teacher's Resource Manual provides background information on the lesson topic and other lesson resources which may be used to answer students' questions and facilitate class

discussions. Please review this manual thoroughly before beginning the lesson. Graphics courtesy of www.epa.gov. Web sites listed in this document are also linked in the Web Resources section at this step.

Title: Ambient Monitoring Program

URL: <http://www.air.dnr.state.ga.us/amp>

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. It is managed by the Georgia Department of Natural Resources, offers current and recent (past three days) data on concentration levels of major air pollutants.

Title: Ambient Monitoring Program Database Query

URL: http://www.air.dnr.state.ga.us/amp/amp_query.html

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. Its interactive database, provided by the Georgia Department of Natural Resources, allows users to select a location, date, one of six pollutants, and one of four weather conditions, to obtain data about air quality. Used in lesson 2 of this unit: "Weather and Ground Level Ozone"

Title: Clean Air Campaign Web Site

URL: <http://www.cleanaircampaign.com>

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. The Clean Air Campaign has created this and other lessons on air quality for grades 4 through 8. For more information, please visit the web site.

Title: Speaker's Bureau

URL:

http://www.cleanaircampaign.com/index.php/cac/about_us/request_a_speaker

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. It allows the user to request a speaker from the Clean Air Campaign. Teachers may wish to make arrangements for a speaker to visit their classrooms.

Title: Environmental Education in Georgia Web Site

URL: <http://www.eeingorgia.org>

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. Additional lessons on environmental education, including the Clean Air Campaign's air quality lessons for grade 4 - 8, can be accessed from this web site.

Title: EPA's Air Quality Index Web Site

URL: <http://www.epa.gov/airnow>

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. It provides information on current and forecasted air quality conditions for the United States.

Title: Air Quality Index for Kids

URL: <http://www.epa.gov/airnow/aqikids/index.html>

Annotation: This EPA Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. It explains air pollution, the Air Quality Index (AQI) and pollution solutions to children.

Title: Ozone Maps

URL: <http://airnow.gov/>

Annotation: This EPA Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. It provides archived maps of ozone concentrations across the United States. Useful to see the impact of ozone from metropolitan areas on the entire region.

Title: Interactive AQI Calculator

URL: <http://airnow.gov/>

Annotation: This Web site is hyper-linked in the 8th Grade Teacher Resource Manual attached at this step. Scroll down to the AQI (Air Quality Index) Calculator on this EPA web site, to easily convert ambient pollution concentrations to index values, or vice versa. This interactive database is used in lesson 1: "Air Pollution in Metro Atlanta and Georgia."

Attachments for Step 1

Title: Metro Atlanta's Air Quality **FileName:** [Metro Atlanta's Air Quality 1.ppt](#)

Description: This optional PowerPoint presentation provides a review of metro Atlanta's air pollution problems. It should be seen by the class if lesson 1 in this unit: "Air Pollution in Metro Atlanta and Georgia," has not been completed. Graphics from Microsoft Office.

Step: 2 Duration: 15 minutes

Give each student a copy of the "Ground Level Ozone and Weather Comparison Worksheet," attached below. Tell students they are going to collect some

weather data from a Web site that will allow them to compare the relationship between the seasons, weather conditions, time of day, and ground level ozone formation. Have students individually predict how they think weather conditions such as temperature, barometric pressure, relative humidity, and wind speed contribute to the formation of ground level ozone. Students should record their predictions on the chart in “Part I: Making Predictions” of the Student Worksheet.

Distribute copies of the Scoring Rubric for students to refer to throughout the lesson. Note that the web resource linked at this step is listed in the Worksheet. This interactive air quality monitoring page provided by the Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch, will be needed for the next step. It can be used to obtain data regarding weather conditions and ground level ozone readings for several specific locations, on specific dates.

Web Resources for Step 2

Title: Ambient Monitoring Program Interactive Database

URL: http://www.air.dnr.state.ga.us/amp/amp_query.html

Annotation: A link to this Web site is provided in the Ground Level Ozone and Weather Comparison Worksheet attached at this step.

This ambient monitoring program database is maintained by Georgia Department of Natural Resources’ Environmental Protection Division – Air Protection Branch.

Attachments for Step 2

Title: Ground Level Ozone and Weather Comparison Worksheet

FileName: [Ground Level Ozone and Weather Comparison Worksheet.doc](#)

Description: This student worksheet will be used to record predictions and data, create charts, analyze statistical information, and draw conclusions. The worksheet provides a link to the Ambient Monitoring Program’s Interactive Database, which students will use to collect statistics for the worksheet. Graphics from Microsoft Office.

Title: Scoring Rubric for Worksheet and Ad Campaign **FileName:** [ScoringRubric-Ozone.doc](#)

Description: This rubric can be used by students as a guideline for completing the worksheet and ad campaign assignments, and by teachers as an assessment for both activities. Provide a copy to each student at the time the Worksheet (also attached at this step) is distributed.

Step: 3 Duration: 30 minutes

Divide students into pairs or groups of three, depending on the number of computers available. Have students go to the DNR website (linked below) and select a mid summer date in the first box (any date in July or August is preferable). Next, have them select a location in Box #2 (for example, Atlanta) and "Ozone- 8 hr average" in Box #2. Then, have students indicate the same geographic location (i.e., Atlanta) in Box #3. Students will then select each meteorological variable, one at a time, (including temperature, barometric pressure, relative humidity, and wind speed) for the same city. The data variables may be selected by clicking on the top one in the list, pressing the control key, and highlighting the variable wanted. For each meteorological variable selected, press the "Submit Query" button and wait a moment.

Have students record the data for the date and location selected on the first chart of the worksheet in Part II: Collecting Weather Data. Have students repeat the entire process twice more for the same city on two different dates in the same year. Important: Tell students that ozone levels are considered unhealthy if the data points exceed 0.085 ppm of ozone. The ozone level should exceed 0.085 ppm on at least one of the dates students have selected.

Note that this activity can be effective without recording data at one hour intervals. For a quicker version of Part II, students may collect and record data only for 6:00a.m., 8:00, 10:00, 12 noon, 2:00p.m. (14th hour), 4:00 (16th hour) 6:00 (18th hour) and 8:00 (20th hour). Another alternative is to complete this activity as a class, with students calling out answers for the teacher to record on an overhead projector version of the worksheet. Copies of the completed worksheet would need to be provided to students for graphing unless that, too, is done as a class. Should data collection and graphing be done as a class, it is recommended that students individually do the SMOG City simulation (in Extensions).

Step: 4 Duration: Homework assignment

For homework, have students graph the 8-hour ozone measurements vs. the weather data for each of the three days selected, using data previously recorded on the Worksheet. Based on their graphs, have students explain how they now think weather contributes to the formation of ground level ozone. Answers should be recorded on the chart in the Drawing Conclusions section of the handout, attached at Step 2. Have students also compare their results to their predictions, as recorded in part 1 of the Worksheet. Note that accuracy of predictions is not a factor in scoring the worksheets.

Background information as well as sample graphs can be seen on the Web site linked at this step. The graph examples could be printed on transparencies to show the class on an overhead projector. Note that the ozone vs. time bar graph

is color-coded to match AQI condition colors for corresponding ozone concentration levels.

Web Resources for Step 4

Title: Air Pollution- What's the Solution?

URL: <http://www.k12science.org/curriculum/airproj/index.html>

Annotation: This Web site has good background information on "good ozone" vs. "bad ozone." For examples of graphs, which can be copied on transparencies and shown to students on an overhead projector, select "Tracking Ozone" from the menu on the left; then scroll down to click on "Teachers" and then, in the Notes sections, click on "Graphing Tips and Examples" and finally, select "Graphing Examples."

Step: 5 Duration: 15 minutes

Show students the attached PowerPoint presentation "Ground Level Ozone and Weather". (Transparencies for an overhead projector can be made from the presentation prior to the start of class, if no multimedia projection equipment is available). Ask students to discuss how their Worksheet conclusions compared to the statements in the presentation.

Attachments for Step 5

Title: Ground Level Ozone and Weather **FileName:** [Ground Level Ozone and Weather.ppt](#)

Description: Use the attached presentation to discuss the relationships between ground level ozone and weather. Graphics from Microsoft Office.

Step: 6 Duration: 20 minutes

Show and discuss the Power Point presentation, Things You Can Do to Prevent Ground Level Ozone Formation. (Transparencies for an overhead projector can be made from the presentation prior to the start of class, if no multimedia projection equipment is available).

Attachments for Step 6

Title: Things You Can Do **FileName:** [Things You Can Do.ppt](#)

Description: This short presentation describes things students can do to help prevent ground level ozone formation. Source of information: www.epa.gov. Graphics from Microsoft Office.

Step: 7 Duration: 40 - 100 minutes in class and one or two weeks of homework (plus 75 minutes for optional in-class presentations)

Working in teams of two, have students create an advertising campaign that educates the public about metro Atlanta's air pollution problem and what can be done to solve this problem. Students should design three components for their campaigns, such as a brochure, billboard, poster, multimedia presentation, radio or television ad, Web site, skit, or other medium. Encourage students to be creative. Students may refer to The Clean Air Campaign, Georgia Department of Natural Resources or EPA websites for background information. This project may be assigned as homework. Give students one week or two weeks to complete it, depending on the ability levels of your class. Teams can present their work to the class in the form of a 5 minute presentation (optional). Teachers should assess student learning using the second half of the Scoring Rubric attached at Step 2. Also refer students to this Scoring Rubric (previously distributed at Step 2) as a guideline.

Step: 8 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: schools@cleanaircampaign.com. Each teacher who responds will receive a Clean Air Campaign goody bag as a 'thank you.'

Materials and Equipment

1. PowerPoint presentations - Ground Level Ozone and Weather and Things You Can Do; attached in steps 5 and 6
2. Transparencies, to be made from PowerPoint presentations for overhead projector, if no multimedia projection equipment is available.
3. Ground Level Ozone and Weather Comparison Worksheet - one per student; attached at step 2
4. Metro Atlanta's Air Quality PowerPoint - optional. See step 1 for details.
5. LCD projector or TV hookup (or overhead projector if no multimedia projection equipment is available)
6. Scoring Rubric - one per student (attached at step 2)

Total Duration

2 – 3 hours in class (plus two homework assignments and 75 minutes for optional ad campaign presentations)

Technology Connection

The teacher will use an LCD projector or TV hookup and the attached PowerPoint presentations to discuss the relationships between ground level ozone and weather; and how students can help prevent ground level ozone formation. In lieu of PowerPoint presentation, teacher may make transparencies and show the same images on an overhead projector. Students will use a computer with Internet access to collect and compare web-based data in order to identify relationships between weather and ozone readings.

Assessment

Student products including the Worksheet and the ad campaign may be assessed using the Scoring Rubric attached at Step 2.

Extension

The web resources below relate to an interactive air pollution simulation game called "Smog City." The attachment provides ideas for activities during smog season (from May – September), including collection of real-time data on weather conditions and ozone levels from media sources.

Web Resources

Title: Smog City

URL: <http://www.smogcity.com/welcome.htm>

Annotation: The Sacramento Metropolitan Air Quality Management District (SMAQMD) has developed an interactive air pollution simulator that demonstrates the impact of smog on an imaginary town called Smog City. Students can manipulate weather conditions, population size, and ozone-forming emissions to see the impact of those changes on the city. (A link is provided in the Extension Ideas attachment).

Title: What You'll Learn Playing Smog City

URL: <http://www.smogcity.com/whatyoulllearn.html>

Annotation: This web page describes learning objectives for the Smog City game and provides a general description of how it is played. (A link is provided in the Extension Ideas attachment). <BR:

Attachments

Title: Extension Ideas **FileName:** [Extension.doc](#)

Description: The web resources at this step relate to an interactive air pollution simulation game called

“Smog City.” The attachment provides ideas for activities during smog season (from May – September), including collection of real-time data on weather conditions and ozone levels from media sources.

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.