Every Breath You Take

In the first of two seventh grade lessons from The Clean Air Campaign about the effects of air pollution on the human body, students will learn the parts and function of the respiratory system from interactive Web sites and will build working models of the lungs and diaphragm. After researching adverse health effects of air pollution, students will modify their lung models to demonstrate pollution–related symptoms. Finally, the class will use knowledge they have gained about when air pollution risks are greatest and which groups of people are most vulnerable, to brainstorm strategies for protecting themselves and others from the adverse effects of exposure to air pollution. (Environmental Education)

Education Committee	*The Clean Air Campaign*	*Fulton*	*EEinGEORGIA.org*

Primary Learning Outcomes

What are the parts of the human respiratory system? How do my lungs and diaphragm work? How does air pollution affect lungs and respiratory functions? Who is at risk of respiratory problems related to air pollution, and what can be done to keep them healthy?

Additional Learning Outcomes

How can I use the Internet to research the effects of air pollution on the respiratory system?

Assessed GPS Standards:

Grade: 7

Science Standards:

S7L2 d,e: Students will describe the structure and function of cells, tissues, organs, and organ systems.

d. Explain that tissues, organs, and organ systems serve the needs cells have for oxygen, food and waste removal.

e. Explain the purpose of the major organ systems in the human body (i.e., digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and for protection from disease).

S7CS5b: Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

b. Understand that different models (such as physical replicas, pictures, and analogies) can be used to represent the same thing.

Math Standards:
M7D1b,f.g: Students will pose questions, collect data, represent and analyze the data, and interpret results.

b. Construct frequency distributions.

f. Analyze data using appropriate graphs, including pictographs, histograms, bar graphs, line graphs, circle graphs, and line plots introduced earlier, and using box-and-whisker plots and scatter plots.

g. Analyze and draw conclusions about data, including a description of the relationship between two variables.

Procedures/Activities

Step: 1 Duration: Teacher Preparation
Decide how to display Web resources for the class (listed at Step 2). For instance, an Internet-connected computer, scan converter, LCD projector and screen or TV monitor, could be used. If this technology is unavailable, transparencies could be made from print-copies of the Web pages and shown on an overhead projector, but the value of animations and interactive diagrams would be lost. As an alternative, students could be directed to visit these Web sites using Internet-connected computers.

At least one week prior to this lesson, ask students to bring in clear, empty one-liter bottles. Cut and prepare the bottles, as indicated in the directions attached at Step 3. Decide how to divide the class into lab partner pairs. Make a copy for each student of the Respiratory System Worksheet, linked at Step 2; the four-page directions for the Do-It-Yourself Lung Model linked at Step 3; and the Notes on Health Effects of Air Pollution Worksheet at Step 4. (Note that lung model directions can also be accessed from the TrackStar Web page provided for students at Step 4, if preferable for students to view these instructions online).

Find out if your school has a policy regarding recess, sports practice, or band practice during Smog Alert days. If students are willing to discuss their asthma,

you may want to arrange for them to talk to the class. Be sure to arrange this with students privately, in advance.

Step: 2 Duration: 30 minutes

Introduction: How the Respiratory System Works

(Optional~ Distribute copies of the scoring rubric in advance so students will know what is expected in this lesson). Distribute copies of the Respiratory System Worksheet (linked below) and tell students that they are to label the diagram as Web sites with pertinent information are displayed. Direct the class to add the following terms to the word bank at the bottom of the worksheet, and advise students that they will be responsible for drawing in and labeling these parts as well: aveoli, esophagus, pleura, ribs. Briefly introduce the basic structure and function of the human respiratory system by displaying the Respiratory System Chart (linked below). Read or paraphrase the text. Then display the American Lung Association's "How Lungs Work" Web page (linked below) and use the interactive diagram to highlight parts of the respiratory system. Show the breathing animation (under "Diaphragm") to demonstrate how the respiratory system functions. Finally, go to the How Stuff Works Web site to display and read the "How You Breathe" and "Where the Air Goes" sections of the "How Your Lungs Work" chapter.

By this point, students should have finished labeling the diagram on the worksheet, including the four extra parts. The worksheets can be used for reference in the next step and later collected and scored to assess student comprehension of this portion of the lesson. (An Answer Key is provided in the Assessment section).

Web Resources for Step 2

Title: Respiratory System Worksheet
URL:
http://www.enchantedlearning.com/subjects/anatomy/lungs/label/
Annotation: Students should label this worksheet, using the word bank and the four additional terms (ribs, pleura, aveoli, and esophagus).

Title: How Lungs Work
URL:
http://www.lungusa.org/site/apps/s/content.asp?c=dvLUK9O0E&b=34706&ct=67764
Annotation: This interactive Web page from the American Lung Association identifies the parts of the respiratory system. Display on a monitor or screen, using a scan converter and Internet-connected computer. Roll mouse over terms to see corresponding parts of respiratory system highlighted, or roll mouse over parts, to see terms highlighted. To view breathing animation, click on "Click

here"; then "Diaphragm"; then "Watch Me Breathe"; and then "Breathe In" and "Breathe Out." A Flash Player is needed. (Link to free Flash Player download provided in Web Resources)

Title: Respiratory System Chart
URL:
http://www.lungusa.org/site/apps/s/content.asp?c=dvLUK9O0E&b=34706&ct=67767
Annotation: Display this chart from the American Lung Association (ALA) on a monitor or screen, using a scan converter, LCD projector and Internet-connected computer (Alternatives: print and make a transparency to display on an overhead projector, or print and make copies for each student). Be sure to emphasize the location and definition of the four parts which students are to draw in and label: esophagus, aveoli, pleura, and ribs (shown in cross section), in addition to the parts already listed on their worksheets. After reviewing parts of the respiratory system, proceed to ALA's How Lungs Work interactive page, using the Web address linked at this step instead of the hotlink on page with Respiratory Chart, which is often broken or misdirects.

Title: Flash Player
URL:
http://www.macromedia.com/shockwave/download/download.cgi?P1_Prod_Version=ShockwaveFlash&P5_Language=English
Annotation: Use this Web site to download a free Flash player, to view the ALA respiratory system animation.

Step: 3 Duration: 60 minutes
Model Making: Lungs and Diaphragm
Divide students into pairs. Provide each pair of lab partners with directions (linked below) and materials necessary to build a working model of the lungs and diaphragm. After the models are assembled, students can pull down on the diaphragm (the balloon stretched and tied across the bottom of the bottle) to cause the lungs to inflate.

Web Resources for Step 3

Title: Directions for Do-It-Yourself Lung Model
URL: http://www.smm.org/heart/lessons/lesson7.htm
Annotation: Print and copy a set of these illustrated instructions for each pair of lab partners. Note that there are four pages.

Step: 4 Duration: 0 (if assigned as homework) to 30 minutes (if assigned as classwork)

Research: Air Pollution Health Effects and Risk Factors

Initiate a discussion about who is at risk of adverse effects from air pollution. Challenge students to think of reasons why some groups of people may be at greater risk than others. [Responses may include the elderly (because their respiratory systems may already be compromised by age or illness); children (because they exercise outdoor more frequently, breathe 50% more air per body weight than adults, and have narrower air passages); people with heart or lung conditions (because their pre-existing health problems make them more vulnerable); active adults (who exercise outdoors and may therefore have greater exposure to air pollution, especially if they run on streets late in the day); people with asthma (because the condition can be triggered or exacerbated by air pollution); and anyone else (when pollution levels are high enough)].

Tell students that they are to research the effects of air pollution on the respiratory system. As they read through the Web resources linked below, students should be taking notes and answering questions on the attached 'Research on Health Effects of Air Pollution' worksheet. Also, they should be thinking of how they could modify their lung models to simulate one or more of the symptoms caused by breathing polluted air.

To complete the research, provide each student with access to Internet-connected computers during class time, distribute printed copies of the Web pages listed below, or assign the research to be done as homework (only if every student has access to an Internet-connected computer at home). Note that all of the following Web sites, as well as those linked at Steps 2 and 3, are easily accessed from a TrackStar Web page created specifically for this lesson. The TrackStar Web address and track number are included on the Student Worksheet.

Web Resources for Step 4

Title: Web Resources for Step 4
URL: http://trackstar.4teachers.org/
Annotation: Open the TrackStar Web site and type 241703 in the 'Find Track' box. When the next Web page opens, click “View in Frames.” The track provides links to each of the Web resources listed at this step, as well as those from steps 2 and 3. Students should use the worksheet attached at this step (Research on Health Effects of Air Pollution) to guide their research and take notes as they survey the Web sites.

Title: The Clean Air Campaign® Health Advisory: Outdoor Physical Activity During Smog

URL:
http://www.cleanaircampaign.com/index.php/cac/tools/document_library/health_technical_documents/health_advisory_guidelines
Annotation: This excellent resource explains why some people are especially sensitive to air pollution; outlines health effects of various types of pollutants; interprets the Air Quality Index color codes; and describes risks of outdoor exercise during smog season. Students will list health effects of air pollution in the chart on the worksheet and continue reading to find strategies for protecting oneself from the health effects of pollution.

Title: EPA's AirNow Web site
URL: http://www.epa.gov/airnow/brochure.html
Annotation: Students should click on "How can ozone affect your health?" to find more symptoms of air pollution, and list these symptoms on the worksheet.

Title: Children's Medical Center of the University of Virginia.
URL:
http://www.healthsystem.virginia.edu/internet/pediatrics/patients/Tutorials/Asthma/home.cfm
Annotation: Students should click the "Why?" link on the left side of Web page to find out what happens during an asthma attack, and list these symptoms on the worksheet.

Attachments for Step 4

Title: Research on Health Effects of Air Pollution Worksheet
FileName: Student Worksheet- Research on Health Effects of Air Pollution.doc
Description: Distribute a copy of this worksheet to each student, to guide their research and provide an organizer for note-taking. The worksheet provides the TrackStar Web address and a track number which students can use to quickly connect to Web resources linked at steps 2, 3, and 4 of this lesson.

Step: 5 Duration: 15 minutes
Modify Lung Model to Demonstrate Health Effects of Air Pollution
Based on research conducted in the previous step, students are to modify their lung/diaphragm models to demonstrate or simulate the adverse health effects which air pollution could cause. Encourage creativity by providing a wide assortment of fasteners, glues, tapes, quilt batting, gelatin, water, corn starch, and other materials which could be used for this activity, and encouraging students to bring additional supplies from home. Some of the effects which may

be demonstrated are reduced lung function; restricted air intake; incomplete exhaling; rapid, shallow breathing; inflammation; mucus accumulation and edema or swelling. See Answer Key - Research on Health Effects of Pollution (attached here) for more information on symptoms the models may portray.

Attachments for Step 5

> **Title:** Answer Key - Research on Health Effects of Air Pollution
> **FileName:** Answer Key for Research on Health Effects of Air Pollution.doc
> **Description:** This Answer Key for Research on the Health Effects of Air Pollution will provide the teacher with information about symptoms students might simulate when they modify their lung models.

Step: 6 Duration: 45 minutes

Debriefing

Have students demonstrate their modified lung models and explain both the health effect they have portrayed and a pollution-sensitive group which may be vulnerable to it. If a student with asthma has been identified in advance and would like to share information about his or her condition, provide an opportunity for that to happen.

Engage students in a review of the lesson's big ideas:

1. Recall parts of respiratory system, using a copy of the chart linked at Step 2.
2. Emphasize that the respiratory system is not a "dead end" but is connected to the circulatory system. Discuss the function of the respiratory system (to provide energy the body needs, by delivering oxygen to the lungs, which subsequently travels through the blood to the cells; and to remove waste by-products of respiration and cell functions, such as carbon dioxide).
3. Review the possible adverse effects of air pollution on the respiratory system (irritated and inflamed airways, damaged lung lining, decreased air flow, shortness of breath or rapid, shallow breathing, coughing, wheezing, chest tightness, aggravated asthma, and decreased stamina are associated with ozone; aggravation of heart and lung diseases, heart arrhythmias, and respiratory infections are associated with particulate pollution; and tightening of muscles around the airways, swelling of airway linings, clogging of airways with thick mucous, and difficulty moving air in and out of the air sacs are symptoms of asthma, which can be triggered or exacerbated by air pollution).
4. Identify groups of people who are at particular risk for the effects of air pollution (The very young and very old, people with asthma and other pre-existing heart and lung diseases, those who are heavily exposed, such as outdoor workers, and people who are highly active).

Step: 7 Duration: 15 minutes

Brainstorming Solutions
Tell about school policies (if any) for protecting students on smog alert days. Challenge the class to brainstorm ways in which people can protect their respiratory systems from adverse effects of air pollution. {Possible responses may include: recognizing the risk factors and symptoms, monitoring the Air Quality Index (smog alerts), limiting exposure during times when air pollution is high, exercising in the morning before ozone levels build, avoiding roadsides when exercising during smog season, and various strategies for reducing air pollution such as reducing the volume of traffic through carpools and work-at-home programs, cleaning up or preventing emissions, using alternative transportation or alternative fuels, etc.

Step: 8 Duration:
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
For each student:
1. One copy: Respiratory System Worksheet, linked at Step 2
2. One copy: Research on Health Effects of Air Pollution Worksheet, attached at Step 4.
3. One copy: Scoring Rubric, attached at Assessment.

For the teacher:
4. Internet-connected computer, LCD projector or TV hook-up, and scan converter, OR
5. Optional overhead projector and transparencies of Web pages at Step 2, if scan converter, LCD projector not available

For the class:
6. Internet-connected computers for research at Step 4, if assigned as classwork (1-2 students per computer)

For lung model, per pair:
7. One copy of directions, linked at Step 3
8. One 1-liter bottle, pre-cut
9. Three balloons

10. 2” cube of modeling clay
11. 6" of surgical or aquarium tubing
12. Scissors
13. One 3-way hose connector

For lung modification, per pair:
14. Small clips, fasteners, glue, gelatin or corn starch and water, cotton, etc.

Total Duration
2 hrs. 45 min. to 3 hrs. 15 min.

Technology Connection
Students will use Internet-connected computers to conduct research at Step 4, if assigned as classwork. The teacher will use the Internet to preview and print student hand-outs; and, in conjunction with a scan converter and LCD projector or TV hookup, may display Web resources for the class.

Assessment
To demonstrate understanding of lesson concepts, each student will correctly label a diagram of the respiratory system (Step 2), construct a working model of lungs and diaphragm (Step 3), and modify the model to illustrate the health impacts of air pollution on people who are at risk (Step 5).

An Answer Key for the diagram is linked below. A Scoring Rubric for all lesson activities is attached. (This rubric can be distributed to students at Step 2, and used as a score sheet at the end of the lesson). Please note that risk groups are listed in Step 4 and health effects are listed in Step 5. In addition, an Answer Key for the research activity is attached at Step 5, to provide the teacher with background information for the model modifications and for the Debriefing discussion. Students' research notes are not intended to be assessed or scored.

Web Resources

Title: Answers to Student Worksheet on Respiratory System
URL:
http://www.enchantedlearning.com/subjects/anatomy/lungs/label/labelanswers.shtml
Annotation: This answer key shows a correctly labeled Student Worksheet. In addition, students should have drawn in and identified four parts not on the Worksheet: aveoli, esophagus, pleura, and ribs. Locations of these parts are shown in the Respiratory System Chart linked at Step 2. Note: Enchanted

Learning is a free resource, but users are encouraged to donate $20 annually to help the creators of this Web site continue to make it available.

Attachments

Title: Answer Key- Research on Health Effects of Air Pollution **FileName:** Answer Key for Research on Health Effects of Air Pollution.doc
Description: This answer key corresponds to the research students conducted at Step 4. The research notes are not to be scored or assessed. Answers are provided to assist the teacher in reviewing the lung model modifications and leading the Debriefing discussion at Step 6.

Title: Scoring Rubric for Every Breath You Take
FileName: Scoring Rubric for Every Breath.doc
Description: This attachment provides criteria for evaluating student performance. The rubric may be distributed to each student at Step 2, as a checklist, or simply used by the teacher at the end of the lesson. Graphics from Microsoft Design Gallery and The Clean Air Campaign (used with permission).

Extension
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.