High School Lesson Plans

- Air Pollution 101 (Grades 9-12)
- Air Quality Index (Grades 9-12)
  “Air Quality Index: How Healthy is the Air You Breathe?” presentation [here](#)
- Particulate Pollution Activity
- The Clean Air Act - Do You Agree or Disagree? (Grades 9-12)
- Climate Change and Air Pollution
  “Climate Change and Our Atmosphere” presentation [here](#)
- The Costs of Air Pollution (Grades 9-12)
  “The Co$t$s of Air Pollution” presentation [here](#)
- The Life Cycle of Your Athletic Shoe (Grades 9-12)
- No Idling: Young Lungs at Work (Grades 9-12)
Air Pollution 101
Grades 9-12

Length of Lesson:
One class period

Standards:
Georgia Science Standards:
• SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
• SEV3. Students will describe stability and change in ecosystems.
• SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
• SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
• SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
• SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards/ScienceStandards9-12.aspx

National Standards Addressed:
• Content Standard: NS.9-12.1 Science as Inquiry
  As a result of their activities in grades 9-12, all students should develop
  o Abilities necessary to do scientific inquiry
  o Understandings about scientific inquiry
• Content Standard: NS.9-12.5 Science and Technology
  As a result of their activities in grades 9-12, all students should develop
  o Abilities of technological design
  o Understandings about science and technology
• Content Standard: NS. 9-12.6 Personal and Social Perspectives
As a result of their activities in grades 9-12, all students should develop an understanding of
  o Personal and community Health
  o Population growth
  o Natural resources
  o Environmental quality
  o Natural and human-induced hazards
  o Science and technology in local, national, and global challenges


Excellence in Environmental Education: Guidelines for Learning Addressed:
  • Strand 1 Questioning, Analysis, and Interpretation Skills
  • Strand 2 Knowledge of Environmental Processes and Systems
  • Strand 3 Skills for Understanding and Addressing Environmental Issues
  • Strand 4 Personal and Civic Responsibility


Focus:
The basics of air pollution; the seven main pollutants and their sources.

Description:
Students will gain background knowledge of the basic sources of air pollution, along with the 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 for each pollutant.

Materials:
  • Background information
  • Clear, plastic (or small glass jars recycled from café) for each student – each student needs their own cup to illustrate how

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
“each and every one of us” impacts our air quality

- Liquid- type food coloring-set for each group/table/student. For this lesson, we used red, green, yellow, and blue. Note: Food coloring will stain clothing/skin

- Ground charcoal (from pet store, or ground substance that will not dissolve in water)

- Cocoa mix and lemonade drink mix (each student will need some of each mix)

- Clean water

- Large container (to hold all of students’ water once they have completed the demonstration)

- Student Worksheet

**Vocabulary:**

- Sulfur Dioxide
- Nitrogen Dioxide
- Carbon Monoxide
- Volatile Organic Compounds
- Particulate Matter
- Ozone
- US Environmental Protection Agency (EPA)

**Background:**

Air pollution affects all living things. It causes health problems in humans and animals, damages plants, kills fish, pollutes water, eats away at infrastructure, and reduces visibility. It can also lead to acid rain, global warming, and smog. In the United States, for example, six out of every 10 people live in areas that fail to meet one or more federal air quality standards during some part of the year. Luckily there are agencies, like the United States Environmental Protection Agency (USEPA), that are looking out for the lungs, leaves, and gills of those who require some clean air!

Pollutants of any sort can ride the air currents for long distances. The air around is never just a local concern, but cuts across regional, national, and global boundaries. Air pollution from human sources is the result of our increasing use of large amounts of fuel from burning
coal, oil, wood, and other fuels we use to run factories, cars, and power plants that generate electricity.

See attachment for extensive information on the seven common air pollutants.

Also click on the following Web site for more information on air pollutants [http://www.epa.gov/air/airpollutants.html](http://www.epa.gov/air/airpollutants.html)

**Procedure:**
Write the words “Air Quality” on the board and ask students the following questions:

- Do you think the quality of the air in their area is good or bad?
- How do you know? What evidence is there of air pollution?
- Have you ever experienced burning eyes, itchy throat, or shortness of breath on polluted days?
- What time of the year does the air seem dirtiest?
- Tell students that the issue of “air quality;” – how good or bad the air is – air quality during the May to Sept. months are often in the GA news.
- Ask students why there is so much talk about “air quality?” Guide them to identify the importance of air for living things. Explain that bad air can contribute to a variety of illnesses such as asthma and cancer.
- Provide information and write on the board the seven pollutants mentioned in the background information.
- Allow students to give input on each pollutant such as: the sources of each pollutant and the health and environmental impacts.
- Have students take notes on the key points for each pollutant.
- Bring students to the conclusion that we are often unaware of how our everyday activities contribute to air pollution. (At the end of Activity One/demonstration, their cups of colored water provide a striking visual reminder of each student's contribution to air pollution.)

**Activity One:**

- Divide your class into work groups of three to six students each
- Give each student a clear plastic cup that is ¾ full of clean water
- Give each work group a set of supplies (food colorings, ground
charcoal, cocoa mix and drink mix)

- Now 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

<table>
<thead>
<tr>
<th>Air Pollutant</th>
<th>Corresponding color/mix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfur Dioxide</strong> (SO²)</td>
<td>Pinch of lemonade mix</td>
</tr>
<tr>
<td><strong>Nitrogen Dioxide</strong> (NO²)</td>
<td>Pinch of cocoa drink mix</td>
</tr>
<tr>
<td><strong>Carbon Monoxide</strong> (CO)</td>
<td>One drop red food coloring</td>
</tr>
<tr>
<td><strong>Lead</strong> (Pb)</td>
<td>One drop green food coloring</td>
</tr>
<tr>
<td><strong>Volatile Organic Compounds</strong> (VOCs)</td>
<td>One drop blue food coloring</td>
</tr>
<tr>
<td><strong>Particulate Matter</strong> (PM10)</td>
<td>Pinch of ground charcoal</td>
</tr>
<tr>
<td><strong>Ozone</strong> (O3)</td>
<td>One drop yellow food coloring</td>
</tr>
</tbody>
</table>

- Now 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)

Here are the “activities” to read to students. Feel free to add or delete activities as they might relate specifically to the school or community.

1. You drove or were a passenger in a car/truck
   a. 1 drop red coloring-represents **Carbon Monoxide (CO)** in motor vehicle exhaust
   b. 1 drop blue coloring-represents the **Volatile Organic Compounds (VOCs)** produced by the engine when gasoline or oil is burned
   c. 1 pinch lemonade mix-represents **Sulfur Dioxide (SO₂)** in auto exhaust
   d. 1 pinch cocoa-represents **Nitrogen Dioxide (NO₂)** from vehicle exhaust

2. You enjoyed heat, air conditioning, or a warm shower
   a. 1 drop green coloring-represents **Lead (Pb)** in electricity generation
1. You or your family drove to school or work
   a. 1 drop blue coloring-represents Volatile Organic Compounds (VOCs) when chemicals evaporate
   b. 1 pinch lemonade mix-represents Sulfur Dioxide (SO₂) emitted by burning fossil fuels to create electricity
   c. 1 pinch cocoa-represents Nitrogen Dioxide (NO₂) from coal combustion

2. You went to a gas station to fill your car with gasoline
   a. 1 drop red coloring-represents Carbon Monoxide (CO) in car exhaust
   b. 1 drop yellow coloring-represents Ozone (O₃) evaporation
   c. 1 pinch lemonade mix-represents Sulfur Dioxide (SO₂) from fuel combustion

3. You got ready for school or work and used nail polish or hairspray
   a. 1 drop blue coloring-represents Volatile Organic Compounds (VOCs) in indoor air

4. You used your computer, IPOD, or Video Games
   a. 1 pinch of ground charcoal-represents Particulate Matter (PM10) resulting from power plants burning coal to produce electricity
   b. 1 drop green coloring-represents Lead (Pb) as a station source providing utilities
   c. 1 pinch lemonade mix-represents Sulfur Dioxide (SO₂) from burning fossil fuels to create electricity

5. You or your family burned firewood or yard debris
   a. 1 drop red coloring-represents the Carbon Monoxide (CO) in wood burning
   b. 1 pinch ground charcoal-represents Particulate Matter (PM10) in the burning, leaving ash and soot

6. You or your family used paint or some type of solvent
   a. 1 drop blue coloring-represents Volatile Organic Compounds (VOCs) when chemicals evaporate
   b. 1 drop green coloring-represents Lead (Pb) as a station source providing utilities

7. You traveled down a dirt or gravel road
   a. 1 pinch of ground charcoal-represents Particulate Matter (PM10) from dust

8. You or your family used gasoline-powered equipment to mow the lawn, blow yard clippings, or whack the weeds.
   a. 1 drop blue coloring-represents the Volatile Organic Compounds (VOCs) in exhaust and gas vapors
   b. 1 pinch lemonade mix-represents Sulfur Dioxide (SO₂) emitted by the equipment’s engine
   c. 1 pinch cocoa-represents Nitrogen Dioxide (NO₂) in exhaust from burning fuel
   d. 1 drop yellow coloring-represents Ozone (O₃) from fuel combustions and evaporation

9. You or your family purchased gasoline at the gas station
   a. 1 drop yellow coloring-represents Ozone (O₃) from evaporation while filling tank (mostly occurs on hot, sunny day)
   b. 1 drop blue coloring-represents Volatile Organic Compounds (VOCs) when chemicals evaporate

10. You put on your favorite shirt, which your parent had dry-cleaned for you.

This lesson plan is available thanks to a grant from The Harland Foundation.
The Clean Air Schools program is helping educate future leaders about air quality and transportation.
Learn more at CleanAirCampaign.org.
a. 1 drop of blue food coloring—represents the Volatile Organic Compounds (VOCs) emitted by the dry-cleaning process

11. You smoked a cigarette
   a. 1 drop red coloring—represents Carbon Monoxide (CO) in tobacco smoke
   b. 1 pinch lemonade mix—represents the Sulfur Dioxide (SO$_2$) gas in tobacco smoke
   c. 1 pinch cocoa mix—representing traces of Nitrogen Dioxide (NO$_2$), which can be found in tobacco smoke

12. You used office equipment such as a printer or copier
   a. 1 drop blue food coloring—represents the Volatile Organic Compounds (VOCs) released when equipment is used

Activity Two: Discussion
Ask your students the following questions:
1. Look inside your cups. If the air pollution around you were this apparent, would you want to breathe the air?
2. What other sources of air pollution, beyond those mentioned in this demonstration, could you think of as being produced in a single day?
3. What could you do to reduce the number of pollutants released each day?
4. Pour each students “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 contribute to air pollution.
5. Help students come up with a list of things they can do to reduce their impact. Such as:
   o Drive less
   o Drive smart
   o Buy smart
   o Choose air friendly products
   o Save energy
   o Practice the 3 R’s (Reduce, Reuse, and Recycle)
   o Don’t smoke
   o Speak up for clean air
   o Visit the following Web site for more information – California Environmental Protection Agency at http://www.arb.ca.gov/html/brochure/50things.htm
Extension:
Rather than a lecture or question and answer format and if time permits, divide the class into seven groups and assign each group one of the six pollutants. After allowing time to research each pollutant, have the group report back to class about their group’s “assigned” pollutant. Several students can even play “Reporter” and interview the groups about their assigned pollutant.

Assessment:
- Students will be assessed by participating in class discussion and activities
- Completion of Student Worksheet detailing description and interesting facts of each of the seven pollutants covered in the lesson

Follow-Up:
After you have taught this lesson plan, please tell the Clean Air Schools program about your efforts in a brief, 60-second online survey at CleanAirCampaign.org. The information you provide is invaluable in helping this non-profit education program direct its resources to improving these lesson plans and creating new materials for your students. Thanks!
# Student Worksheet for Air Pollution 101

<table>
<thead>
<tr>
<th></th>
<th>Brief Description</th>
<th>3 Interesting Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfur Dioxide (SO₂)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nitrogen Dioxide (NO₂)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Carbon Monoxide (CO)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lead (Pb)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Volatile Organic Compounds (VOCs)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Particulate Matter (PM10)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ozone (O₃)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
Air Quality Index
Grade 9-12

Length of Lesson:
One to three class periods, plus time for collection of data for Particulate Pollution Activity

Standards:
Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards/ScienceStandards9-12.aspx

National Science Standards Addressed:
- **Content Standard: NS.9-12.1 Science as Inquiry**
  As a result of their activities in grades 9-12, all students should develop
  - Abilities necessary to do scientific inquiry
  - Understandings about scientific inquiry
- **Content Standard: NS.9-12.5 Science and Technology**
  As a result of their activities in grades 9-12, all students should develop
  - Abilities of technological design
  - Understandings about science and technology
- **Content Standard: NS. 9-12.6 Personal and Social Perspectives**
As a result of their activities in grades 9-12, all students should develop an understanding of
  o Personal and community Health
  o Population growth
  o Natural resources
  o Environmental quality
  o Natural and human-induced hazards
  o Science and technology in local, national, and global challenges


National Technology Standards Addressed:
  • **Content Standard: NT.K-12-5 Technology Research Tools**
    o Students use technology to locate, evaluate, and collect information from a variety of sources
  • **Content Standard: NT.K-12-6 Technology Problem-Solving and Decision-Making Tools**
    o Students use technology resources for solving problems and making informed decisions.

North American Association for Environmental Education (NAAEE): Guidelines for Learning Addressed:
  • Strand 1 Questioning, Analysis, and Interpretation Skills
  • Strand 2 Knowledge of Environmental Processes and Systems
  • Strand 3 Skills for Understanding and Addressing Environmental Issues
  • Strand 4 Personal and Civic Responsibility


Focus:
The lesson focuses on the Air Quality Index: what pollutants are monitored, how it is calculated, the AQI chart and reporting, and what the AQI levels mean for public health.

Description:
Students will watch a PowerPoint presentation detailing the Air Quality Index.

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
Materials:
- PowerPoint presentation: “Air Quality Index. How Healthy is the Air You Breathe?”
- Materials below for “Particulate Pollution Activity”
- Microscope slides (Two per location to be studied or one slide plus one cover slip)
- Markers
- Rulers in mm
- Masking tape
- Self-adhesive labels
- Microscopes or magnifying glasses
- Petroleum jelly or double-sided tape

Vocabulary:
- Air pollution
- Air Quality Index
- Standards
- Particulates
- Ground-level ozone
- Carbon monoxide
- Sulfur dioxide
- Nitrogen dioxide
- Air quality standard
- Environmental Protection Agency (EPA)

Background:
Air pollution is often colorless or odorless, so it must be monitored through specific means in order to protect the public, animals, vegetation, materials and buildings. The EPA’s ‘Air Quality Index’ is a tool for monitoring 5 major air pollutants, determining a level of hazard, and disseminating that information to the public, governmental agencies, and industry/commerce. See below for more detailed background information.

Web sites:
AQI Brochure and information:
http://airnow.gov/index.cfm?action=aqibroch.index

AQI calculator:

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
http://airnow.gov/index.cfm?action=aqi.conc_aqi_calc

See page 9 at the following link for an interesting graphical diagram of AQI; page 16-18 of the pdf includes the equation used to calculate AQI for an individual pollutant:
http://www.epa.gov/airnow/aqi_tech_assistance.pdf

AIRNow- FAQ about AQI calculations and maps
http://airnow.gov/index.cfm?action=airnow.faq

Procedure:
1. Warm-up
2. Show PowerPoint presentation: “Air Quality Index. How Healthy is the Air You Breathe?”
3. Complete Activity and/or extension

Warm-up:
1. Write on the board: “How Healthy is the Air You Breathe?”
2. Ask students how they would answer the question, and how they know their answer. Ask if they think this information is important to the public, government, or industry/commerce.
3. After brief discussion, ask how a scientist would judge how healthy the air is- the answer should be with empirical observations, such as monitoring data from the atmosphere, or health data from people.
4. Introduce AQI topic as a tool developed to help us understand the health of the air we breathe. It uses monitoring data to help us understand the risk of certain health concerns from the air we breathe daily.

Activity One:
PowerPoint presentation: “Air Quality Index. How Healthy is the Air You Breathe?”

Activity Two:
Particulate Pollution Activity
Extension One:
Smog City 2
Students will extend the ideas learned in this lesson by using an interactive air pollution simulator to see how individual choices, land use, and environmental factors may affect the air we breathe. The simulation may be used by individual students with computer access, small groups, or as a class.
http://www.smogcity2.org/

Extension Two:
Divide students into five groups, with each group focusing on just one of the AQI monitored pollutants. Have each group take pictures of everyday activities (or find pictures on the Internet or in magazines) and make a poster for their assigned pollutant. What activities contribute to each pollutant?

Assessment:
- Participation in class discussion and class activities
- Completion of Particulate Pollution Activity Lab Report

References:
http://www.air.dnr.state.ga.us/information/aqi.html
http://airnow.gov/
http://airnow.gov/index.cfm?action=aqi_toolkit.main
http://www.epa.gov/ne/students/teacher/aire.html

Follow-Up:
After you have taught this lesson plan, please tell the Clean Air Schools program about your efforts in a brief, 60-second online survey at CleanAirCampaign.org. The information you provide is invaluable in helping this non-profit education program direct its resources to improving these lesson plans and creating new materials for your students. Thanks!
Particulate Pollution Activity

Materials:
- Microscope slides (Two per location to be studied or one slide plus one cover slip)
- Markers
- Rulers in mm
- Masking tape
- Self-adhesive labels
- Microscopes or magnifying glasses
- Petroleum jelly or double-sided tape

Procedure:
1. Place label across the short side of the slide as a label for information about the site where the slide will be placed and duration.

2. If microscopes are not being used, draw a 2 cm by 2 cm square on slides to be placed, using a marker. Draw lines at 1 cm in both directions inside square to aid in counting particles.

3. Determine site placement of slides. It is suggested that slides be placed indoors, including some near electronic appliances, which attract particulate matter, and some placed outside near roads and also farther away, some near parking lots, pedestrian-only areas, etc. List locations in lab notebook, and label slides accordingly. (Label also with time period if that is to be varied.) Students should hypothesize which site would have the greatest particle pollution.

4. Lightly spread petroleum jelly inside square drawn on slides, or place double-sided tape on slides, leaving the tape cover strip on until placed at site.

5. Place slides with petroleum jelly-side up in the locations noted, or with tape side up and remove cover strip. Two slides per location may be used to increase data or to average. Adhere

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

8/25/2009
with masking tape to keep slide in place where the air easily reaches it and it will not be disturbed.

6. Leave slides in place for 24 hours or more; alternatively, multiple slides could be placed in one location, and the time left varied from 24 hours to one week.

7. When slides are retrieved, carefully place a cover slip or another slide on top to preserve particles trapped by petroleum jelly or tape.

8. Using the microscope or hand lens, students should count the number of particles within each 2 cm square and record in their lab notebooks. If microscopes and mm rulers are available, students may record the number of particles per mm².

9. If a microscope is available, students may measure particle size or record the various particles seen, and note color, shape, and size.

10. Students graph data and compare results.

Lab reports should include answers to the following questions:

1. Which site(s) had the highest and lowest particle density?
2. Was there a pattern of particle density noted?
3. What factors might account for the difference in particle size and density at the various locations?
4. If slides were placed for various time periods, does the data gathered follow the expected results?
5. Were they any specific particles that could be identified?
6. Are any of the results different than expected? Why?
7. What factors might have influenced the data collected? (season, traffic patterns, etc.)
8. What type of air pollution does this experiment track? Does it correlate with published Air Quality Index data for the same dates?
9. What type of air pollution is not measured by this experiment?
The Clean Air Act – Do You Agree Or Disagree?
Grades 9-12

Length of Lesson:
One to two class periods

Standards

Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

National Standards Addressed:
- **Content Standard: NS.9-12.1 Science as Inquiry**
  As a result of their activities in grades 9-12, all students should develop
  - Abilities necessary to do scientific inquiry
  - Understandings about scientific inquiry
- **Content Standard: NS.9-12.5 Science and Technology**
  As a result of their activities in grades 9-12, all students should develop
  - Abilities of technological design
  - Understandings about science and technology
- **Content Standard: NS. 9-12.6 Personal and Social Perspectives**

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
As a result of their activities in grades 9-12, all students should develop an understanding of
- Personal and community Health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

North American Association for Environmental Education (NAAEE): Guidelines for Learning Addressed:
- Strand 1 Questioning, Analysis, and Interpretation Skills
- Strand 2 Knowledge of Environmental Processes and Systems
- Strand 3 Skills for Understanding and Addressing Environmental Issues
- Strand 4 Personal and Civic Responsibility

Focus:
The Clean Air Act and the pros and cons of air pollution regulations

Description:
Students will learn about the Clean Air Act and the rules and regulations required for enforcement. Students will learn to distinguish fact from opinion and identify bias while deciding their position on air pollution regulations/The Clean Air Act. Working in groups, students will learn to reconsider their stance in light of new information.

Materials:
- Four pieces of paper or poster board (*Reduce paper waste by using the back side of a used piece of paper)
  Label each paper with one of the following statements: Strongly Agree, Agree, Strongly Disagree, and Disagree
- Handout for students. See link/attachment for information on The Clean Air Act
- Paper and pencils for each student

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
Vocabulary:
- Four corners
- Agree
- Disagree
- Opinion
- Persuasive
- Summarize
- Attainment
- Non-Attainment
- Environmental Protection Agency (EPA)
- Environmental Protection Division (EPD)

Background:
Governments rely on the development of standards as the basis of most regulations. For example, most environmental regulations are based on public or environmental health standards that help gauge the dangers posed by a certain level of pollution or contamination. However, people should understand that such standards are not purely scientific. Hard scientific data is always subject to the political process before it is written into regulations. Also, there is usually disagreement within the scientific community over the data itself. Standards are the result of this process.

The standard we are going to talk about today is referred to as The Clean Air Act. This act was passed in 1963, and then amended in 1970 and 1990. The goal of the Clean Air Act is to reduce pollution in our air.

Under this Act, six pollutants, called “criteria” pollutants, are regulated. The pollutants are: Nitrogen Dioxide, Carbon Monoxide, Sulfur Dioxide, Ozone, Lead, and Particulate Matter. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats. The six “criteria” pollutants are discharged in large quantities by a variety of sources. The Environmental Protection Agency (EPA) has regulatory authority for clean air standards. Each state must take action to ensure the standards are met. Areas not meeting the standards are called “non attainment.” In GA, The Environmental Protection Division (EPD) is the state agency charged with overseeing environmental wellness.
Click the following links for additional information on the Clean Air Act and Georgia’s current air quality information.
http://www.epa.gov/ne/students/pdfs/rd_cleanair.pdf

Click on the link below for The State of Georgia’s Environmental 2009 Report Card detailing the progress made and challenges ahead in the protection of our natural resources, including air quality.

Activity One:
- Create four signs, each with one of the following words: Strongly Agree, Agree, Disagree, or Strongly Disagree.
- Place one sign in each of the four corners of the classroom.
- Explain to the students that today they will have time to debate each other, which is basically a “facilitated argument.” Explain basic rules of a debate such as: respecting others opinions, only one person speaks at a time, no name-calling, time limits, etc.
- Present a statement that takes a stand on an issue of interest to students such as “Drivers should not use cell phone while driving” or “High School students need more sleep and therefore should start school two hours later.” You can also choose an issue/statement centered around local or world events.
- Allow students to have a brief period to state their views and come to the realization that different opinions exist on a topic and are neither right nor wrong.
- Give brief information on Clean Air Act and provide handout to students.
- Give students 15-20 minutes to think about their opinion on the topic, then ask the students if they Strongly Agree, Agree, Disagree, or Strongly Disagree.
- Have each student move to the corner of the classroom whose label/sign most matches their opinion on the Clean Air Act
- Hopefully, you will have groups in all four corners, if not, work with two to three groups.
- Appoint one student in each corner to take notes as they spend five to 10 minutes discussing with their group the reason they agree, disagree.
- Choose one spokesperson from each group to share with the
class some of their reasons and ideas.

- After all groups have spoken, ask if any students have a different opinion about the Clean Air Act and if so, allow them to change corners.
- Allow five to 10 more minutes for students to discuss in groups while each student writes a paragraph of four key points for their final position.

**Activity Two:**
- Help students come to an agreement on the key points for both sides, those that agree and disagree on this issue.
- Remember: allow students to change corners if their opinions have changed since the start of the lesson.
- Points to consider are listed below as well as Web sites for groups that either support or oppose air quality regulations.
- Allow five to 10 more minutes for students to discuss in groups while each student writes a paragraph of four key points for their final position.

**Proponents for clean air regulations generally site the following:**

1. Improved health and well-being with air regulations
2. Damage to the environment
3. Short term business gains are outweighed by long term costs which will be paid by generations to come

Organizations that generally support air quality regulations:
- American Lung Association
  [www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=33691](http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=33691)
- The Clean Air Campaign
  [www.cleanaircampaign.org](http://www.cleanaircampaign.org)
- Environmental Defense Fund
  [www.edf.org/page.cfm?tagID=97](http://www.edf.org/page.cfm?tagID=97)
- Save the Clean Air Act
  [http://ga3.org/campaign/cleanair_05_06](http://ga3.org/campaign/cleanair_05_06)

**Opponents to clean air regulations generally site the following:**

1. Government interventions interfere with free market choices
2. The cost of complying with air regulations outweighs benefits to society
3. Our leaders are “over-reacting” to air pollution and other “green” issues.

Organizations that generally support air quality regulations:
- CATO Institute
  www.cato.org/researcharea.php?display=4
- Texas Public Policy Foundation
  www.texaspolicy.com/publications.php?cat_level=88
- US Chamber of Commerce
  www.uschamber.com/issues/index/environment/airquality.htm

Extension:
- Allow students to come up with their own discussion topic
- Use the four-corner strategy to discuss three or four different statements. Then have students write a position paper on the statement they have the strongest feelings about.
- Provide time for students to read aloud their papers, and then provide time for peer reaction. First, ask students to share only positive comments about their classmates' papers; then provide time for students to share only constructive criticism. ("You might have done this differently...")

Assessment:
- Students will be assessed by participation within their group. See sample “Participation Rubric” attached.
- Each student will write a concise paragraph of four key points for their final position.

Follow-Up:
After you have taught this lesson plan, please tell the Clean Air Schools program about your efforts in a brief, 60-second online survey at CleanAirCampaign.org. The information you provide is invaluable in helping this non-profit education program direct its resources to improving these lesson plans and creating new materials for your students. Thanks!

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
Your Position:

___Strongly Agree  ___Agree  ___Strongly Disagree  ___Disagree

### Participation Rubric

<table>
<thead>
<tr>
<th>Criteria</th>
<th>3 points</th>
<th>2 points</th>
<th>1 point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of engagement in class</strong></td>
<td>Student proactively contributed to class by offering ideas and asking questions in class</td>
<td>Student rarely contributed to class by offering ideas and asking questions</td>
<td>Student did not contribute to class by offering ideas and asking questions</td>
</tr>
<tr>
<td><strong>Listening &amp; Speaking skills</strong></td>
<td>Student listened when others talked and spoke loud enough to be heard with confidence</td>
<td>Student listened, but interrupted others and did not speak with confidence</td>
<td>Student did not listen or talk about position</td>
</tr>
<tr>
<td><strong>Support with facts</strong></td>
<td>Used many facts that supported topic</td>
<td>Used some facts that supported topic</td>
<td>Did not use facts that supported topic</td>
</tr>
<tr>
<td><strong>Persuasiveness</strong></td>
<td>Position was clear and convincing</td>
<td>Position was sometimes clear and convincing</td>
<td>Position was never clear and convincing</td>
</tr>
<tr>
<td><strong>Teamwork</strong></td>
<td>Used team members effectively with equal timing</td>
<td>Allowed only one or two members to dominate the talking</td>
<td>No one spoke or shared viewpoints</td>
</tr>
</tbody>
</table>

**Total Points**

---

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation.
Learn more at CleanAirCampaign.org.

12/21/2009
Climate Change and Air Pollution
Grades 9 - 12

Length of Lesson:
One to two class periods

Standards:
Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards/ScienceStandards9-12.aspx

National Science Standards Addressed:
- Content Standard: NS.9-12.1 Science as Inquiry
- Content Standard: NS.9-12.5 Science and Technology
- Content Standard: NS. 9-12.6 Personal and Social Perspectives

National Technology Standards Addressed:
- Content Standard: NT.K-12.4 Technology Communication Tools
- Content Standard: NT.K-12.5 Technology Research Tools
- Content Standard: NT.k-12.6 Technology Problem-Solving And Decision-Making Tools

National Language Arts Standards Addressed:
- Content Standard: NL-ENG.K-12.4 Communication Skills
- Content Standard: NL-ENG.K-12.5 Communication Strategies

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
• Content Standard: NL-ENG.K-12.12 Applying Language Skills

North American Association for Environmental Education (NAAEE): Guidelines for Learning Addressed:
• Strand 1 Questioning, Analysis, and Interpretation Skills
• Strand 2 Knowledge of Environmental Processes and Systems
• Strand 3 Skills for Understanding and Addressing Environmental Issues
• Strand 4 Personal and Civic Responsibility

Focus:
This lesson focuses on climate change - what it is, how we know it is happening, and the causes.

Description:
Students will gain background knowledge regarding the effect of air pollution on climate change by viewing a PowerPoint presentation and participating in an activity to reinforce learning.

This lesson is appropriate for Environmental Science, Earth Science, Biology, and Chemistry classes as an introduction to climate change and air pollution, as well as for classes that consider current issues.

Materials:
• PowerPoint presentation “Climate Change and Our Atmosphere.”
• Internet access
• “Personal Solutions” worksheet

Vocabulary:
• Climate change
• Global warming
• Greenhouse gases
• Greenhouse effect
• Troposphere
• Stratosphere
• CO2
• Methane

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation.
Learn more at CleanAirCampaign.org.

12/21/2009
This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009

- Nitrous Oxides (NOx)
- Ozone
- Ozone Depletion
- Food chain/web
- Ultraviolet (UV) rays
- DNA
- Chlorofluorocarbon (CFC)
- Catalyst

**Background/ References:**
- View the PowerPoint presentation prior to showing it to students.
- Visit the following links for more information on climate change and air pollution:
  - [http://epa.gov/climatechange/basicinfo.html](http://epa.gov/climatechange/basicinfo.html)
  - [http://www.epa.gov/climatechange/fq/science.html](http://www.epa.gov/climatechange/fq/science.html)
  - [http://www.epa.gov/ozone/strathome.html](http://www.epa.gov/ozone/strathome.html)

**Procedure:**
- Complete the Warm-Up to introduce lesson.
- Show the “Climate Change and Our Atmosphere” PowerPoint presentation.
- Complete Activity Two and Activity Three if time permits.

**Warm-up:**
- Write on the board, “Climate Change and Our Atmosphere.”
- Ask students to list some of the points they already know about climate change.

**Activity One:**
- Students view PowerPoint presentation “Climate Change and Our Atmosphere.”
Activity Two:
- Complete the attached "Personal Solutions" worksheet.

Activity Three:
- Calculate your family's CO2 emissions and potential savings using the emissions calculator at the following site: http://epa.gov/climatechange/emissions/ind_calculator2.html#c =theBasics&p=reduceOnTheRoad&m=calc_currentEmissions

Extension: Cooperative learning exercise
- Visit the following link for the IPCC Report for Policymakers: http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf
- Using the "Summary for Policymakers" report of Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC), divide students into groups to read and report to the class on each of the following sections:
  - Human and Natural Drivers of Climate Change
  - Direct Observations of Recent Climate Change
  - A Palaeoclimatic Perspective
  - Understanding and Attributing Climate Change
  - Projections of Future Changes in Climate (omit 'Emissions Scenarios')
- Discuss the following questions with the class.
  - Is climate change "real"?
  - Is there accurate science behind the observations and predictions?
  - What are some ways to limit the causes of climate change?
  - Are the changes that can be made enough to eliminate further climate change?
  - What might the world be like if we don’t make changes?
  - What are YOU going to do to help solve this problem?

Assessment:
- Participation in class discussion and class activities
- Completion of activity

Follow-Up:
After you have taught this lesson plan, please let us know what you think by clicking on Feedback Form at http://www.cleanaircampaign.org/Kids-Schools/Lesson-Plans. The

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
information you provide is invaluable in helping us strengthen these lesson plans, align them with your learning objectives, and create new materials for your students. Thanks for your help!
# Climate Change and Our Atmosphere

## Personal Solutions Worksheet

<table>
<thead>
<tr>
<th><strong>PERSONAL SOLUTION</strong></th>
<th><strong>WHY WOULD THIS HELP PREVENT CLIMATE CHANGE?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Costs of Air Pollution
Grades 9 - 12

Length of Lesson:
One to two class periods

Standards:

Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards/ScienceStandards9-12.aspx

National Science Standards Addressed:
- Content Standard: NS.9-12.1 Science as Inquiry
- Content Standard: NS.9-12.5 Science and Technology
- Content Standard: NS. 9-12.6 Personal and Social Perspectives

National Social Studies Standards Addressed:
- Content Standard: NSS-EC.9-12.17 Using Cost/Benefit Analysis To Evaluate Government Programs
- Content Standard: NSS-EC.9-12.8 Role of Price In Market System
- Content Standard: NSS-EC.9-12.9 Growth

National Language Arts Standards Addressed:
- Content Standard: NL-ENG.K-12.4 Communication Skills
- Content Standard: NL-ENG.K-12.5 Communication Strategies

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation.
Learn more at CleanAirCampaign.org.
North American Association for Environmental Education (NAAEE): Guidelines for Learning Addressed:

- Strand 1 Questioning, Analysis, and Interpretation Skills
- Strand 2 Knowledge of Environmental Processes and Systems
- Strand 3 Skills for Understanding and Addressing Environmental Issues
- Strand 4 Personal and Civic Responsibility

Focus:
This lesson focuses on the economic or internal costs of air pollution, as well as the hidden or external costs, including health and environmental costs of air pollution. The PowerPoint presentation concludes with a brief overview of some economic principles and a short discussion of full-cost pricing as a part of “environmental economics.”

Description:
Students will gain background knowledge regarding the various prices paid for our economic prosperity and the resulting air pollution. They will view a PowerPoint presentation and then participate in an activity to reinforce learning.

This lesson is appropriate for Environmental Science, Earth Science, Biology, and Economics classes, as well as classes that address current issues.

Materials:
- PowerPoint presentation “The Costs of Air Pollution.”

Vocabulary:
- Economics
- Internal Costs
- External Costs
- Consumers
- Productivity
- Non-renewable Resources


The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.
- Renewable Resources
- Greenhouse Effect
- Acid Deposition
- Gross Domestic Product (GDP)
- Gross National Income (GNI)
- Ecological Debt
- Sustainable
- Subsidies
- Abatement

**Background:**
- View PowerPoint presentation prior to showing it to students.
- Visit: [http://www.epa.gov/NE/students/teacher/aire.html](http://www.epa.gov/NE/students/teacher/aire.html) - Health Effects, Acid Deposition, Automobiles and Air Pollution, Air Pollution Allowance Trading

**Procedure:**
- Complete Warm-Up to introduce lesson.
- Show the **“The Costs of Air Pollution”** PowerPoint presentation.
- Complete Activity Two as time permits.

**Warm-up:**
- Write on the board, “The Costs of Air Pollution.”
- Ask students to list some of the costs they have learned about while studying air pollution.
- Ask students to think of ways to reduce those costs and list on board.

**Activity One:**
- Students view PowerPoint presentation “The Costs of Air Pollution.”

**Activity Two:**
Visit [http://www.epa.gov/NE/students/teacher/aire.html](http://www.epa.gov/NE/students/teacher/aire.html) and choose from the following activities:
- Activity 1: Lifestyles and the Environment
- Activity 17: The Business of Clean Air
- Activity 18: Air Pollution Allowance Trading
- Activity 19: The Cost Of Polluting
Extension:
Cooperative learning: Students complete one of the above activities in groups or research one of the following topics:
  • Technologies for air pollution abatement and their costs
  • Incidence of asthma in Georgia, groups affected, and associated costs
  • Effect of acid deposition on Georgia habitats
  • Effect of acid deposition on Georgia or US monuments/ historical sites
  • Current status of ‘cap-and-trade’ legislation in US
  • Current use of ‘cap-and-trade’ laws in other countries

Assessment:
  • Participation in class discussion and class activities
  • Completion of activity

Follow-Up:
After you have taught this lesson plan, please let us know what you think by clicking on Feedback Form at http://www.cleanaircampaign.org/Kids-Schools/Lesson-Plans. The information you provide is invaluable in helping us strengthen these lesson plans, align them with your learning objectives, and create new materials for your students. Thanks for your help!
The Life Cycle of Your Athletic Shoe
Grades 9-12

Length of Lesson:
One to two class periods

Standards:
Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards/ScienceStandards9-12.aspx

National Science Standards Addressed:
- Content Standard: NS.9-12.1 Science as Inquiry
- Content Standard: NS.9-12.5 Science and Technology
- Content Standard: NS. 9-12.6 Personal and Social Perspectives

National Technology Standards Addressed:
- Content Standard: NT.K-12.4 Technology Communication Tools
- Content Standard: NT.K-12.5 Technology Research Tools
- Content Standard: NT.k-12.6 Technology Problem-Solving And Decision-Making Tools

National Language Arts Standards Addressed:
- Content Standard: NL-ENG.K-12.4 Communication Skills
- Content Standard: NL-ENG.K-12.5 Communication Strategies

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
North American Association for Environmental Education (NAAEE) Guidelines for Learning Addressed:
- Strand 1 Questioning, Analysis, and Interpretation Skills
- Strand 2 Knowledge of Environmental Processes and Systems
- Strand 3 Skills for Understanding and Addressing Environmental Issues
- Strand 4 Personal and Civic Responsibility

Focus:
Students will understand that all of the products they buy, such as athletic shoes, have an impact on the environment, including air quality. That goes beyond disposal of the packaging or other waste associated with the product.

Description:
Students will work in groups to research the life cycle stages of a pair of athletic shoes. Students will also develop a collection/recycling program for used athletic shoes.

Materials:
- Access to Internet (or printed background information)
- Student worksheets: “Life Cycle of an Athletic Shoe”

Vocabulary:
- Manufacturing
- Eco-footprint
- Life Cycle Analysis
- Cradle to Grave Analysis

Background:
We hear a lot about greenhouse gases and carbon footprint, mostly as they relate to transportation and energy production. But, EVERYTHING WE DO and EVERY PRODUCT WE BUY has an ecological footprint that impacts our air, water, and land.
Just like life cycles in nature, every product has a “life cycle.” Perhaps the best tool to consider the true impact of a product is a Life Cycle Analysis (LCA), also sometimes referred to as “Cradle-to-Grave” Analysis.

The term 'life cycle' refers to the notion that a fair, holistic assessment of a product’s impact requires the consideration of:

- materials used in the product and their production
- manufacturing of the product
- distribution of the product
- use of the product
- disposal of the product
- all transportation steps caused by the product's existence

The sum of all those steps - or phases - is the life cycle of the product. The concept can also be used to optimize the environmental performance of a product or to optimize the environmental performance of a company.

A Life Cycle Analysis (LCA) has most often been used to compare two products, such as paper or plastic bags, cloth diapers vs. disposable diapers, etc. to determine their environmental impact. A LCA can be used to compare the energy usage between two products, however it does not provide a way to rank the importance of the factors researched. For example, what impact should be ranked highest in importance: energy usage, air quality, water quality, or solid waste? Many companies actually hire private firms to conduct LCA’s on their products as a marketing tool. This could mean lots of profits for some companies who tout their product as “environmentally friendly.”

The company Nike works to reduce the environmental impact of its athletic shoes, from the research stage, all the way through the disposal phase, which they refer to as “downcycling” rather than recycling. Downcycling is a term Nike coined to explain how an athletic shoe is collected, processed, and turned into “other” sport-related materials such as: running track surfacing, tennis courts, playground surfaces and even padding for indoor flooring. The ultimate goal of any eco-friendly product life cycle is to “close the loop” by creating a product that can be reused or recycled when it is at the end of “its life.” This would be “closing the recycling loop.”
Sustainable companies design products with people, product, and the planet in mind. Nike is one such company working to close the loop in the sporting goods industry. Click the link to see more information on how Nike is using LCAs to reduce its environmental impact and reduce costs.  
http://www.nikebiz.com/responsibility/considered_design/reuse_a_shoe.html

Click on the following link for more detailed information on life cycle analysis and assessment.  http://www.gdrc.org/uem/lca/lca-for-cities.html

**Procedure:**
- Review a product life cycle with students.
- Have students work in groups to complete the worksheet “The Life Cycle of an Athletic Shoe.”
- Have students implement a collection/recycling program for used athletic shoes within their school or community.

**Warm-up:**
- Ask students if they own a pair of athletic shoes. How many think their favorite “Jordans” have an eco-footprint?
- Review with students a “natural” life cycle, such as a butterfly, frog, or even the water cycle.
- Ask students if they’ve realized their favorite shoes or “gadgets” have a life cycle.
- Ask students if they have ever thought about how a shoe is manufactured, shipped, and consumed?

**Activity One:**
- (Optional) Have students take off one of their shoes and put it on their desk. Ask students to write down the materials that went into “manufacturing” of their shoe. This list could include: leather, plastic, metal, cotton, rubber, etc.
- Discuss with students some examples of everyday products and what resources went into making that particular product. For example: Plastics used in phones, roller blades, medical devices, etc. are made from a large group of chemicals derived from petroleum and natural gas. Bikes, cars, beverage cans, jewelry, etc. are made from aluminum or other materials.
• Continue this discussion if desired; otherwise, begin today’s lesson: conducting a life cycle analysis of an athletic shoe. Because of the complexity of conducting a life cycle analysis, the goal of the lesson is to introduce students to thinking beyond the final product that sits on the store shelf.

1. Divide the class into the five life cycle research groups. Each group will research an athletic shoe, looking at a particular stage of the product’s life cycle.

2. Assign each group one of the following stages to research

   Groups: (See student worksheet)
   Phase 1: Research & Design
   Phase 2: Manufacturing
   Phase 3: Retail and Packaging
   Phase 4: Consumers
   Phase 5: Disposal/Recycling.

3. Ask students to record their research on the student worksheet below.

4. Have each group report back to the class on their particular research. Conclude with a discussion about the environmental impact of products ...every step of the way from production to disposal. Discuss specific affects the product has on air quality, water quality, land use, etc.

**Activity Two:**

• Investigate the life cycle of another popular teen product, such as a cell phone or even a cheeseburger and determine the ecological footprint.

**Extension:**

• Organize a shoe collection and arrange for the collected shoes to be recycled. Some nonprofits, civic groups, and schools have conducted “shoe collections” as part of Nike’s Reuse-A-Shoe (RAS) program. Since Nike started their “reuse-a-shoe” program, more than 20 million pairs of athletic shoes have been recycled and more than 250 sport surfaces have been built from recycled athletic shoes.

• Have students design a “shoe collection” for their school. This program needs to include an awareness campaign educating on the impacts of a shoe on air, water, land, etc. The program

---

This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.

12/21/2009
should also include a collection system for the shoes and transportation to get them to recycling facility.

See the link below to Nike’s Reuse-A-Shoe Program.  
http://www.nikereuseashoe.com/

Assessment:  
- Participation in class discussion and class activities  
- Completion of student worksheet

Follow-Up:  
After you have taught this lesson plan, please let us know what you think by clicking on Feedback Form at  
http://www.cleanaircampaign.org/Kids-Schools/Lesson-Plans.  The information you provide is invaluable in helping us strengthen existing lesson plans, align curriculum with your learning objectives, and create new materials for your students.  Thanks for your help!

Student Worksheet:  Life Cycle of an Athletic Shoe

Phase 1: Research & Design

1. **Who is the target customer?**

2. **Why were the materials chosen?**

3. **What resources were used to make this item?**

4. **What substances will be introduced into the life cycle of this product?  Air pollutants?  Water pollutants?  (For example:  trucks transporting materials release carbon dioxide into the air;  if the item is heavy, more fuel is used.  If excess packaging is used, then this adds to our municipal solid waste.  )**
5. *Is this product designed to last a long time? How long?*

**Phase 2: Manufacturing**

1. *How is this item put together? (stitched, glued, etc.)*

2. *Is there another way this item could be put together?*

3. *What substances were introduced into the environment? Air pollutants? Water pollutants? (for example: trucks transporting materials for manufacturing release carbon dioxide into the air; if the item is heavy, more fuel is used. If excess packaging is used in transport, then this adds to our municipal solid waste.)*

4. *How could waste be prevented in the manufacture of this item?*

5. *What resources were used to make this item?*

6. *Is excess waste produced when making this item?*

7. *What is the energy usage for production?*
Phase 3: Retail/Packaging

1. How is the product packaged (box, bag, no packaging)?

2. Does the product need to be packaged this way? Why?

3. Is the packaging too much, too little, or just right?

4. Is the packaging recyclable or made from recycled materials?

5. What substances were introduced into the environment in the packaging or retail phase? Air pollutants? Water pollutants? (For example: trucks transporting materials release carbon dioxide into the air; if the item is heavy, more fuel is used. If excess packaging is used, then this adds to our municipal solid waste.)

Phase 4: Consumers

1. Why would a consumer need this product?

2. Do consumers care if the product is made from recycled materials?
3. **What does a consumer do with this product when it’s “life cycle” is over?**

4. **Is there a location in your community that collects this item for recycling?**

5. **How long would this product last for a consumer?**

---

**Phase 5: Disposal/Recycling**

1. **Is this item generally sent to a landfill or recycled in your community?**

2. **If this item were reused and/or recycled, would it have the same structure and performance the second time around?**

3. **What substances were introduced into the environment by landfilling or recycling this product? Air pollutants? Water pollutants?**

4. **Do the product “parts” have to be separated for recycling, if so how would this be done?**
No Idling: Young Lungs at Work
Grades: 9-12

Length of Lesson:
One to four class periods

Standards:
Georgia Science Standards:
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system.
- SEV3. Students will describe stability and change in ecosystems.
- SEV4. Students will understand and describe availability, allocation, and conservation of energy and other resources.
- SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.
- SEC5. Students will assess the impact of human activities on the natural world, and research how ecological theory can address current issues facing our society, locally and globally.
- SM5 Students will differentiate the climates of Earth, how climate changes through time, and the theories regarding current climate change.

https://www.georgiastandards.org/Standards/Pages/BrowseStandards /ScienceStandards9-12.aspx

National Science Standards Addressed:
- Content Standard: NS.9-12.1 Science as Inquiry
- Content Standard: NS.9-12.5 Science and Technology
- Content Standard: NS. 9-12.6 Personal and Social Perspectives

National Language Arts Standards Addressed:
- Content Standard: NL-ENG.K-12.4 Communication Skills
- Content Standard: NL-ENG.K-12.5 Communication Strategies


North American Association for Environmental Education (NAAEE) Guidelines for Learning Addressed:
- Strand 1 Questioning, Analysis, and Interpretation Skills
- Strand 2 Knowledge of Environmental Processes and Systems

This lesson plan is available thanks to a grant from The Harland Foundation.
The Clean Air Schools program is helping educate future leaders about air quality and transportation.
Learn more at CleanAirCampaign.org.
Strand 3 Skills for Understanding and Addressing Environmental Issues
Strand 4 Personal and Civic Responsibility

Focus:
Students will participate in peer conferencing and develop a point of view regarding no idling of vehicles. Students will also develop a public awareness campaign to encourage a no-idling policy on their campus.

Description:
Students will use an inner circle-outer circle system to debate vehicle idling. Students will also write an opinion essay and help develop a no-idling awareness campaign.

Materials:
- Classroom chairs for every student
- Printed information on vehicle idling or access to internet
- Paper, posters, markers (or other materials to make awareness posters/signs, etc.)

Vocabulary:
- Debate
- Vehicle Idling
- Vehicle Emissions
- Carbon Monoxide
- Nitrogen Dioxide
- Nitrogen Monoxide
- Sulphur Dioxide
- Benzene
- Formaldehyde
- Polycyclic Hydrocarbons

Background:
Ah, the ideal community – less traffic and air pollution, pedestrian friendly streets, recycling bins everywhere, sunny days...we can dream
right? But we should all desire a healthy, sustainable community. To accomplish this, we have to encourage citizens to take individual action. That action could be taken in a variety of ways: recycling, practicing water conservation, serving as a crime-watch neighbor, reducing idling of vehicles, etc. This lesson today focuses on doing our part to reduce air pollution and greenhouse gases by reducing unnecessary vehicle idling.

Exhaust from idling vehicles and buses contains harmful substances in the form of particle pollution. Particle pollution is harmful not only to agriculture, plants, and animals, but primarily to humans. Numerous studies have shown an increased rate of asthma cases and risk of respiratory infections in children who are regularly exposed to vehicle exhaust. Increased exposure to air pollution attacks the lungs in a way that is compared to getting “sunburned” in the lungs. Vehicle exhaust can lead to shortness of breath, wheezing and coughing, and even premature death.

The link below targets High School students and gives the basics of climate change, causes and scientific research, current and expected impacts, as well as solutions that we can take to reduce greenhouse gases. [http://www.climatechangenorth.ca/section-BG/B3_HighSchool_Outline.html](http://www.climatechangenorth.ca/section-BG/B3_HighSchool_Outline.html)

See the link below for the following: Student Handout: The Truth About Vehicle Exhaust, Ford Motor Company letter regarding idling vehicles (You will not need the Teacher Handout: Social Marketing.) [http://www.climatechangenorth.ca/section-LP/LP_27_HI_S_jennifer_SH.html](http://www.climatechangenorth.ca/section-LP/LP_27_HI_S_jennifer_SH.html)

The metro Atlanta region is considered a non-attainment area. A non-attainment area is one that does not meet the Environmental Protection Agency's standards for ozone pollution and can be classified as "non-attainment" of those standards. The current standards do not allow areas to exceed .08 parts per million of ozone over an eight-hour period.

In 2005, 725 tons of nitrogen oxides (NOx) were emitted daily in the 13-county metro Atlanta ozone non-attainment area. Mobile sources contributed more than half of the total, with 42 percent from on-road...
motor vehicles and an additional 15 percent from off-road vehicles, such as equipment used in construction, as well as aircraft and trains. NOx emissions from mobile sources will be increasingly important to air quality in the metro Atlanta area. For on-road mobile sources, projected population growth means that the number of vehicle miles traveled daily is expected to increase for at least the next 25 years.

Click the link below to access the State of Georgia’s Environment Report 2009, produced by Georgia’s Environmental Protection Division (EPD). This report contains up-to-date information on what we know, and don’t know, about the current condition of our water, land and air resources. [http://www.gaepd.org/Documents/soe2009.html](http://www.gaepd.org/Documents/soe2009.html)

Procedure:
- Engage students will several essential questions.
- Conduct inner circle-outer circle peer debates (described in Activity 1).
- Have students write a persuasive essay and take a stand on vehicle idling.
- Design a school-based no-idling campaign to educate parents, school officials and community members about the health affects of pollution and why no idling is so important.

Warm Up:
- Ask students the following:
  1. When was the last time you walked down the street or stood near your school’s student pick-up line and got a lung full of exhaust from either a car or bus?
  2. Do you like spending your hard-earned money on gasoline?
  3. Do you or your parents idle vehicles at a school in a student pick-up area?
- Inform students that when they are IDLING, they are getting ZERO miles per gallon. What a waste of your hard-earned money!

Activity One:
Inner-Outer Circle No Idling Debate: This debate involves listening to the point of view of others and writing a persuasive essay.
Instruct students that they will be "debating" environmental issues with many different classmates, but in a one-on-one situation.

Have students stand in a big circle. Every other person should take one giant step inside the circle and turn around facing those in the outer circle. In other words, there should be two circles with the outer circle people facing inward and the inner circle people facing outward, and everyone should be directly across from another student. (This procedure often works best if students use chairs rather than standing.)

Read one of the environmentally-related questions to students. (Questions below or make up your own.) Allow approximately 2 minutes for students to discuss/debate "their view" of this issue with the person directly across from them (inner circle student that is facing the outer circle student.)

After two minutes, have the outer circle rotate one space counter-clockwise and the inner circle rotate one space clockwise, so that each student is now facing a "new" debate partner. (Teacher can designate any number of "spaces" to rotate). Present another environmental question for students to discuss.

After two minutes, have the groups rotate once more. Continue as desired with a number of questions. Lead the students to the "main" discussion for the day: Idling of vehicles.

Continue with this "idling" debate/discussion, but after 2 minutes, have the groups rotate once again, but continue discussing the "idling" topic. Continue yet for a third round of rotations on this topic so that students are discussing the "idling" topic with several classmates.

Once students have spent sufficient time discussing this topic, have students return to their seats to begin Activity Two.

Environmentally-related debate questions:
- Should marine mammals be in captivity?
- Should recycling be mandatory?
- Should citizens be restricted from washing their cars during a drought?
- Can every driver do "something" to help reduce air pollution?
- Main debate question for this lesson:
- Should drivers turn off their engines while waiting to drop off or pick up students at school?
- While waiting for someone to come out of a store?
- While waiting for friend to come out of their house?

**Activity Two:**

**Persuasive Essay: Where Do You Stand On Vehicle Idling?**

- Have students spend the remainder of the class writing a persuasive essay on Vehicle Idling. Remind students that in persuasive writing, a writer takes a position FOR or AGAINST an issue and writes to convince the reader to believe or do something. As persuasive writing is more than just opinion, facts or examples are required to support an argument.
- For more details on persuasive writing, click the link below.
  [http://www.orangeusd.k12.ca.us/yorba/persuasive_writing.htm](http://www.orangeusd.k12.ca.us/yorba/persuasive_writing.htm)
- Discuss possible arguments for or against idling:
  - To keep frost from windshield
  - To keep car warm while you run in somewhere or wait for someone
  - To warm up engine on cold days
  - To prevent wear on the starter
  - To save fuel
  - Add to list based on student discussions

**Activity Three:**

**Develop a No-Idling Awareness Campaign for School**

- Students develop a no-idling campaign to reduce idling in the school parking lots and student drop-off areas. This will help improve the health of students by asking students, parents, staff, and visitors to turn off their engines instead of idling. The program can include outreach to bus drivers as well, however, most school systems already have policies in place regarding bus idling. Students will need to access the Clean Air Campaign’s No-Idling template to help plan and implement a No Idling program (see Extension below.)
  [http://www.cleanaircampaign.org/Kids-Schools/The-Clean-Air-Schools-Initiative/Programs/No-Idling-Program](http://www.cleanaircampaign.org/Kids-Schools/The-Clean-Air-Schools-Initiative/Programs/No-Idling-Program)
- Some things students need to consider: A timeline, how to create awareness about the campaign, finding a teacher or PTA
This lesson plan is available thanks to a grant from The Harland Foundation.

The Clean Air Schools program is helping educate future leaders about air quality and transportation. Learn more at CleanAirCampaign.org.