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## Lesson Plan: Clean Air, Good Health

Center for Urban Resilience

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## LESSON 4: CLEAN AIR, GOOD HEALTH

### OVERVIEW:

*The purpose of this investigation is to have students understand the causes and impact of air pollution especially as it relates to ground level ozone and air particles as well as the role of cities in producing air pollution. Students will read a brochure about ground level ozone created by the Environmental Protection Agency. They will then run a simulation controlling for different factors in a city and recording how changes affect the air pollution within a given location. Lastly, students will analyze ground level ozone data for the New England area from 1983 – 2007 in order to determine if the Clean Air Act is having an impact on air pollution in that region.*

### SUB-QUESTION:

How do various factors affect the air that I breathe?

### WAYS OF KNOWING URBAN ECOLOGY:



Students will...

#### Understand

- Understand the difference impact that ground level and atmospheric ozone has on ecosystems. (*ecosystem change, ecosystem state and structure, forces and drivers, human impact*)
- Understand ground level ozone is formed when by products of combustion interact in the environment. (*ecosystem change, ecosystem state and structure, forces and drivers, human impact*)
- Understand that air pollution results from the interactions of many environmental factors. (*ecosystem change, ecosystem state and structure, forces and drivers, human impact*)

#### Talk

- Develop an argument for whether they think the Clean Air Act has had an impact on ground level ozone in the New England Area.

#### Do

- Use a simulation game to explore how different environmental factors impact air pollution in a city.
- Analyze ground level ozone layer in New England from 1983 – 2007.

#### Act

*No specific goals connected with acting on urban ecology in this lesson.*

### SAFETY GUIDELINES

No specific safety issues are associated with this lesson.

### PREPARATION:

**Time:**

2 – 3 class periods

**Materials:****Day 1:****Activity 4.1**

For each student

Ozone Brochure (EPA)

**Day 2:****Activity 4.2**

For each student

Access to the internet ([www.smogcity2.org](http://www.smogcity2.org))

Worksheet 4.2

**Day 3:****Activity 4.3:**

Ozone Map PowerPoint (optional)

For each student

Worksheet 4.3

**INSTRUCTIONAL SEQUENCE****Activity 4.1: EPA Ozone Brochure - Reading**

1. Begin by asking students what they know about ozone. Remind students that they have been talking about public health in cities and ask them to think about how ozone impacts individual's health, particularly for people living in cities. Write their answers on the board in order to refer back as the lesson continues.
2. Distribute the Ozone Brochure to students. Many strategies may be used in this section of the lesson. Students could read individually, the class could read aloud, or students could be given different parts of the brochure to read and then report out to the class.
3. Before moving onto the next activity, the main points associated with the brochure should be highlighted for students.
  - *Ozone occurs in two layers of the atmosphere. Ground level ozone is bad for your health while ozone higher in the atmosphere is good for your health because it prevents some UV radiation from entering the Earth's atmosphere.*
  - *Ground-level ozone is created by chemical reactions between industrial emissions and sunlight.*
  - *Breathing ground-level ozone can negatively affect lung function.*
  - *High levels of ground-level ozone can also damage vegetation and ecosystems.*

**Teaching Strategy**

Literary Strategy: In order to help students to understand the information of the brochure, students can suggest a one sentence summary of each section that highlights the key points. These sentences can then be compiled as a basic summary of the brochure.

**Additional Resource**

A supplemental EPA brochure “Smog – Who does it hurt?” has also been included with this lesson that elaborates more specifically on the effects of ground-level ozone on lung function. Information from this brochure can be used to expand on the health issues related to breathing ozone.

**Activity 4.2: Smog City 2 Simulation**

1. Tell students that besides ozone there are other air pollutants in cities that impact public health. Another major pollutant is particle pollution or particulate matter. Ask students if they know what particle pollution is or if they can think of any examples.
  - *Students’ responses will vary. They may talk about cars, buses and factories producing particles.*
  - *Particle pollution or particulate matter consists of fine solids (like dust, ash and soot) and aerosols (i.e. solids suspended in liquid) suspended in the air we breathe.*
2. Tell students they will be using a simulation of a city to investigate what some of the pollutants are as well as how cities can be decide to limit air pollution.
3. Students can work individually at computers if enough exist or they can be paired. Distribute the worksheet 4.2. Students will access [www.smogcity2.org](http://www.smogcity2.org). Directions have been included on the worksheet to guide students through the steps to run the simulation.
4. After the students have had ample time to try different scenarios in the simulation (approximately 20 minutes), they should answer the questions found on the worksheet.
5. Discuss the two questions on the student worksheet. Before continuing on to the next activity, the fundamental factors that influence smog should be reviewed in order to confirm that all students understood the lesson. These factors can be found on the teacher version of the worksheet.

**Teacher Background**

- *Sunlight accelerates the chemical reactions that form ozone. Clouds reduce sunlight and slow ozone formation. Particle pollution forms more quickly when there is moisture or cloud droplets in the air and increasing cloud cover speeds up particle pollution formation.*
- *A temperature inversion is a layer of warm air above the ground that traps*

*particle pollution and ground-level ozone below it. This ‘lid’ prevents air from mixing upward as it normally does.*

- *Winds blow emissions from the pollution source to other areas. Calm winds cause emission levels to build up, or increase.*
- *Heat increases the chemical conversion of emissions to ozone and particle pollution. Lower temperatures enable gaseous emissions to convert into particles.*
- *All forms of electricity production affect the environment. Most of the electricity in the US is generated from fossil fuels such as coal, natural gas, and oil. Emissions from burning of fossil fuels can lead to smog, acid rain and haze. Renewable energy like hydroelectric power, wind and solar technologies produce significantly fewer emissions than traditional power generation technologies.*
- *Most all modes of transportation also release emissions due to burning fossil fuels*
- *Some consumer products like hair spray, paints, paint thinner, charcoal lighter fluid, glue, adhesives and gasoline add VOCs to the environment.*
- *Manufacturing facilities power plants, oil refineries and distribution centers, and food and agricultural processing also add to emissions by burning fossil fuels.*

*Although the weather plays a major role in air pollution, it cannot be controlled therefore students should be discussing ways of limiting emissions that are realistic and is supported by the data they provided above.*

### **Activity 4.3: New England Ozone Data 1984 – 2007**

1. Before beginning this activity, remind students about what they read in activity 4.1 about the Clean Air Act.
  - *The Clean Air Act regulates the emissions that are put into the air by industries as well as motorized vehicles.*
2. Then show them the maps provided on the PowerPoint 4.3 that show the sites from which ozone data was collected throughout New England. It is important to note that the data from these cities were then averaged to provide the data that is seen on the table in the worksheet.
3. The students should then look at the data provided on the worksheet. Before beginning to graph, you can ask some starting questions
  - a. What are your first impressions when you look at the data provided?
  - b. What do expect your graph to look like?
  - c. Are there particular states you expect to have poorer air quality? Why?
  - d. Are there particular years you expect to have poor air quality? Why?
4. Give students some time to work on the graph and questions. Before ending class, the overall question: Is the Clean Air Act” working in New England should be discussed by the class.
  - The trend on the graph suggests that the Clean Air Act might be working, there may be other variables that students propose. The number of ozone days in New England has been decreasing overall.

**Concluding the Lesson**

- As an end of the class reflection, have students consider the following question:  
*Given that the weather cannot be controlled, what do you think is a good way for our community to prevent air quality in the atmosphere?*