

CO Buildup City

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Abstract

During this lesson students will use a computer simulation, at <http://coep.pharmacy.arizona.edu/air/index.html> or <http://www.smogcity.com/> (for advanced students) to explain the relationship between city size, temperature, and air quality. The purpose of the lesson is to explain how city size, temperature, and pollution are related to the air quality.

Objectives

Students will be able to:

- i. Conduct a controlled experiment.
- ii. Collect data in an organized manner.
- iii. Analyze data to reach a conclusion.
- iv. Communicate findings.

National Science Education Standard

Content Standard D - STRUCTURE OF THE EARTH SYSTEM

- The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.

Arizona Science Education Standards

Strand 6 - Earth Science

Concept 1 – Structure of the Earth

PO 1. Describe the properties and the composition of the layers of the atmosphere.

PO 5. Describe ways scientists explore the Earth's atmosphere.

Teacher Background

Whenever you burn fuel (like gasoline in your car or diesel in your truck), CO is produced. You may be breathing elevated levels of CO near busy roads and intersections. Other sources of CO include almost anything with an engine, power plants that burn coal, gas, or oil, and incinerators used to burn garbage. Inside your home, CO can come from your furnace or space heater, wood-burning fireplace, or from cigarette smoke. More carbon monoxide is emitted into the air during the winter months. This is because fuels burn less efficiently at cold temperatures. Also, the air is more stagnant in cold weather. When the air is stagnant, it doesn't get as mixed up, so the pollution just hangs around.

At very high levels, carbon monoxide causes death and there are more poisoning deaths in the U.S. each year from carbon monoxide than from any other substance. Every living thing needs oxygen to stay alive, and breathing is the way we get oxygen into our bodies. Oxygen in the lungs is carried to vital body parts by a delivery molecule called hemoglobin. However, if there is a lot of CO is around it will push the oxygen out of the way and consequently the hemoglobin will deliver less oxygen to the body. When exposed to very high levels of CO, a person might notice shortness of breath or a slight headache. These symptoms will be more intense if the person is exercising, has a weaker heart or lungs, or has a respiratory disease like asthma. Much lower levels of CO like those found near roadways where there is lots of traffic may have health effects. For example, the babies of pregnant women who lived near busy roads in Los Angeles were found to be lower birth weight. And elevated levels of CO near a roadway means that there is lots of traffic – and the traffic emissions not only include CO but other pollutants as well. CO is a “surrogate” for the other pollutants.

Related and Resource Websites

<http://coep.pharmacy.arizona.edu/air/index.html>

http://www.airinfonow.org/html/ed_co.html

<http://www.smogcity.com/>

Asthma and Allergies Health Observance Package

Time 1-2 class period (45 minutes)
Preparation Time 5 minutes securing computer lab or setting up a Proxima or AverKey
5-10 minutes becoming familiar with simulation at
<http://www.airinfonow.org/html/activities.html>

Materials Computer Lab or Proxima or AverKey if lab is unavailable
Protocol Sheets (if you prefer students to follow one)

Teacher Preparation 5 minutes

Activity

1. As students enter the room, have the following question on the board “What is the relationship between city size, temperature, and the amount of pollution?” Students should write it down and a hypothesis in their science notebooks.
2. Ask students to share their ideas with the class, making sure that all hypotheses have an explanation for their ideas. (Quality hypotheses will refer to the previous lab results.)
3. Tell students they will be visiting the computer lab today (and possibly tomorrow). While they are there, they will conduct a controlled experiment to see how different variables affect the amount of pollution or air quality. The better the air quality, the lower the numerical value.
4. Take students to the lab and have them open the CO Buildup City flash animation free from Air Info Now at <http://coep.pharmacy.arizona.edu/air/index.html>
5. Allow students a few minutes to become familiar with program before getting to work. This will maximize their on-task time during the experiment.
6. Once students are familiar with the program have them design an experiment that will test the effects of only one of the two possible variables (time of day and city size). Students should write up their procedures and design a data table before beginning.
7. Once the procedures and table are complete students may begin. (see Size Protocol and Time Protocol for protocol for both experiments as well as possible data charts)
8. When they have finished collecting data, have students write a formal conclusion in their science notebooks. What did they discover? What was the relationship between the independent and dependent variable?
9. Students can now go back and repeat steps 6-8 controlling for the other variable. This will give them a complete picture. If you are pressed for time, you might elect to have half the class control for temperature (time of day) and the other half control for city size (amount of CO released into the air). Advanced groups might carefully control both variables simultaneously.

Embedded Assessment

When students have completed both experiments, bring them back together in the science room. Have students share their findings. Did all groups agree about what was causing their results? Why? Ask students to relate their findings to asthma. What size city is best for a student with asthma? Why? When is the safest time of the day to be outdoors? When is the most dangerous? Why?

Extensions

Have students write a brief paragraph about how they, or their families, could help reduce their personal CO emissions.

Another resource they could use is Smog City at <http://www.smogcity.com/>. This animation is more complicated than the one from Air Info Now and may be suited to more advanced students.