

Lesson 5- Air Pollution

Knocking Over Pollutants

Background Information

The U.S. Environmental Protection Agency (EPA) has established national ambient air quality standards for six air pollutants- ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, particulate matter, and lead. These pollutants can be emitted from several sources.

Carbon monoxide is an odorless, colorless, poisonous gas that comes mainly from motor vehicles and other combustion exhaust. This pollutant interferes with the blood's ability to carry oxygen to the brain, heart, and other tissues. It is particularly dangerous for people with existing heart disease and unborn or newborn children.

Ozone is the major harmful ingredient in smog. It is not emitted directly into the air but produced in the atmosphere when gases or vapors of organic chemicals called hydrocarbons combine with nitrogen oxide compounds in the presence of sunlight. Organic hydrocarbon gases, one of the raw ingredients of ozone, are released from a variety of sources related to human activities. Major sources include refineries, gas stations, motor vehicles, chemical plants, paints, and solvents. Harmful ozone in the lower atmosphere should not be confused with ozone in the upper atmosphere which protects us from ultraviolet radiation. Ozone reacts with lung tissue. It can inflame and cause harmful changes in breathing passages, decrease the lungs' working ability, and cause both coughing and chest pains.

Nitrogen dioxide and related nitrogen oxides are produced when fuel is burned especially in power plants and motor vehicles. These oxides of nitrogen compounds contribute to ozone formation and are health problems. Nitrogen dioxide changes in the atmosphere to form acidic particles and liquid nitric acid. These pollutants may threaten human health.

Nitrogen dioxide acts on the body like both ozone and sulfur dioxide.

Sulfur dioxide is created when sulfur-containing fuel (such as coal) is burned primarily in power plants and diesel engines. Like nitrogen dioxide, sulfur dioxide can also change in the atmosphere into acidic particles and sulfuric acid. Sulfur dioxide constricts air passages making it a problem for people with asthma and for young children whose small lungs need to work harder than adult lungs. Even brief exposure to relatively low levels of sulfur dioxide can cause an asthma attack.

Particulate matter includes microscopic particles and tiny droplets of liquid. These particles come from the burning of fuels by industry and diesel vehicles and from earth-moving activities such as construction and mining. Larger particles can be stopped in the nose and upper lungs by the body's natural defenses. The smallest particles escape the body's defenses and go deep into the lungs where they become trapped. Exposure to particulate pollution can cause wheezing and other symptoms in people with asthma or sensitive airways. Particulate pollution has been linked to increased hospital admissions and emergency room visits for respiratory problems and to a substantial increase in premature deaths.

Lead has been known as a poisonous substance for many years. Due to past major reductions and the elimination of lead in gasoline, there has been a significant decrease in public exposure to lead in outdoor air. Remaining air pollution sources include lead smelters, incineration of lead batteries, and burning lead-contaminated waste oil. However, the most common sources of current lead exposure are indoors from old lead-containing paint and soil. Exposure to high levels of lead can damage the blood, brain, nerves, kidneys, reproductive organs, and the immune system. Lower levels, which are more commonly associated with current exposures can result in impaired mental functioning and development in children and raising blood pressure in middle-aged men.

According to the American Heart Association, chronic exposure to air pollution has been linked to various health-related illnesses including heart disease. Air can adversely

affect the cardiovascular system. These pollutants, including carbon monoxide, nitric dioxide, sulfur dioxide, and particulate matter, cause the blood to become "thick" increasing its tendency to clot, which damages arteries and thus promotes arteriosclerosis (a buildup of fatty deposits in vessel walls). These pollutants can also cause inflammation in the lungs making it harder to breathe and reducing the blood's capacity to carry oxygen. Several pollutants to be aware of are carbon monoxide, nitric dioxide, sulfur dioxide, and particulate matter.

Objectives

After completing the lesson, the students will be able to:

1. Use encyclopedias, science reference magazines, books, and other media to obtain information related to science concepts.
2. Use researched information to complete a biographical sketch about a pollutant.
3. Describe the six common pollutants and how they harm humans.
4. Create challenging questions using researched information.

Materials

1. Newspaper clippings about air quality issues (optional)
2. Six of the Six Common Pollutants Biography hand-outs
3. Computers with Internet access and/or other air pollution reference materials
4. Six bowling pins or 2 liter soda bottles
5. One kickball
6. Index cards

Preparation

1. Label the six bowling pins or soda bottles. Each pin or bottle needs to have the name of one of the following pollutants:

carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

2. Find a place in your room or in the school where you can set up a "bowling alley". There needs to be a place where the kickball can be rolled toward the bowling pins. The pins will need to be set up similar to the pins in an actual bowling alley.

3. Write a list of the six most common air pollutants on the board.

Procedure

1. Write the words "Air Quality" on the board and ask students what they think those words mean. Ask students whether they think the quality of the air in their area is good or bad. How do they know? What evidence is there of air pollution? Have the students ever experienced burning eyes or shortness of breath on polluted days? What time of the year does the air seem the dirtiest? Tell the students that the issue of "air quality"- how good or bad the air is- is often in the news in Oklahoma especially in the summer. (Show news articles if available.)

2. 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.

3. Introduce the students to the names of the six common air pollutants. Tell them that there are more pollutants but these are the "biggies." Many people don't know anything about these pollutants. It will be the students' job to find out as much as they can about the pollutants.

4. Divide the class into six groups. Distribute the "Six Common Pollutants" hand-out to each group. Assign one pollutant to each group. Challenge the students to treat the pollutant as a

character. They are to put together a biographical sketch on their assigned pollutant. The students are to use the Internet, encyclopedias, and other resources to answer the questions on the hand-out.

5. Explain that the groups will be preparing this biographical information for a "Meet the Pollutants" Press Conference in which each pollutant will be interviewed to discover what information about them. Each group should choose one person to be the pollutant and answer questions from the press. However, the other members of the group should be involved in presenting the information. Each group should develop materials that can make the invisible pollutant visible and interesting to others (using visual aids, drama, music, costumes, etc.) but whatever they use must aid in explaining the scientific facts about the pollutant.

6. As students research and develop materials, circulate and assist them as needed. Encourage them to be creative yet scientifically accurate. Ensure that there is a designated person to "personify" the pollutant but also, that each member of the group participates in some way.

7. After the students have done their research and prepared their materials, begin conducting the press conference. Each group will take turns. The interviewee and presenters will be in the front of the room with the rest of the class acting as reporters. The reporters will ask questions but they must also take good notes. They will need their notes later.

8. After each session, be sure to applaud the presenters and briefly highlight the important points relating to the source of the pollutant, its effect on living things, and what can be done about it. Congratulate the entire class on an exciting press conference and their ability to make invisible things that are hard to grasp much more visible and understandable.

9. Using their notes from the press conference, each student is to write six challenging questions about the pollutants. The students should have one question per pollutant. Each question needs to be on an index card with the answer. Collect the questions and organize them according to pollutants.

10. The students in their groups are now going to knock over pollutants as they go bowling in the school. Students in each group will take turns rolling the kickball toward the pins. If a group knocks over all six pins, they automatically get six points and don't have to answer any questions. If a group knocks over less than six pins, they have to answer a question(s) about the pollutant(s) written on the pin(s) that is still standing. For each question that they answer correctly, the group gets to add one point to their score including the point(s) for the pin(s) they already knocked over.

11. The game ends once every student has had at least one turn. Congratulate the students on being knowledgeable about the six common pollutants.

Extensions

1. Have the students write an article about three of the six common air pollutants for an "Air Quality Journal". The article must be at least three paragraphs long, describing, at least, where the pollutants come from, their effects on living things, and what can be done about them. Students may illustrate the article if they wish.

Sources

"6 Infamous Air Pollutants" *Georgia Clean Air Campaign*.
www.cleanaircampaign.com/index.php/cac/for_schools.

"Teacher Resource Manual" *Georgia Clean Air Campaign*.
www.cleanaircampaign.com/index.php/cac/for_schools.

"The Awful Eight Lesson Plan" *Texas Commission on Environmental Quality*.
www.tnrcc.state.tx.us/air/monops.lessons.

Six Common Pollutants Biography

Name of Pollutant: _____

1. What do you look like?
2. Where do you come from?
3. Where do you hang out?
4. What problems do you cause for humans and other living things?
5. What are humans doing to stop you from creating more harm?