

## Details



**Completion Time:** About 1 period

**Permission:** Download, Share, and Remix

# Clean Air—Good For Us and Our Environment

## Overview

In this lesson, students will play a fun board game that teaches about the sources and types of some air pollutants, and how they affect the health of both people and the environment. Students will learn that not all pollutants are greenhouse gases. This game can be a lead-in for a discussion about climate change and what people can do to help clean up the air. Note: This lesson was put together by a substitute teacher with the idea that it could be lengthened or shortened depending on the age level of students and time available.

## Objectives

1. Students will be introduced to sources and types of air pollutants.
2. Students will learn how air pollutants affect human and environmental health.
3. Students will learn that our technological society impacts our environment.
4. Students will learn some actions they can take to help improve air quality.

## Lesson Preparation

Students may not be familiar with all the abbreviations used on the game board, so displaying the following list and a quick discussion about each will give the teacher a rapid baseline assessment of students' knowledge in this subject area. Especially for younger students, it will make the game more fun to have a basic understanding of what the symbols and abbreviations on the game board mean.

- PM=Particulate matter
- CO=Carbon monoxide; has no taste or smell; non-natural sources include motor vehicle exhaust, industrial activities, coal/wood burning.
- VOC=Volatile organic compounds (found in things such as paints, lacquers, pesticides, glues, cleaning

## Materials

- Clean Air Game Board, preferably laminated, see Resources section.
- Dice (one per game board)
- Playing pieces to move around board
- Game pieces to represent pollutants (such as plastic bingo chips, or for younger students, Fruit Loops or Cheerios)



- supplies, tobacco smoke, etc.)
- O<sub>3</sub>=Ozone, which is helpful at higher levels in the atmosphere to protect us from the sun's UV rays, but close to the Earth's surface, high concentrations are toxic to people and plants and contribute to warming.
- Pb=Lead; a naturally occurring metal, but also found in emissions from refineries, smelters, waste incinerators.
- NO<sub>x</sub>=Nitrogen Oxide, which comes from burning fossil fuels (considered a greenhouse gas)
- SO<sub>2</sub>=Sulfur dioxide, a colorless gas with a strong odor; sources include oil and gas processing, burning of coal and heavy oil, paper mills, metallurgical industries, etc.

### Procedure

- Students should divide into teams, with about 4 students per team.
- Pass out game boards, dice, playing pieces and pieces to represent pollutants
- I like to start with 15 pieces (pollutants) in the center of the game board, which students will take from or add to, depending on the instructions of the space on which they land.
- Students are given 10-15 game pieces (pollutants) which they add to the "atmosphere" in the center of the board when they land on a space that tells them to do so.
- Students roll the dice and move their playing piece the number of spaces shown on the dice, and read the instructions aloud. The student then removes a "pollutant" from the atmosphere (pieces in the center of board), or adds to the pollutants from his own pile of chips.
- Students continue to play until the teacher says "Stop", at which time the team with the fewest "pollutants" in the center of the board wins. As a reward, the game creators suggest something fun, such as presenting the winning team with a jar of "clean" air!
- Note: This type of game that allows the teacher to decide how much time is spent playing is great for a substitute/visiting teacher.

### Extension

- This game will more than likely result in questions and comments from students. Try to allow some time for this after the playing of the game.
- Help guide students to understand that not all pollutants are greenhouse gases. See if they can pick out the ones on the game board that are considered greenhouse gases (NO<sub>x</sub>, and ozone at ground level). You may also want to ask students if they can think of a greenhouse gas that is not on the game board, such as CO<sub>2</sub>, and explain that it occurs naturally in the environment and is not considered a "pollutant" but that in excess can cause problems/big changes for the Earth and its occupants. You may want to point out that since the Industrial Revolution, humans are adding lots of "non-natural occurring" CO<sub>2</sub> to the atmosphere (Students may also mention methane and CFCs).
- Have the teams brainstorm for a few minutes to come up with things they could do or actions they could take to help improve the atmosphere. Be sure to remind them that even small changes by many people can make a big difference! They should choose someone to write down their ideas and someone to stand up and share them with the class



(Responses may include turning lights out when not needed, biking or walking instead of driving, recycling, etc.)

### **Resources**

The Clean Air Game Board can be found at: [www.greenteacher.com/articles/cleanair-game.pdf](http://www.greenteacher.com/articles/cleanair-game.pdf)

### **Assessment**

Through successful playing of the Clean Air Game and follow-up class discussion, the teacher will be able to assess the extent to which the students reached an introductory understanding of the health of our atmosphere, its effect on people and the environment, how the activities of our technological society affect the atmosphere, and how it all relates to climate change.

### **Credits**

Jo Anne Chenoweth. Adapted from the book 'Teaching About Climate Change: Cool Schools Tackle Global Warming', edited by Tim Grant and Gail Littlejohn



## **National Science Education Standards (NSES):**

### **Content Standards, Grades 5-8**

Content Standard F: Science In Personal and Social Perspectives

- a. Personal health
- b. Populations, resources, and environments
- d. Risks and benefits
- e. Science and technology in society

### **Content Standards, Grades 9-12**

Content Standard F: Science In Personal and Social Perspectives

- a. Personal and community health
- c. Natural resources
- d. Environmental quality
- e. Natural and human-induced hazards
- f. Science and technology in local, national, and global challenges

## **Other Standards**

Alaska Science Content Standards

E: A student should understand the relationships among science, technology, and society. A student who meets the content standard should:

1. Develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events;
2. Develop an understanding that solving problems involves different ways of thinking, perspectives, and curiosity that lead to the exploration of multiple paths that are analyzed using scientific, technological, and social merits;
3. Develop an understanding of how scientific discoveries and technological innovations affect and are affected by our lives and cultures.

# The Clean Air Game



by Deborah Avalone-King



Playing the Clean Air Game is a great way to initiate discussion of the importance of protecting the atmosphere and help students understand distinctions between air pollutants and greenhouse gases.

The objectives of the game are to acquaint students with sources and types of air pollutants, their impact on the health of people and the environment, and actions individuals can take to prevent air pollution. The game can be used in a number of ways: to spark discussion of how our energy choices create or ameliorate environmental problems; to highlight how non-living aspects of the environment change in response to human and other factors; and to assess the environmental impacts of technology.

## Playing the game

The Clean Air Game can be played by students from elementary school (fourth grade) to high school. The suggested play time is 20 to 30 minutes for younger students and 10 to 15 minutes for older students. Additional time is needed for processing and sharing what is learned.

To play the game, students form teams of four or five. Each student has a playing piece and each team has a die. Players start on one of the two Green Spaces and move clockwise around the board. As players land on spaces, they read aloud the description and add or remove pollutants from their atmosphere as directed. When landing on pollutant spaces, players must add one of those pollutants to their atmosphere. (The purpose of these spaces is to familiarize students with the names and chemical abbreviations of pollutants.) Individual players may wish to keep track of their own scores, but the team score is what matters. The team with the lowest score (cleanest air) wins the game.

Scoring can be done on score sheets or by using manipulatives such as pieces of packaged cereals (e.g., “Cheerios” or “Fruit Loops”) to represent pollution. When using manipulatives, each student starts the game with 15 pieces of cereal and a handful is placed in the center of the game. To remove pollutants, players eat the cereal pieces. To add pollutants, they take pieces from the center of the board and add them to their own pile.

Scoring strategies can be varied with older students. For example, students may keep a general pollution score with one column for adding pollutants and one column for removing pollutants, and sum it up at the end of the game. Or they may track each of the six pollutants on the board.

Celebrate at the end of the game by rewarding the team that has the cleanest air (least points) with applause or, for fun, a jar of clean air! Have each group share examples of the actions or events that resulted in dirtier air or cleaner air. This reflection is an important way to process the information and better relate the activity to their own lives and the actions they can take to reduce pollution.

## Greenhouse gas follow-up

While greenhouse gases are not directly addressed in the game, a follow-up discussion on this topic will enrich students’ understanding of the link between air pollution and climate change. Discussion could include:

- ❖ Are any of the pollutants in the game also greenhouse gases? (*Nitrous oxide and ground-level ozone are called greenhouse gases because they have the ability to absorb and emit heat energy. Some volatile organic compounds undergo a chemical reaction in sunlight to produce ground-level ozone. Ozone has a split personality: in the lower atmosphere it is a heat-trapping pollutant; in the upper atmosphere it forms a layer that shields the Earth from harmful ultraviolet radiation. The “hole” in the ozone layer is not directly related to the greenhouse effect.*)
- ❖ What major greenhouse gases are not represented on the game board? Why not? (*Carbon dioxide, methane, and chlorofluorocarbons or CFCs are not on the board. Carbon dioxide and methane are produced naturally in the respiration and decomposition of organisms and so have not previously been considered air pollutants. For millions of years, these gases have contributed to the natural greenhouse effect, playing a beneficial role in regulating the Earth’s surface temperature. However, human activities such as burning fossil fuels for energy, clearing forests, and raising livestock are rapidly increasing the levels of these gases in the atmosphere. As a result, the greenhouse effect is enhanced and the Earth is getting warmer. CFCs are human-made compounds which are not pollutants at ground level but act as powerful greenhouse gases in the atmosphere: their heat-trapping ability is thousands of times greater than that of carbon dioxide.*)
- ❖ Which practices or processes represented on the game board result in the emission of carbon dioxide? (*Activities involving the combustion of the carbon-containing materials such as fossil fuels or wood all produce CO<sub>2</sub> emissions.*) ❖

*Deborah Avalone-King is an environmental educator with the Maine Department of Environmental Protection in Augusta. The Clean Air Game was developed by Page Keeley.*

**PARTICULATE MATTER (PM)**

Your family reduces their energy use.

*BREATHE THE FRESH AIR AND TAKE ANOTHER TURN.*

Your diesel trucks need engine maintenance.  
Add one PM and Toxic to your atmosphere.

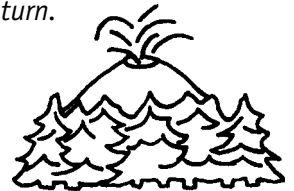


You burn small, hot fires with seasoned wood in your woodstove.

Remove one PM and Toxic from your atmosphere.

Volcanoes, pollen, forest fires and trees add natural pollutants to the atmosphere.

Lose one turn.



You have a headache from CO or toxic exposure.  
Lose one turn.

Start here  
**GREEN SPACE**  
You may remove any one pollutant.

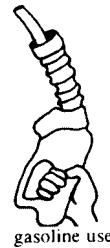
You are careful not to let your car idle for very long.  
Remove one CO, PM and VOC from your atmosphere.

Your woodburning stove gives off CO, PM and Toxics.  
Add one of each to your atmosphere.

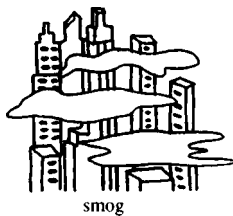


**CARBON MONOXIDE (CO)**

Regional wind patterns carry pollutants long distances.  
Take one pollutant from each category and add it to your atmosphere.

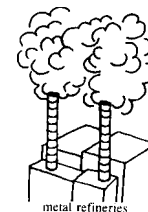


1. Start on a Green Space.
2. Take turns rolling die and moving game pieces. Read aloud and follow instructions on each space you land on. If you land on a pollutant space, add one of that pollutant to your score.
3. Record scores on a tally sheet.
4. The team or player with the lowest score (cleanest air) wins.



You buy a new car that uses an alternative fuel or is a low emissions vehicle.  
Remove one O<sub>3</sub> and PM from your atmosphere.

You live near a metal refinery or have found lead paint and pipes in your home.  
Add one Pb to your atmosphere.



**LEAD (Pb)**  
**HAZARDOUS AIR POLLUTANTS (HAPs)**  
**TOXICS**

SULFUR DIOXIDE (SO<sub>2</sub>)

You have a coal-burning furnace.  
Add one SO<sub>2</sub> to your atmosphere.

To reduce acid rain, your local power plant switches to low sulfur coal or oil and installs scrubbers to remove SO<sub>2</sub> from your smokestream.  
Remove one SO<sub>2</sub> from your atmosphere.

You voice your concerns to your legislators.  
Every player may remove one pollutant from their atmosphere.

OZONE (O<sub>3</sub>)



Every member of your family commutes to work alone each day.  
Add one ozone to your atmosphere.

You ride your bike to work each day instead of driving.  
Remove one ozone from your atmosphere.

Start here  
**GREEN SPACE**  
You may remove any one pollutant.

You can't exercise today because high ozone levels make it difficult to breathe.  
Lose one turn.

respiratory problems

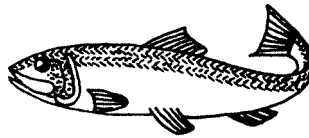
The Clean Air Act passes.  
**BREATHE THE FRESH AIR AND TAKE ANOTHER TURN.**

NITROGEN OXIDES and VOLATILE ORGANIC COMPOUNDS (NO<sub>x</sub> and VOC)

# the Air Game



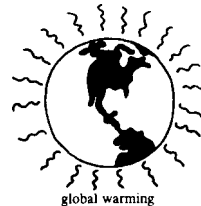
heart damage



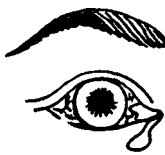
dead aquatic life



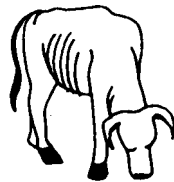
less oxygen in blood



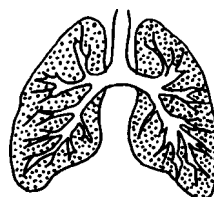
global warming



eye irritation



contaminated livestock



lung damage

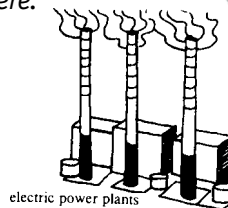
Your sink cabinet and garage contain toxic cleaning solvents and other poisons which increase your risk of cancer.  
Lose one turn.



toxic cleaning solvents

You regularly have your car tuned up.  
Remove one NO<sub>x</sub> and O<sub>3</sub> from your atmosphere.

Your local power plant burns coal.  
Add one NO<sub>x</sub> to your atmosphere.



electric power plants