The Clean Air Game

by Deborah Avalone-King

laying 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_2 emissions.)*

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The Clean

PARTICULATE MATTER (PM)

Your diesel trucks need engine maintenance.

Add one PM and Toxic to your atmosphere.

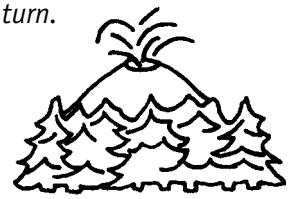

diesel engines

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.


volcanoes, forests

Your family reduces their energy use.

BREATHE THE FRESH AIR AND TAKE ANOTHER TURN.


contaminated crops


brain damage


gasoline use


dry cleaners

You have a headache from CO or toxic exposure.

Lose one turn.

Start here

GREEN SPACE

You may remove any one pollutant.

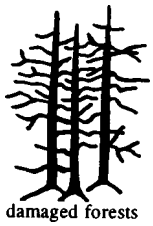
1. Start on a Green Space.
2. Take turns rolling die and moving game pieces. Read aloud and follow instructions on each space you land on. If you land on a pollutant space, add one of that pollutant to your score.
3. Record scores on a tally sheet.
4. The team or player with the lowest score (cleanest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

You are careful not to let your car idle for very long.

Remove one CO, PM and VOC from your atmosphere.


smog


reduced alertness


damaged forests

Your woodburning stove gives off CO, PM and Toxics.

Add one of each to your atmosphere.


wood stoves

CARBON MONOXIDE (CO)

Regional wind patterns carry pollutants long distances.

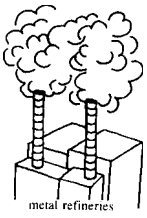
Take one pollutant from each category and add it to your atmosphere.

You buy a new car that uses an alternative fuel or is a low emissions vehicle.

Remove one O_3 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.


metal refineries

LEAD (Pb)
HAZARDO
AIR
POLLUTAN
(HAPs o
TOXICS

n Air Game

SULFUR DIOXIDE (SO_2)

You have a coal-burning furnace.

Add one SO_2 to your atmosphere.

To reduce acid rain, your local power plant switches to low sulfur coal or oil and installs scrubbers to remove SO_2 from your smokestream.

Remove one SO_2 from your atmosphere.

You voice your concerns to your legislators.

Every player may remove one pollutant from their atmosphere.

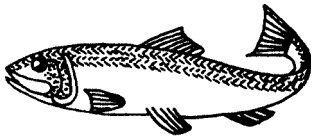
OZONE (O_3)

cars

Every member of your family commutes to work alone each day.

Add one ozone to your atmosphere.

heart damage



dead aquatic life

less oxygen in blood

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.

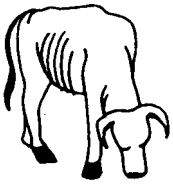
global warming

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

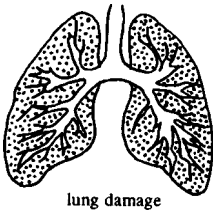
Lose one turn.

respiratory problems

eye irritation



contaminated livestock



lung damage

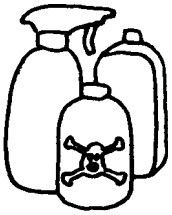
The Clean Air Act passes.

BREATHE THE FRESH AIR AND TAKE ANOTHER TURN.

NITROGEN OXIDES and VOLATILE ORGANIC COMPOUNDS (NOx and VOC)

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

Lose one turn.



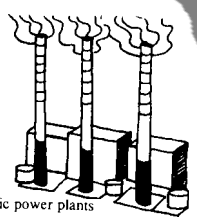
toxic cleaning solvents

You regularly have your car tuned up.

Remove one NOx and O_3 from your atmosphere.

Your local power plant burns coal.

Add one NOx to your atmosphere.



electric power plants