

# 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.*) ❖

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## 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.

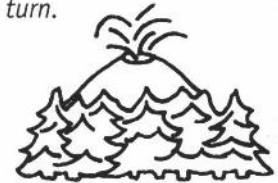


You burn small, hot fires with seasoned wood in your woodstove.

Remove one PM and Toxic from your atmosphere.

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

Lose one turn.



volcanoes, forests



dry cleaners

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.



contaminated crops



brain damage



gasoline use

# The Clean

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.



smog



reduced alertness



damaged forests



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<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.



metal refineries

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.*

## ean Air Game



dead aquatic life



less oxygen in blood



global warming

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



eye irritation



contaminated livestock



lung damage

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

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

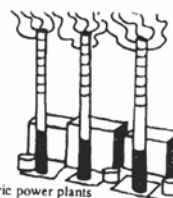
Your sink cabinet and garage contain toxic cleaning solvents and other poisons which increase your risk of cancer.  
*Lose one turn.*



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

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



## Blindfold Nature Games- Part 2



### Objectives-

- To make connections to important ecological concepts such as adaptation, diversity, interdependence, and predator-prey relationships

Adaptation: all living things have evolved to fit how and where they live

Diversity: differences in living things allow for the success of all life

Interdependence: all living things are connected to and depend on other living things to survive

Predator-prey relationships: studying the interactions between two species and the interdependence to one other

- To open the eyes of the learner to the natural environment; especially heightened adaptations of the senses
- To engage and develop skills of the learner: knowledge of local flora and fauna, observation and listening skills

**Materials-** Blindfolds, scarfs

## “Echo Location Activity”

### Method-

- 1- Explain the adaptation of echo location for animals in their survival- (it is one of the communication marvels of the animal world and nowhere is it better developed than in whales, dolphins and bats). These mammals have adapted to use echo location for navigation and finding their way in the dark. It is also used to communicate with one another, as well as to find prey.
- 2- Whales, dolphins and bats make clicking sounds or squeaking calls which bounce off objects. When these calls bounce back off the objects, the returning sounds give them information to find their prey, navigate and locate other animals.
- 3- Fin whales can send out calls that can be heard 3,220 kilometers away. Whales use echo location to locate schools of fish, krill, squid and other prey. Bats use echo location to find small insects at night including mosquitos, black flies and moths.
- 4- Any number of predator/prey variations to this activity are possible such as whale/squid, dolphin/fish, bat/bug etc...
- 5- Play this game several times letting different players take on the predator/prey roles.
- 6- Choose a quiet location to play the Echo Location game
- 7- Have one person be the whale, dolphin or bat (predator). They will wear a blindfold (or simply close their eyes)
- 8- Be sure that the student wearing a blindfold has their ears exposed for better listening.
- 9- Choose another student to be the prey (fish/krill/squid/ or bug).
- 10- Have the remaining students form a circle with the predator and prey inside. The circle represents the habitat (ocean or forest). The predator and prey must remain inside the circle habitat.
- 11- The students who create the habitat are called “sea weed” or “trees”.
- 12- When the predator makes a call (they call out their name “whale” “dolphin” or “bat”) and the prey must respond back immediately with the echo call of their name (“Fish/krill/squid/or bug”).
- 13- The predator is simply trying to catch its’ prey by using echo location.

**Rules:**

- No running, only walking is permitted by predators and prey
- Prey must respond immediately with their response call
- Students who form the circle habitat must remain quiet and cannot talk. However, if the predator gets too close they call out their names by saying “seaweed” or “tree”

**Variations**

- Change the size of the circle habitat by shrinking or enlarging the distance between students.
- Change the number of prey inside the habitat circle. For example, have two prey inside the circle habitat at one time.

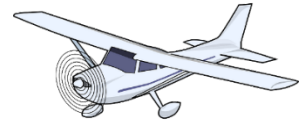
**Conclusion:** Following this activity take time to discuss other adaptations that whales or bats have.

Also discuss the importance that predators have in keeping populations healthy by increasing the strength of a prey population when feeding on old, sick or injured prey. Predators also help keep a healthy balance of prey and prevent over population which enable prey to have a steady food supply. Other animals also benefit from prey being eaten when there are left overs for them to feed upon.

Bats in particular can be helpful by reducing certain bug populations. They eat mosquitos which can transmit human diseases such as malaria, dengue, West Nile virus, chikungunya, yellow fever, etc. Bats also eat moths and other bugs which can be extremely harmful to tree and forest infestations. One individual bat can eat up to 1,000 bugs in one night!



## Nature Trivia Questions – Part 6



### “Survival Situation”

(Please note: Answer and Rational pages can be found on a separate attachment)

**Instructions:** This is an activity that can be used for group decision making or for individual interest. Your first task is to rank 15 items according to their importance for survival in a given situation. Your second task is to then work as a group with family members, friends, or colleagues and together once again rank each of the fifteen items. This means that each item will be ranked individually and as a group exercise. Survival items must be agreed upon by each group member before it becomes a final group decision. Use your imagination to put yourself into “the Situation” as it is described to you. Your answers and the group answers’ will later be compared with the correct ranking answers provided by from survival experts.

#### Guidelines to reaching consensus:

Consensus is sometimes difficult to reach. Therefore, not every ranking will meet everyone’s’ complete approval. Group members should all be at least in partial agreement for each decision made.

1. Remember these three important factors in reaching decision by consensus: discuss the underlying assumptions in your given situation, listen carefully to one another, and encourage the participation of all members.
2. Avoid arguing for your own individual judgements. Present your position as clearly and logically as possible but listen to other members’ reactions and consider them carefully before you press your point.
3. Avoid changing your mind just to reach an agreement or to avoid a conflict. Have an open mind and be willing to support positions that have objective and logical points of view.
4. Avoid using procedures that reduce discussions such as majority vote, tossing a coin, rock/scissor/papers or bargaining to reach decisions.
5. Seek out differences of opinion within your group. Try to involve everyone in the decision making process.
6. Respect differences and disagreements since these are a part of the decision making process. A wide range of information and opinions improves the chances for the group to find more efficient solutions.

#### The Survival Situation:

You have just crash landed in the woods of La Vérendrye wildlife reserve which is one of the largest reserves in the province of Quebec. It is 1:30 in the afternoon in mid-January. The small plane has been completely destroyed except for the frame. Miraculously, everyone has survived the crash and no one is seriously injured. Your plane was expected to arrive at the Gatineau airport at 3:30 that same day.

The crash came suddenly before the pilot had time to radio for help or inform anyone of your geographical location. Since the pilot was trying to avoid a storm you know the plane was off course before the crash. The pilot recalls that the plane was eighty kilometers northwest of a small town that is the nearest habitation. There is no cell phone reception in your area so making phone calls or sending text messages is not possible.

You are in a wilderness area made up of thick woods with many lakes and rivers. The last weather report indicated that the temperature would reach 20 degrees below zero during the day, and minus 30 degrees at night. You are dressed in winter clothing that is appropriate for being in the city; light weight winter jackets, jeans, dress pants, light winter boots, etc.

While escaping from the plane you and your group were able to salvage the fifteen items listed on the next page. Your task is to rank these items according to their importance for survival with #1 as being the most important and # 15 being the least important.

You may assume that the number in your group is between 5 to 10 people and that the group has agreed to stay together.



## Survival Decision Form for Ranking

Ranking order (numbered 1 to 15)  <u>Your answer</u>	Survival Items found	Ranking order (numbered 1 to 15)  <u>Group answer</u>
	Rubbing alcohol	
	10 meters of gauze bandage	
	Box of 25 individual plastic water bottles (full of water)	
	Lighter	
	Newspaper (50 sheets)	
	Compass	
	Two ski poles	
	Knife	
	Large sheet of heavy duty plastic	
	10 meters of rope	
	Box of chocolate bars (25 bars)	
	Flashlight with working batteries	
	Extra clothes including shirt and pants for each survivor	
	6 cans of Pepsi	
	Whistle	

### Calculating your score:

- 5 points for each item correctly ranked
- 4 points for each item which is off by 1 number
- 3 points for each item which is off by 2 numbers
- 2 points for each item which is off by 3 numbers
- 1 point for each item which is off by 4 numbers

### Ranking your score:

- 60 to 75 points = Outstanding
- 45 to 60 points = Excellent
- 30 to 45 points = Very Good
- 15 to 30 points = Fair
- 0 to 15 points = Poor

### Survival Situation Answer and Scoring Sheet

Survival Item	Reasoning and brief explanation	Correct Ranking Number	Your Answer	Your Score	Group Answer	Group Score
Rubbing alcohol	<ul style="list-style-type: none"> <li>- Good for starting a fire</li> <li>- First aid antiseptic</li> </ul>	#2				
10 meters of gauze bandage	<ul style="list-style-type: none"> <li>- Good for treating injuries</li> <li>- insulation to protect skin</li> <li>- Making candle wicks</li> <li>- Tinder for starting a fire</li> </ul>	#12				
Box of 25 individual plastic water bottles (full of water)	<ul style="list-style-type: none"> <li>- Clean drinking water to prevent dehydration</li> <li>- Water for sterilizing</li> <li>- Water for cooking</li> </ul>	#10				
Lighter	<ul style="list-style-type: none"> <li>- Fire is first priority</li> <li>- Warmth</li> <li>- Fire as a signaling device</li> </ul>	#1				
Newspaper (50 sheets)	<ul style="list-style-type: none"> <li>- Good for starting a fire</li> <li>- Can be used for insulation</li> </ul>	#9				
Compass	<ul style="list-style-type: none"> <li>- Minimal use as a reflector for signaling</li> </ul>	#15				
Two ski poles	<ul style="list-style-type: none"> <li>- Signaling device</li> <li>- Stabilize as a walker</li> <li>- Support for shelter</li> </ul>	#13				
Knife	<ul style="list-style-type: none"> <li>- Assist with making tinder for starting a fire</li> <li>- Versatile tool</li> </ul>	#11				
Large sheet of heavy duty plastic	<ul style="list-style-type: none"> <li>- Useful for shelter protection</li> <li>- Ground sheet</li> <li>- Useful for keeping warm</li> </ul>	#5				
10 meters of rope	<ul style="list-style-type: none"> <li>- Fire starter</li> <li>- Shelter building</li> <li>- Tool for securing shelter supports</li> <li>- Versatile tool</li> </ul>	#8				
Box of chocolate bars (25 bars)	<ul style="list-style-type: none"> <li>- Energy resource</li> </ul>	#4				
Flashlight with working batteries	<ul style="list-style-type: none"> <li>- Signaling device at night</li> </ul>	#7				
Extra clothes including shirt and pants for each survivor	<ul style="list-style-type: none"> <li>- Provides extra warmth</li> <li>- Shelter</li> <li>- Bedding</li> <li>- Signaling device</li> <li>- String</li> </ul>	#3				
6 cans of Pepsi	<ul style="list-style-type: none"> <li>- Can is versatile tool</li> <li>- Signaling device</li> <li>- Heating water</li> </ul>	#6				
Whistle	<ul style="list-style-type: none"> <li>- Signaling device</li> </ul>	#14				
	<b>Total scores</b>		<b>Your Score</b>		<b>Group Score</b>	



## " Survival Situation"

### Answers and Rational for Ranking

1. **Lighter:** The greatest danger facing the group is exposure to the cold. The greatest need for the group is a source of warmth and the second greatest need is for making signaling devices. This makes building a fire as the first priority. The lighter would be the most valuable survival item since it can be significant for starting a fire. Even if the lighter runs out of fuel it could still provide sparks to help start a fire. The fire will not only provide warmth, but will also produce smoke for daytime signaling and firelight for nighttime signaling.
2. **Rubbing alcohol:** This is a highly flammable liquid which would serve valuable for starting a fire. Even if the lighter is without fluid, the sparks could still help ignite the rubbing alcohol to get a fire started. The alcohol could be used as a first aid antiseptic if someone has an injury.
3. **Extra clothes including shirt and pants for each survivor:** Clothes are probably the most versatile items someone can have in a situation like this. Besides adding warmth to the body they can also be used for shelter, signaling by making flags, bedding, bandages, string when unraveled, and tinder to make fires. The versatility of clothes and the need for warmth, fire and signaling devices make this item number three in importance.
4. **Box of chocolate bars (25 bars):** Gathering wood for the fire and setting up signals, and shelter requires energy. The chocolate bars would supply energy to sustain the survivors for quite some time. Since the chocolate is mainly carbohydrates, it would supply energy without making digestive demands on the body.
5. **Large sheet of heavy duty plastic:** The sheet of plastic would be extremely useful for helping maintain warmth to the survivors. It is an invaluable piece of equipment for shelter protection. Plastic serves as a wind and waterproof barrier to protect the survivors from the elements of cold winds, snow and rain precipitation. A piece of the plastic can be used as a ground sheet or wrapped around the survivors for keeping warm.
6. **6 cans of Pepsi:** Cans would be a versatile tool. The most important use would be as a signaling device. The lid of the can and pieces of aluminum could be as used as reflectors of sunlight similar to a mirror. The reflected sunbeam from Pepsi can lids and pieces of aluminum could be seen from a far distance. To increase the effectiveness one member of the group could climb a tree to extend the signal above trees and help reach search planes. Empty cans can also be used as cups. Empty cans would be useful for heating water, melting snow, or cooking food on a fire.
7. **Flashlight with working batteries:** There is little hope for survival if the group decides to walk out of the wilderness. The group's major hope is to catch the attention of search planes. During the day the lid reflectors, smoke, and flags made of clothing represent the best signaling devices. During the night the flashlight is the best night signaling device besides the fire. In the cold flashlight batteries lose power very quickly. Batteries therefore must be kept warm if they are to work, which means they must be kept close to someone's body. The value of the flashlight is it can be turned on immediately if a plane is heard. It can be turned on and off to make signals.
8. **10 meters of rope:** The rope is another versatile piece of equipment. It could be used to pull dead limbs off trees for firewood. When cut into pieces the rope will help in building a shelter. It can be burned when frayed into thin strips and then be used as tinder to start fires.
9. **Newspaper (50 sheets):** The newspaper could be used for starting a fire similar to the rope. Newspaper will also serve as insulation when rolled up and placed under clothing around a person's legs or arms to provide extra air space for added protection from the cold.

10. **Box of 25 individual plastic water bottles (full of water)**: Clean drinking water will help prevent dehydration and maintain energy for the survivors which would be essential. If survivors become dehydrated they will be at risk for becoming severely weak, or even worse they could become unconscious from dehydration. Water could be heated on the fire in the Pepsi cans and served as a hot drink to warm the body. Water could be used to boil any possible food items for cooking.
11. **Knife**: A knife is a versatile tool. It could be used for cutting the Pepsi cans for creating sun reflectors as a signaling device. It would also be useful for cutting plastic and rope into desired lengths, as well as making shavings from wood for starting fires.
12. **10 meters of gauze bandage**: The best use of this item is to wrap the gauze around exposed areas of the body for insulation. Feet and hands are most vulnerable to frostbite, and the gauze can be used to keep them warm. The gauze can be used as a candlewick when dipped into the alcohol. It could serve as tinder for starting fires. Gauze is also useful for treating any possible injuries.
13. **Two ski poles**: Although they are not that important, the poles are useful as a flag pole for signaling. They can be used for stabilizing a person while walking through the snow to collect wood, test the thickness of ice on a lakeshore or stream. Probably their most useful function could be as supports in a shelter.
14. **Whistle**: The whistle is an important signaling device if people are on the ground and are within distance to hear the whistle call. Since you are situated deep in the wilderness and far from the closest town, the whistle is not too useful. It would be discouraged for anyone to attempt to leave the group, walk towards town and try to use the whistle as a signaling device. The chance of survival would be extremely low and it is unlikely that the whistle call will be heard. This is the reason why the whistle is the second lowest item on the list of importance.
15. **Compass**: Because the compass may also encourage some survivor to try to walk to the nearest town, it then becomes a dangerous item. One beneficial feature of the compass in this situation is the use of its glass as a reflector of sunlight to signal search planes. It is the least effective item from the list as a signaling device. The possibility that it might encourage someone to walk away from the crash site makes it the least desirable item of all fifteen on the list.