IN THE AIR

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CORE Activity

"Cleaner Air Everywhere"

6-8 EDUCATION MODULE

EPA

Missouri Botanical Garden

Correlation with Education Standards Summary

Core Activity - Classrooom Game "Cleaner Air Everywhere"

For a narrative description of these standards please refer to the Teacher's Guide.

National Standards

SOURCE: www.education-world.com/standards

NPH-H 5-8 .1.2
NL-ENG K-12 .3 .4
NS. 5-8 .6
NSS-C 5-8 .5

Missouri Show-Me Standards

SOURCE: www.dese.mo.gov/standards

Performance Standards:
GOAL 1: 1, 6, 10
GOAL 3: 1, 2, 3, 5, 6, 8
GOAL 4: 1, 3

Knowledge Standards:
CA 1
HPE 5
SC 8
SS 7

Funding was provided by U.S. EPA, with generous support from Missouri Botanical Garden's EarthWays Center, and the 69 reviewers and partners.

Overview

Students will use decision-making skills to identify and select practices to reduce air pollution. In this classroom game, students are divided into teams. Each team represents a town competing to be the next location of a successful environmental theme park. In other cities, this type of park has generated so much revenue that property taxes have been abolished. The planners are looking for a location where residents have a high personal responsibility level for the environment. The ideal town will have low costs associated with living there and good environmental quality. The competing teams will attempt to balance the need for government involvement in managing environmental issues, and the resulting higher costs, with the potential cost of inaction.

Goals

- To illustrate the impact that personal and community decisions have on our environment and our economy
- To compare and contrast actions that can positively or negatively impact the environment

Objectives

When the activity is completed, students will be able to do the following:

- Develop strategies to reduce his/her exposure to toxic air pollutants.
- Categorize sources of air pollution and give an example of each.

"Cleaner Air Everywhere"

Recommended Grade Level:

6-8

Preparation Time:

Approximately 30 minutes is needed to run photocopies and make game pieces. Poster optional. The survey will need to be administered and scored prior to playing the game with the scores ready to be returned to the students at the beginning of play. The identical survey is administered at the end of the game.

Presentation Time:

Time will vary depending on Connecting Activities chosen. The game will take approximately 60 minutes including time for brief discussions.

Materials

- A copy of the booklet for each student. These can be double sided and saddle stapled (may be re-used).
- Pen or pencil per student.
- One die for each team.
- One copy of the survey and the worksheet (note: the worksheet is two-sided) for each person. For ease of scoring staple survey to the worksheet. Survey to be administered and scored before the first game session.
- One classroom set of "game cards". These can be copied double-sided onto cardstock and cut apart. Using three colors, one for each round, will help keep the cards from getting mixed up.
- Posterboard for scoring, one for each town. These can be displayed in between class sessions. This may be omitted if you are playing the game in one session and score can be kept on the board.
- Art supplies to decorate posters with (also optional).

Materials (Continued)

- Make five copies of the collection mat, one for each team. This mat is used to collect play money and pollution point tokens.
- Make one copy per student of game tokens/play money sheet and have students cut them apart.

Goal Of The Game

The winning team will have a town with the lowest average pollution in its environment, and the lowest average fee/costs/taxes.

Reminder: Distribute surveys and tally before game day.

- Copy the survey and worksheet. If you plan to reuse the booklets, you will need to make an extra set of surveys for the post assessment. Staple the worksheet and the survey together. Have the students complete the survey and put their names on both sheets of paper. Return the survey and worksheet to the teacher. Teacher will score the surveys and mark the scores on the worksheet. Score the survey by adding the numbers of the response selection (e.g., response 1 receives one point, 2 receives two points, 3 receives three points). The teacher will keep the surveys but return the worksheets to the students at the start of the game.

Procedure : How To Play The Game

1. Distribute worksheets with the recorded survey scores to each student.

2. Divide the class into five teams of three to five students. Each team will represent a town or city council.

3. Allow students a few minutes to give their town a name. Have them enter the name on their worksheets and write the town names in columns on the board (see example below). If time allows and you are using posters, give the teams time to decorate them.

Note: All numbers scored should be team averages.

"Cleaner Air Everywhere"	Town		Town		Town		Town		Town	
	Pollution Points	Costs/Fees Taxes	Pollution Points	Costs/Fees Taxes	Pollution Points	Costs/Fees Taxes	Pollution Points	Costs/Fees Taxes	Pollution Points	Costs/Fees Taxes
Beginning Situation										
Round One										
Round Two										
Round Three										
Grand Total										

4. Distribute tokens and money to each student. These may be pre-cut or students may cut them apart.

5. Distribute die and collection mats to each team.

6. Each class member will roll the die to determine the type of car they drive.

7. Have each team member record vehicle information on side one of their worksheet. Each player will pay the amount of money owed for his or her car to the “Fee, Taxes, and Costs” pile on the collection mat.

ROLL		COST	POLLUTION POINTS
1	Hybrid Car	$ 4	1
2	New Energy Efficient Car	$ 3	2
3	Used Car/ Good Maintenance	$ 2	3
4	Used Car / Poor Maintenance	$ 1	4
5	Sport Utility Vehicle	$ 5	5
6	Roll Again		

8. Each player will add their number of pollution tokens to the “Environment” section of the collection mat and make change as necessary. This amount is the total pollution points from his or her vehicle plus the points from his or her beginning survey. The individual information and the team totals are recorded on students’ worksheets.

Beginning of Play

9. If you are not using posters, create a scoring table on the chalkboard to tally the dollar amounts and the pollution points for all of the teams. Update these scores at the end of each round. Students are to also record this information on the worksheet in the appropriate boxes.

10. Teacher will begin the game by reading the opening scenario.

Opening Scenario

Each team represents a city or town that is competing to be the next location of a successful environmental theme park. In other cities, this type of park has generated so much revenue that property taxes have been abolished saving each resident thousands of dollars each year. The theme park planners are looking for two main factors at each location:

a. The ideal town will have a low cost of living.
b. The ideal town will demonstrate good environmental quality (i.e., clean water and air).

Your job is to balance the need for government involvement to protect the environment, and the resulting higher costs, with the potential cost of inaction. The key to winning the game is to identify and practice individual responsibility so that altogether your town rates well.

11. Tell the students that for each round, they will be given time to read the background information contained in the booklet. (You can insert the applicable Connecting Activities at specific points within the rounds.) The teams will be given time to discuss the proposals amongst themselves. After discussion they will vote on the proposals. The teacher will poll each group and record the team vote on the board. Students will record their individual and team decisions on their worksheets and will pay or deduct money and pollution points from the collection mat accordingly.

12. Once each team has read the background information, voted on all proposals and all scores are recorded, play proceeds with the cards for Round One. The teacher takes the

first card off of the deck and reads the card for the first team. The card applies only to the team it is read for. If a card requires an answer or a decision, the team will be given a brief amount of time to determine their response. The teams will pay fees to the fee pile, pay pollution points to the Environment pile, or deduct points or monies from these piles and record results on their worksheets. This procedure is repeated for each of the teams. Be sure to remind students to take notes on all the cards played in the round. They will need this information for the wildcard portion of round three. There are ten cards for rounds one and two, allowing two cards per team. There are five cards for round three and the wildcard portion. (Note: Student worksheet contains synopsis explanations for most steps in the game.)

13. Play proceeds the same for round two.

14. Play proceeds for round three, but this round has only five cards (one per team). After those cards are read and scored, each team will have a wild card opportunity. Begin with the team in last place (the team that has the highest totals) followed by the team with the second highest total, etc. They may choose any single action in the game they have not already taken. This includes votes taken on proposals and any card used throughout the game by the other teams. (The teacher may refer to the proposals and the cards to help remind students of possible choices.) Allow time for the teams to discuss their options amongst themselves. After they have chosen their wild card, their score is tabulated. Wild cards may be used only once. If one team chooses an action that another team desires, the second team must choose again.

15. Total all game points for the rounds on student worksheets.

16. Have students complete the post survey either in their workbooks or, if you are reusing the workbooks, on a separate copy, and deduct or add points from their teams pollution totals.

17. The town with the lowest combined average pollution points and average costs score wins.

18. If there is a tie for first place, or if for some other reason there is no clear winner, the tiebreaker will be read. Students on the tied teams are given time to discuss their submission.

Tiebreaker

Your town holds a Riding Lawn Mower Rodeo and BBQ each year to raise money and support the local businesses. Hundreds of people show up with their riding lawnmowers to compete. Unfortunately, this event is held in the summer when some of the worst air pollution is registered. This is a big concern for the theme park people; they don't want to locate in a town that disregards an important issue such as air pollution. All of the area citizens are riled up, too. They want their rodeo and BBQ no matter what. It's a tradition. Your job is to write a proposal for a more environmentally friendly event. People will vote for the one that sounds like the most fun and offers a cleaner alternative.

19. Each of the tied teams will be given time to write a description of a more environmentally friendly event.

20. The submissions are read by the teacher aloud, and then all class members will vote. The winning proposal will be the new location of the theme park.

21. Have students discuss the game and how they felt about the decisions they made. Have each team identify the most important decision they made to protect the environment.

22. The teams may decorate their posters to show their results.

Discussion Questions

- Did anything in the game surprise you?
- Do you feel that the situations in this game were realistic? Why or why not?
- Was it fair that the negative consequences of not protecting the environment (Uh Oh! Cards) only happened to some of the teams? Is this like or unlike real life? Give an example.
- At the end of the game, points were deducted from your environment score if you answered your survey differently. The idea was that greater knowledge about the environment helps to protect it. Do you agree or disagree with this idea? Give examples.
- Can you take an action to reduce your exposure to toxic air pollutants? What might that action be?

Conclusion

After completing this activity, students conclude that the decisions people make have an impact on the environment and the economy.

Cleaner Air Everywhere

SURVEY

Name: _____

Circle your choices.

In the Air

Where do you believe most air pollution comes from?

1. Cars, trucks, and buses (mobile sources).
2. Homes and small businesses (area sources).
3. Large pollution sources such as factories and power plants (point sources).

Air pollutants in the air

1. Can pollute land and water.
2. Stay in the air.

Which of the following statements do you believe to be most true?

1. What we do as individuals can reduce pollution.
2. Pollution doesn't get better, it only gets worse.

The air in the town is

1. Much the same in the different neighborhoods.
2. Much worse in some neighborhoods than others.

Getting around town

If you had a choice, how would you choose to get around?

1. Take mass transit, (bus, train, or light rail) carpool, walk, or ride my bike.
2. Carpool or take mass transit sometimes.
3. Take your own car.

Shop 'til you drop

When shopping, which is most important to you?

1. Shopping only in stores that are close to home even if they don't offer the largest selection or the best price.
2. Shopping at large stores because they have a better selection and lower prices.
3. Shopping at many different stores even if some are out of the area.

Errands

When it is time for your family to run errands, which is most true?

1. We are organized and can combine many errands in one trip. (This is called trip chaining.)
2. We do things more on the spur of the moment and may make several trips depending on when things are needed.

At Home

When using products around your home are you most likely to:

1. Always read labels on the cleaning products used at home, even ordinary products like bathroom cleaners and window cleaners.
2. Only read labels on products you are unfamiliar with. Products that are used in homes are safe when using common sense.
3. Not read labels on everyday products that everybody uses. Companies could not sell products if they were not safe.

SCORE _____

Cleaner Air Everywhere!  **Round One**	**Cleaner Air Everywhere!**  **Round One**
Cleaner Air Everywhere!  **Round One**	**Cleaner Air Everywhere!**  **Round One**
Cleaner Air Everywhere!  **Round One**	**Cleaner Air Everywhere!**  **Round One**
Cleaner Air Everywhere!  **Round One**	**Cleaner Air Everywhere!**  **Round One**
Cleaner Air Everywhere!  **Round One**	**Cleaner Air Everywhere!**  **Round One**

Cleaner Air Everywhere

GAME CARDS

Round 1 **Commuter Costs** If your city passed the mass transit proposal, you may ride a bus or train operated by your system at no additional fee. If your city has not passed this proposal, you will take your personal car and pay the following rates: hybrid $1, energy efficient car $2, used car/good maintenance $3, used car/poor maintenance $4, Luxury/Sport Utility Vehicle $5. Your pollution will increase by one point for every person on your team.	**Round 1** **Carpool** Everyone in your town carpools to work reducing the commuter miles driven by nearly half. Deduct 2 pollution points per town member and $1 in costs per town member.
Round 1 **Question:** What is the name of the federal agency charged with protecting the quality of our land, air, and water? *(U.S. Environmental Protection Agency)* For a correct answer, you may deduct one point for each team member from either your cost pool or from your pollution points.	**Round 1** **Shopping** Big Box, or chain stores will cost you less money and may have a larger selection of goods to choose from. Small local stores will cost your team $1 but will reduce your pollution by 2 points per town member. Do you want to shop at local stores? Adjust your scores accordingly.
Round 1 **Tax Rebate** Business in town is great. You may subtract $1 for each person on your team from your town's cost pool.	**Round 1** **Question** True or false, mobile sources account for more than half of our hazardous air pollution. *(True)* For a correct answer, you may subtract 1 point for each town member from your pollution total.
Round 1 **Golden Opportunity** Change Your Car People in your town may change the type of car they drive. Which car will you choose? Each person on the team should deduct/add the point differences of your original points from your pollution points and from your cost column. Re-score your team total.	**Round 1** **Environment Bonus** You may remove one point from your pollution point total for each person in your town.
Round 1 **Uh Oh!** Every person on your team with a used car needs car repairs Refer to your beginning situation sheet. - If you do not have good maintenance, you pay $2 - If you have good maintenance, you must pay $1 Determine your individual costs add together and adjust your team score.	**Round 1** **Errands** What is it called when you combine several errands into one trip? *(Trip chaining)* For a correct answer deduct 1 point for each town member from your pollution point total.

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere!

Round Two

Cleaner Air Everywhere

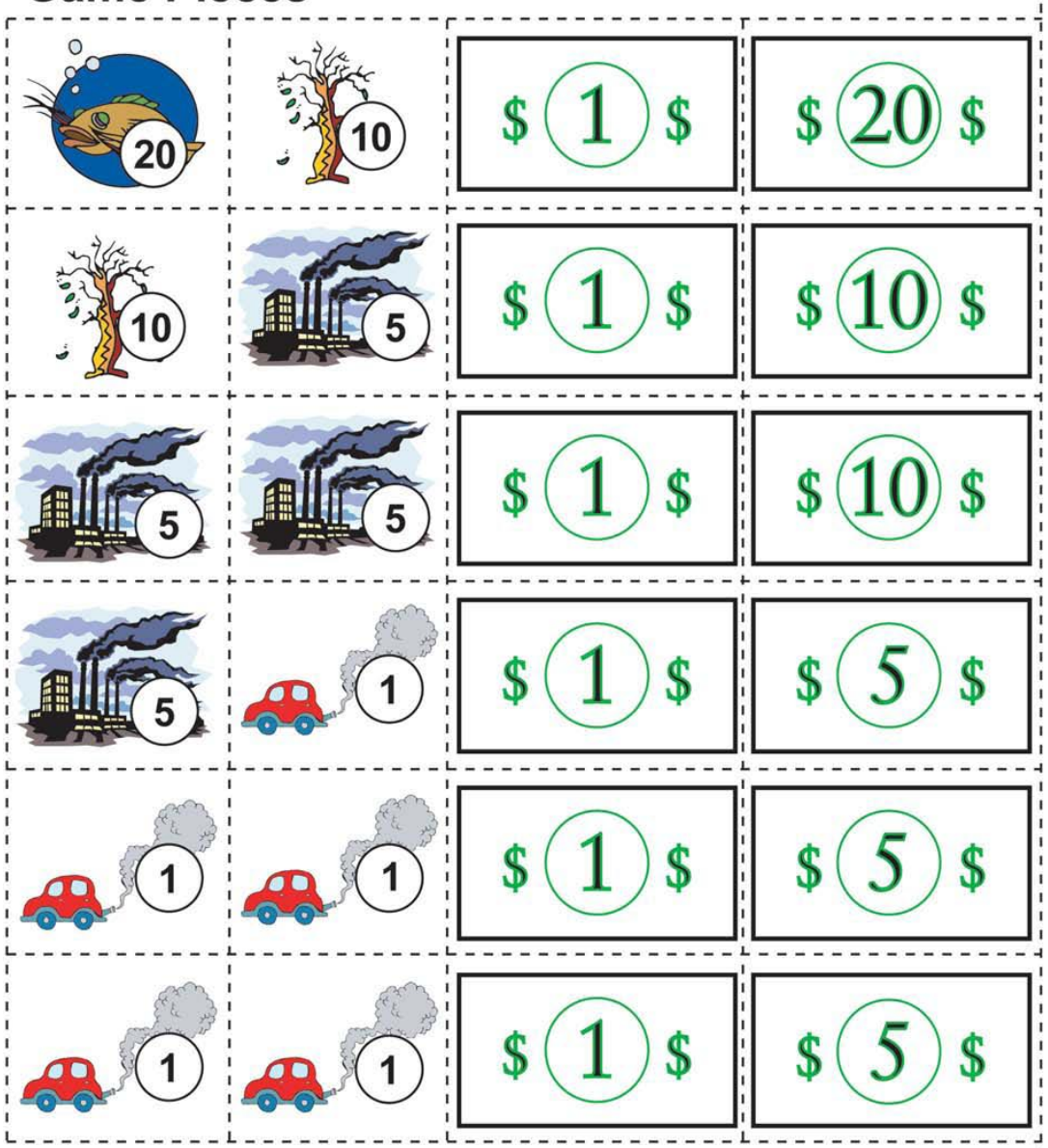
GAME CARDS

Round 2 **Home Remodeling** You have a major wood refinishing project. After testing and finding no lead in the painted surface, you choose a safer stripper that does not contain methylene chloride and choose a no VOC paint. Deduct one point for each town member from your pollution point total.	**Round 2** **Spring Cleaning** Store bought cleaners cost more money than homemade ones and may contain toxic air pollutants or chemicals that can pollute water if improperly disposed of. You use safer nonpolluting cleaners and reduce your cost total by $1 per team member. You may also deduct one pollution point for each town member.
Round 2 **Uh Oh!** Watershed cleanup and water treatment. If your city has built a Household Hazardous Waste collection facility, no additional monies are needed. If your city has no such facility, the cost to each town member is $2.	**Round 2** **Dry Cleaning** You need to have some dry cleaning done. You can choose an environmentally friendly cleaner that uses CO2 or water processing but it will cost you $2 and no pollution points for each town member. If your town supported the loan program it will only cost $1 and no pollution points per town member. You may choose to use a traditional dry cleaner, but it will cost $1 and one pollution point for each town member.
Round 2 **Question** This disease is common and involves the narrowing of airways. Symptoms include coughing, wheezing, and difficulty breathing. This condition can be made worse by air pollution. What is this disease? *(Answer: Asthma)* For a correct answer, your team members may deduct $1 for each town member from your cost total.	**Round 2** **Question** In your yard, how can you reduce water usage and pollution from fertilizers and pesticides? *(Answer: Use native plants)* For a correct answer, each team member may deduct one point from the pollution point score.
Round 2 **Question** The abbreviation for volatile organic compound is ___ ___ ___. *(Answer: VOC)* For the correct answer, your team members may deduct one point for each town member from your pollution point score.	**Round 2** **Question** True or false, houseplants can remove toxics such as formaldehyde from the air. *(Answer: True)* For a correct answer, each team member may deduct one point from the pollution point score.
Round 2 **Question / Action** True or false Many hazardous air pollutants such as benzene, formaldehyde, arsenic, and many others are found in cigarette smoke. *(Answer:True)* For every team member who pledges not to smoke you may deduct one point from the cost and one point from the pollution point score.	**Round 2** **Environment Bonus** Many people in your town have begun composting instead of burning leaves and using the compost as fertilizer. Your team members may deduct one point per town member from your pollution total or $1 per town member from your costs.

Cleaner Air Everywhere!  **Round Three**	
Cleaner Air Everywhere!  **Round Three**	
Cleaner Air Everywhere!  **Round Three**	
Cleaner Air Everywhere!  **Round Three**	
Cleaner Air Everywhere!  **Round Three**	

	Round 3 **Question / Action** Name three things you can do to cut down on your home's energy usage. *(Answer: Weatherizing, turning off the lights when you leave the room, using fluorescent bulbs, etc.)* For three correct answers, every member on your team may deduct $1 from your cost/fee pile or one point from your pollution point total.
	Round 3 **Uh Oh!** You electric bill is due. If you have installed energy efficient bulbs in your town, the bill for your team is $1 each. If you have old-fashioned incandescents, each team member will pay $3.
	Round 3 **Uh Oh!** If you have not approved an increase in electric rates to clean up your power plant, each player will pay $2 for environmental cleanup.
	Round 3 **Uh Oh!** Health Care Costs Pollution in the environment damages human health resulting in increased medical costs and time lost from work and school. If your team has fewer than an average of 3 pollution points in your environment, it will only cost $1 per team member. If you have an average of 3 or more points, you will pay $2 per town member.
	Round 3 **Question** What are three examples of renewable energy? *(Possible answers: wind, solar, biomass (ethanol), hydropower, geothermal, hydrogen)* For three correct answers, each of your team members may deduct one point from your pollution score or $1 each from your costs.

Game Pieces



CAR WORKSHEET AND NOTES ON CARDS PLAYED BY OTHER

ROLL	COST	POLLUTION POINTS
1. Hybrid Car	$ 4	1
2. New Energy Efficient Car	$ 3	2
3. Used Car/ Good Maintenance	$ 2	3
4. Used Car / Poor Maintenance	$ 1	4
5. Sport Utility Vehicle	$ 5	5

Your car is _____

Your cost is _____

Your car pollution points are _____

Notes on round cards played by other

This information will be useful in the wildcard portion of round three.

(All Pollution Points Go Here)

Town Collection Mat

Town Collection Mat

(All Money Paid Goes Here)

Cleaner Air Everywhere

Individual Responses

Student Name_____

Beginning Situation

Number on Die _____

Type of Car _____

Cost of Car $_____ Pollution points _____
(Beginning Survey Score)

Total Individual Beginning Situation_____
(Total = Add beginning survey score plus cost of car)

Your Survey Scores (pollution points)	
Beginning of game	
End of game	
Difference	+ / -

This total will be used at the end of the game

Round One - Proposal # 1 Building a Mass Transit System
My Vote: ☐ Yes ☐ No Team Vote: ☐ Yes ☐ No

Round Two - Proposal #1 Offering Small Business Loans
My Vote: ☐ Yes ☐ No Team Vote: ☐ Yes ☐ No

Round Two - Proposal #2 Building a Household Hazardous Waste Facility
My Vote: ☐ Yes ☐ No Team Vote: ☐ Yes ☐ No

Round Three - Proposal #1 Power Plant Pollution Prevention Measures
My Vote: ☐ Yes ☐ No Team Vote: ☐ Yes ☐ No

Round Three - Proposal #2 Changing Lighting in Your Town
My Vote: ☐ Yes ☐ No Team Vote: ☐ Yes ☐ No

Team Responses

Name of Town _____

Town Members _____

Action	Team Pollution Points	Team Costs, Fees, and Taxes	Explanation
Beginning Situation			Team Pollution Points = Total survey points plus vehicle pollution points for all town members. Team Costs/Fees = Total of all town member's car costs.
Round One Proposal YES / NO	_____		Mass Transit Proposal - If this proposal passes it will increase taxes $2 per town member.
Card One			Describe:

Team Responses (continued)

Action	Team Pollution Points	Team Costs, Fees, and Taxes	Explanation
Card Two			Describe:
Round One Team total			Total all columns for round one team total. The amounts should equal tokens on your Collection Mat.
End of Round One Average Team Total			Divide the total of the pollution points by the number of town members that played in this round. Do the same for the costs/ fees/taxes column.
Round Two Proposal #1 YES / NO			Small Business Loans - If this proposal passes it will cost each town member $1, but you may deduct 1 point each from your pollution column.
Round Two Proposal #2 YES / NO	———		Household Hazardous Waste Facility - If this proposal passes it will cost each town member $1.
Card One			Describe:
Card Two			Describe:
Round Two Team total			Total all columns for round two team total. The amounts should equal tokens on your Collection Mat.
End of Round Two Average Team Total			Divide the total of the pollution points by the number of town members that played in this round. Do the same for the costs/ fees/taxes column.
Round Three Proposal #1 YES / NO			Power Plant Pollution Prevention Measures - If this proposal passes it will cost each town member $1 for higher electricity costs.
Round Three Proposal #2 YES / NO			Town Lighting - If this proposal passes it will cost each town member $2, but you may also deduct 2 pollution points for each person.
Card One			Describe:
Wild Card			Your town chooses any card or action you have not already taken. Adjust score accordingly. Describe:
Round Three Team total			Total all columns for round three team total. The amounts should equal tokens on your Collection Mat.
End of Round Three Average Team Total		Costs/Fees/Taxes Final Avg.	Divide the total of the pollution points by the number of town members that played in this round. Do the same for the costs/ fees/taxes column.
Bonus Pre/Post Survey Scores Avg. Difference From Student Worksheets.	– Pollution Final Avg.		Total the difference of pre/post survey results from all town members and divide by the number of members this is your team average.Subtract this from your pollution point total.
Grand Total			Enter the Final Averages from boxes above.
Final Town Score	Pollution Points +	Costs/ Fees Taxes =	Total — Add the Grand Total scores together. This is the final score for your town.

Funding was provided by U.S. EPA, with generous support from Missouri Botanical Garden's EarthWays Center, and the 69 reviewers and partners.

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SOURCES

[1] EPA: Taking Toxics Out of the Air, EPA-452/K-00-002

[2] http://www.epa.gov/air/aqtrnd97/brochure/toxicair.html

[3] http://www.epa.gov/ttn/oarpg/t3/fact_sheets/utilfs.pdf

[4] http://www.epa.gov/clearskies/OverviewSO2_NOx_Hg.ppt

[5] http://www.epa.gov/ttn/oarpg/t3/fact_sheets/utilfs.pdf

[6] http://www.epa.gov/clearskies/OverviewSO2_NOx_Hg.ppt

[7] http://www.epa.gov/clearskies/OverviewSO2_NOx_Hg.ppt

[8] http://www.epa.gov/ttn/oarpg/t3/fact_sheets/utilfs.pdf

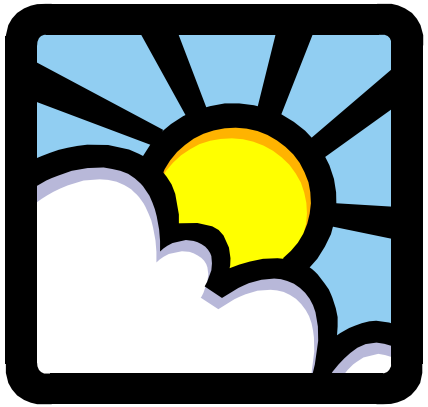
[9] National Wildlife Federation, Clean the Rain, March 22, 2001, "Conservation Groups Unite to Fight Electric Industry's Attempts to Reverse Mercury Pollution Restrictions." Also found at http://www.epa.gov/clearskies/OverviewSO2_NOx_Hg.ppt

[10] http://www.epa.gov/clearskies/OverviewSO2_NOx_Hg.ppt

[11] DOE – Energy Savers: Tips on Saving Energy & Money at Home, DOE/GO-102000-1121, August 2001

[12] DOE – Energy Savers: Tips on Saving Energy & Money at Home, DOE/GO-102000-1121, August 2001

Cleaner Air Everywhere!



A Classroom Game About Pollution Prevention

STUDENT BOOKLET

Cleaner Air Everywhere!

Pollution has been a problem for a long time in the United States and around the world. The U.S. Environmental Protection Agency (USEPA) is the government agency responsible for protecting our country's air, land, and water from pollution that may harm human health. Federal laws, affecting all of the states, help to limit the amount of pollution that can be released into our environment.

In this game, you will learn more about air pollution. Air pollution comes from natural and man-made sources. Humans have little control over natural sources such as volcanic eruptions, radon gas, and forest fires; therefore our focus is on the man-made sources of air pollution. When an air pollutant can damage human health, it is said to be hazardous. **Hazardous air pollutants** can also be called **air toxics.**

The **health risk** from pollution is difficult to determine. Risk from pollution is based on what pollutant you have been exposed to, how much of it you have been exposed to, and the length of exposure. Older adults, children, and people who have diseases such as asthma or heart disease are more sensitive to air pollution and are at higher risk of experiencing negative effects.

Exposure to pollutants can cause symptoms ranging from those that are reversible and mild, such as irritated eyes or throat to more serious ones such as difficulty breathing. Sometimes, the effects can be much more serious such as irreversible damage to organs, cancer, and even death. Some toxics affect unborn babies and cause birth defects or cause changes to a person's DNA that may not show up until later in life.

All of us are exposed to tiny quantities of toxic air pollutants everyday. Exposure to these small amounts usually does not bother most people; in fact you probably don't even notice it. Even though our exposure to hazardous air pollution may not be immediately dangerous, this topic deserves our attention. By learning more about toxic air pollution in our environment, we can reduce our exposure to it.

The sources of air pollution
To identify where certain pollutants come from air pollution is categorized into three groups, mobile sources, area sources and point sources. In this game you will learn more about the sources of pollution and some choices that people can make for cleaner communities and better health.

Follow-up Survey

In the Air
Where do you believe most air pollution come from?
1. Cars, trucks, and buses (mobile sources).
2. Homes and small businesses (area sources).
3. Large pollution sources such as factories and power plants (point sources).

Which of the following statements do you believe to be most true?
Air pollutants in the air
1. Can pollute land and water.
2. Stay in the air.

Which of the following statements do you believe to be most true?
1. What we do as individuals can reduce pollution.
2. Pollution does not get better.

The air in the city is
1. Much the same in the different neighborhoods.
2. Much worse in some neighborhoods than others.

Getting around town
If you had a choice how would you choose to get around?
1. Take mass transit/ bus/train or light rail/carpool/ walk, or ride my bike.
2. Carpool or take mass transit sometimes.
3. Take your own car.

Shop 'til you drop
When shopping, which is most important to you?
1. Shopping only in stores that are close to home even if they don't offer the largest selection or the best price.
2. Shopping at large stores because they have a better selection and lower prices.
3. Shopping at many different stores even if some are out of the area.

Errands
When it is time for your family to run errands, which is the most true?
1. We are organized and can combine many errands in one trip. (This is called trip chaining.)
2. We do things more on the spur of the moment and may make several trips depending on when things are needed.

At Home
When using products around your home what are you most likely to?
1. Always read labels on the cleaning products used at home, even ordinary products like bathroom cleaners and window cleaners.
2. Only read labels on products you are unfamiliar with. Products that are used in homes are safe when using common sense.
3. Not read labels on everyday products that everybody uses. Companies could not sell products if they were not safe.

Total your points by adding the numbers in front of your responses

_____
Total

Round Three Proposals
Point Sources

Proposal 1

Power Plant Pollution Prevention Measures

Additional pollution prevention measures can be taken by the power plant to reduce the pollution it produces. This proposal is to incorporate these measures. **If these changes are made, it will cost each team member $1 for higher electricity rates.**

High levels of mercury and other pollutants are being found in waterways and in some fish. Many neighboring area waterways are closed to fishing.

Where is the pollution in your water coming from?
Some people believe that it is medical waste leaking from a landfill. Others believe it is caused by air pollution. Is this possible?

Option: Conduct an investigation on pollution deposition, see Connecting Activity #3: "Tiptoe Through the Toxics"

After discussing this issue, your town will vote on this proposal. How will you vote?

☐ **Yes, we should incorporate additional pollution prevention measures at the power plant.**

☐ **No, we should not incorporate the additional measures.**

Proposal 2

Town Lighting

Your town council has already voted to replace all the light bulbs in town. You must decide what type of light bulbs to use. If you use Edison- type, incandescent bulbs it will cost you no extra money. **To outfit your town with compact fluorescent bulbs will cost $2 per town member but you will deduct two points per member off your teams pollution total.**

After discussing this issue, your town will vote on this proposal. How will you vote?

☐ **Yes, we should spend the money to improve our lighting.**

☐ **No, we should not spend the money to improve our lighting.**

Round One: On the Road
Mobile Sources of Air Pollution

What are mobile sources of air pollution?

Mobile sources, (cars, trucks, buses, planes, trains, tractors, etc.) are responsible for half the air pollution in the United States.[1]

Pollutants in this group include hydrocarbons, carbon monoxide, nitrogen oxide, lead, particulate matter, and other toxic air pollutants, such as benzene, 1,3-butadiene, and formaldehyde.

What health risks are associated with mobile source pollution?

Many of the toxics pollutants in exhaust from mobile sources aggravate asthma and other lung and heart diseases.

Pollution from mobile sources also contains known or probable cancer-causing agents. Benzene found in petroleum products such as gasoline is a known cancer-causing chemical. Long-term exposure to low levels of benzene has caused various blood disorders and leukemia.[2] Short-term exposure to high amounts of benzene may cause headaches, drowsiness, dizziness, respiratory irritation, unconsciousness, and death.

Other mobile source pollutants are likely to cause cancer. EPA estimates that fifty-percent of all cancers that are attributed to outdoor sources of air toxics come from mobile sources.[3]

Pollution from mobile sources is a major contributor to smog and ground level ozone.

How can we reduce pollution from mobile sources?

If you were a driver, here are some actions you could take to reduce pollution.

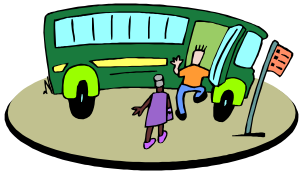
In the summer, refuel vehicles during the cooler parts of the day to lessen impact of gas fumes.

Avoid topping off gas tanks, which releases gas fumes into the air and cancels the benefits of any anti-pollution devices on the pump.

Combine errands into one trip. This is called trip chaining.

1 2 3

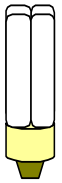
Take mass transit, share a ride or car pool.



Carpooling can reduce the number of cars on the road and total miles driven. It can save you money, too.

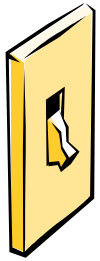
To reduce the amount of mercury and other toxic pollutants produced by electric power plants that burn coal, cut down on electricity use. Replace your incandescent light bulbs with compact fluorescent bulbs and cut the energy use by 75%!

Incandescent or Edison-type bulb also known as a "regular" light bulb.



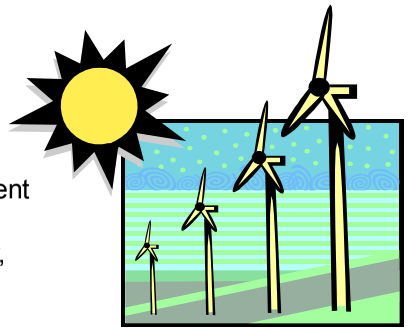
Compact fluoresecent lamp = cfl

Fluorescent bulbs have a small amount of mercury vapor in them. Dispose of burned out bulbs properly by protecting them from breakage and sealing them in a plastic bag. Better still, find out if local recycling facilities will recycle the bulbs.



Save electricity. Turn out the lights when you leave the room.

Support the development of renewable energy sources such as solar, biomass, wind, hydrogen, geothermal, and hydropower.

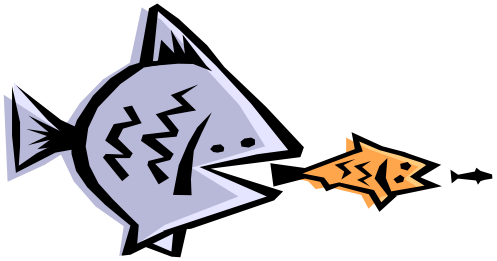


What choices can we make to reduce mercury and other pollutants from point sources?

Reducing the amount of energy you use at home will save you money and prevent pollution

Inspect your home for energy wasting drafts. Seal all the seams, cracks and openings to the outside, you can save 10 percent or more on your energy bill by just reducing those air leaks in your home.[12]

Some toxic chemicals enter the food chain and bio-magnify. One example is mercury. Mercury is a toxic metal that can cause brain damage.



Limit the amount of fish you consume from mercury-contaminated waters.

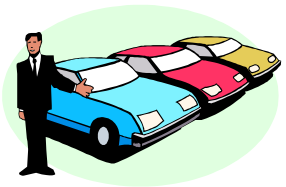
Money Isn't All You're Saving

Be an educated consumer. Look for the Energy Star™ symbol, which indicates the item is efficient. Consider the items you use that require electricity and minimize their use.

Maintaining your car by getting regular tuneups, changing the oil, and making sure that your tires are properly inflated will improve gas mileage and extend your car's life.

Traffic jams produce more pollution. Avoid areas of traffic congestion, or travel at non-peak times of the day.

Ride your bike, walk, or run.



Consider purchasing a more fuel-efficient vehicle or a hybrid car that minimizes emissions.

Round One Proposal
Mobile Sources

Proposal for a Mass Transit System
A proposal to improve your mass transit system is up for a vote.

If this proposal is approved it will increase taxes for each player by $2.

Those in favor say:

A better mass transit system will improve our air quality by reducing the number of cars on the road.

Those against say:

How do we know that the most air pollution comes from our cars? What about the pollution from factories. The polluters should be paying for cleaner air. Why should the money come out of my pocket?

Even if we build it, no one will use it.

Option: Conduct an investigation to determine what percentage of pollution comes from mobile sources and how wind direction affects our potential exposure to pollutants, See Connecting Activity #1: "Pee Yew! Is that You?"

After investigating this issue, your town will vote on this proposal. How will you vote?

☐ **Yes, we should improve our mass transit system.**

☐ **No, we should not improve our mass transit system.**

Round Three: In the Air
Point Sources of Air Pollution

What are point sources of air pollution?
This round focuses on point sources. Point sources are those that produce large amounts of pollution and are specific to one location. Point sources are responsible for 26 percent of our nation's air toxics.[1] These sources may release air toxics from smokestacks or vents, and vapor leaks from pumps, valves, compressors, and other equipment used in facilities. Examples of some of these pollutants include dioxin, asbestos, and metals such as cadmium, mercury, chromium, and lead compounds. Some other toxic pollutants found in these emissions that contribute to ozone formation include acetaldehyde, benzene, formaldehyde, toluene, hexane, and styrene.[2] Point sources include large factories, refineries, and coal fired electric power generating plants.

What toxics are associated with coal fired power plants?
Coal-fired power plants provide 50 percent of our nation's electricity. The pollution from these plants include 67 air toxics, including chromium, nickel, arsenic, dioxins, and mercury.[3] These pollutants can travel hundreds of miles from their source. They may take the form of tiny solid particles or liquid droplets and remain in the air for years. They can return to the earth through wet and dry deposition. Wet deposition removes pollutants from the air and deposits them back on the Earth's surface in rain, snow, sleet, hail, or fog. In dry deposition, these particles simply fall onto land and water surfaces without precipitation.

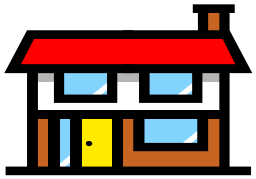
What health risks are associated with point source emissions?
Pollution from point source emissions can affect serious respiratory illness and cause acid rain. Many pollutants deposited in lakes and streams reduces biodiversity and kill fish.

Why the big deal about mercury?
Mercury may be the pollutant of greatest immediate health concern.[8] Mercury is a toxic metal and can cause brain damage, damage to the cardiovascular system, impaired motor and thinking skills, difficulty speaking and hearing, and problems with immune and reproductive systems.

The most exposed populations are those who eat large amounts of fish. Almost 400,000 children born in the United States each year are at risk of brain damage due to mercury.[9] There are 42 states that have fish advisories warning about mercury contamination.[10] Coal-fired power plants are responsible for approximately one-third of the man-made mercury emissions each year in the United States.[5] Once in the water, mercury enters the food chain. At each step of the food chain the mercury builds up contaminating plants, animals, and anything that eats them.

Round Two Proposals
Area Sources

Proposal 1
Small Business Loans



Small businesses are willing to clean up their act, but they need money to replace and update old equipment. This proposal is to have the city provide low-cost loans to businesses to help them reduce their air and water pollution. **If this proposal passes it will cost each town member $1. But you may deduct 1 point per person from your pollution point total.**

After discussing this issue, your town will vote on this proposal. How will you vote?

☐ **Yes, we should provide low-cost loans to reduce pollution.**

☐ **No, we should not provide the loans.**

Proposal 2
Hazardous Waste Facility

Your city has no facility to dispose of household hazardous waste. The proposal is to build a permanent site within the city to collect these household waste products.

If you pass this proposal, it will cost each town member $1 .

Those in favor say:
Having a permanent facility to take my household chemicals is important.
Those against say:
The chemicals I use around my home are safe and pose no harm to the environment.

Option: Conduct an investigation on alternative cleaning products, See Connecting Activity # 2: "Are Household Chemicals Safe?"

After investigating this issue, your town will vote on this proposal. How will you vote?

☐ **Yes, we should build the Household Hazardous Waste facility.**

☐ **No, we should not build the facility.**

Round Two: At Home
Area Sources of Air Pollution

What are area sources of air pollution?

All pollution that is not from a mobile source or from a point source is classified as an area source. Area sources are a broad category and include the pollution from our homes and small businesses. Other sources may be large but not specific to one location such as windblown farm dust or road dust. (Point sources, covered in round three, are those that produce large amounts of pollution but are specific to one location, such as a power plant or large factory.) The amount of pollution coming from a single home or small business may not seem like much compared to a huge factory but when you multiply that pollution by the number of homes and small businesses, it really adds up! Area sources account for approximately 24 percent of air toxics.[1] While the pollution from area sources include dusts, soot, chemicals, metals, etc., the ones we may have the most individual control over are the chemical products we use in and around our homes.

Many household products contain volatile chemicals. A volatile chemical is one that evaporates easily at room temperature. Paint thinners and glues contain volatile chemicals such as toluene, xylene, and methylene chloride. Tetrachloroethylene/perchloroethylene (PERC) is a volatile chemical used in drycleaning. Many household cleaners and some cosmetics contain volatiles. If label directions are followed, the products we use in our homes may be considered safe.

Where are potentially harmful chemicals found in the home?

Potentially harmful chemicals are released when burning fuels such as gasoline, wood, coal, natural gas and from using solvents, paints, glues, and other products that have been manufactured with them. Cigarette smoke is a source of many toxic chemicals. **Homes and small businesses are the second largest source of pollution from volatile chemicals.**

What health risks are associated with exposure to chemicals found in our homes?

Not much is known about what health effects occur from the levels of chemicals usually found in homes. Health effects vary greatly depending upon the type of chemical, the exposure level, and the time someone is in contact with it.

Accidents and intentional abuse (huffing or sniffing) of household products can result in eye and respiratory tract irritation, nausea, headaches, dizziness, vision problems, and memory loss. Serious damage to kidneys, liver, the central nervous system, and death can occur. Many volatile chemicals are known or suspected to cause cancer.

What can be done to reduce our exposure to chemicals at home?

Keep exposure to benzene a minimum.
Benzene causes cancer and is a component of gasoline. It is found in tobacco smoke, stored fuels, paint supplies, and auto emissions. Provide maximum ventilation while using products containing benzene.

Do not smoke. Many toxic chemicals such as benzene and arsenic are hazardous air pollutants found in tobacco smoke.

Use only approved containers for gasoline and other fuels.

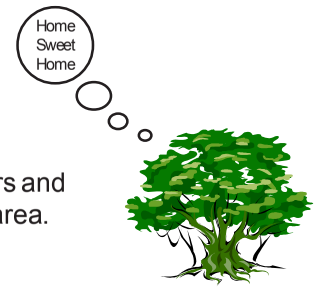
Use water-based paints. Look for low volatiles or no volatiles formulas.

Important:
To prevent pollution dispose of household chemicals and containers according to label instructions. When in doubt, contact your city hall or local health department.

Persons with allergies and asthma may also be affected by other pollutants in the home such as dust, pet dander and mold.

Avoid exposure to products containing **methylene chloride**, which is found in paint strippers, adhesive removers, and in some aerosol spray paints. It has been known to cause cancer. Methylene chloride is converted to carbon monoxide in the body and can cause symptoms associated with carbon monoxide poisoning.

Some house plants clean the air by removing toxics such as formaldehyde. Properly maintain plants to reduce molds.



To reduce water usage and prevent pollution from fertilizers and pesticides, landscape with plants that are native to your area.

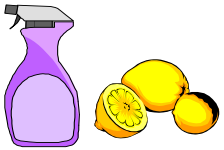
Read all labeling and follow directions. Be aware of what chemicals are contained in the products you use in and around your home.

Cap products tightly when not in use.

Keep all household products out of the reach of children and away from pets.

Reduce dust by changing your vacuum bag as recommended.

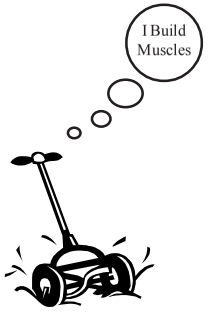
Do not mix household products unless directed on label. (Example: Mixing bleach and ammonia forms a poisonous gas.)



Look for safer product substitutions i.e., toluene free nail polish remover, environmentally safer cleaners to cut grease, water based paint products and enzyme-based drain cleaners. Many homemade cleaners are as effective as store-bought products and cheaper, too.

Keep exposure to dry cleaning chemicals such as tetrachloroethylene/perchloroethylene, or PERC, to a minimum. In laboratory studies, this chemical has been shown to cause cancer in animals. If your dry cleaned clothing has a strong chemical odor, do not accept it until it has been properly dried. Shop for environmentally friendly cleaners that do not use tetrachloroethylene or avoid drycleaning altogether.

Consider using a natural gas grill or a propane gas grill instead of a charcoal grill. If using a charcoal grill, start the briquettes with a chimney-type fire starter instead of using lighter fluid.



Minimize the use of gas-powered engines for some jobs that can be done by hand.