



CASE STUDY

The Case of the Burning Leaves

Teaching Instructions

Overview

In the case study, students analyze how a growing community deals with air pollution caused by backyard leaf burning. Students will learn how the harmful effects (external, or spillover, costs) of this practice have led many communities to ban leaf burning. The alternatives usually are landfilling, mass incineration, or some form of composting. As your students will see, the solution is not always clear cut, and there is often disagreement. Your students will learn that environmental issues are often interrelated because many concepts about solid waste disposal from the Case of the School Cafeteria in Unit 1 are encountered again.



Learning Objectives

After completing the case study, students will:

1. Apply the Five-Step (PACED) decision-making model to solve a problem affecting a community.
2. State why pollution from burning leaves results in external (spillover) costs.
3. Identify the advantages and disadvantages of personal and city-wide composting, land filling, and incineration as solutions for leaf disposal.
4. Understand that policy decisions usually involve trade-offs.
5. Identify the opportunity costs of various leaf disposal options.

Prerequisite Skills

Students must know how to use the Five-Step (PACED) decision model to solve a problem. This involves making decisions based on personal and group goals and communicating ideas in a group setting.



Important Concepts To Emphasize

Pollution Control Efforts Involve Costs. Efforts to control pollution benefit the environment. However, these efforts are not costless since they require the use of scarce productive resources. It takes resources to compost leaves, burn them in incinerators, or put them in landfills. To protect cities from smog, individuals must pay the cost of installing catalytic converters. As economists are fond of saying, "There is no such thing as a free lunch!" *Cost is a primary criterion to consider when making decisions about pollution control.*

Pollution and External Costs. The smoke from the burning leaves was an external (spillover) cost imposed on Mrs. Johnson. The external costs of air pollution arise primarily because no one *owns* the air, and there is no cost for using it. Government often intervenes to correct this problem, usually with regulation and/or taxation. The government tries to "internalize" these external costs so the producers and consumers who benefit from using the air also bear the cost.



Methods for Dealing with Solid Waste. Students should know the five basic methods for dealing with solid waste: source reduction, reuse and recycle, composting, landfilling, and incineration. With leaf disposal, the first two methods are impractical, so communities use the last three methods. Below are the advantages and disadvantages of these methods as they apply to leaf disposal.

Composting - Citywide

Advantages

- a. Returns organic matter to the environment
- b. Reduces amount of waste put in landfills

Disadvantages

- a. Can be costly to implement and maintain
- b. Compost must be redistributed back to citizens.
- c. Results in some air pollution from transporting

Composting - Personal

Advantages

- a. Relatively inexpensive to implement
- b. Most compost gets returned to the environment.
- c. Results in no air pollution

Disadvantages

- a. Regulating/insuring compliance can be costly or impractical.
- b. Can cause odors and animal problems

Landfills

Advantages

- a. Easy to implement
- b. May be a relatively low cost solution
- c. Organic wastes, such as leaves, are not harmful to landfills.



Disadvantages

- a. Increasingly costly as landfill rates (tipping fees) increase
- b. Doesn't return organic matter to home sources
- c. Results in some pollution from transporting

Mass Incineration

Advantages

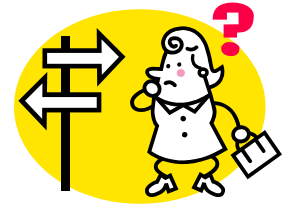
- a. Relatively low cost method for larger cities
- b. Results in much less air pollution than individual leaf burning
- c. Can burn all trash, not just leaves
- d. Heat from combustion can be used as energy source, reducing the use of coal, natural gas, oil, etc.

Disadvantages

- a. Returns no organic matter to the environment
- b. Results in some air pollution
- c. The ash from trash incineration (not just leaves) is more concentrated and toxic than unburned trash. The ash must be put in a properly prepared landfill.

Trade-Offs. When policy decisions are made, there are usually trade-offs. For example, if Mrs. Johnson accepts Mr. Lucano's proposal to stop leaf burning and use the landfill (instead of her proposal for city-wide composting), she gains cleaner air and health, but is trading off the benefits she perceives from having a compost program.

Opportunity Costs. Whenever decisions are made, there are always opportunity costs. For example, if the city chooses to continue leaf burning, the opportunity cost is poorer air quality and health problems for some citizens. If the city implements Mrs. Johnson's proposal, the opportunity cost would be all of the other things that would have been purchased from the \$3 a month fee collected from each household.



Teaching Suggestions

1. Hand out the case study scenario. Divide your class into small groups, and let each determine a solution to the case study. Have groups report their solutions to the class.
2. Review the Five-Step (**PACED**), decision-making model. 1. Define the **P**roblem; 2. List **A**lternatives; 3. Identify **C**riteria/Goals 4. **E**valuate Alternatives Against the Criteria; 5. Make a **D**ecision. Show students how to use the Decision-Making Grid. (See end of lesson.)
3. Students will probably list criteria other than those given in the suggested solution grid below.
4. While other leaf disposal options are discussed in the scenario (personal composting, incineration), in their decision grid, students should list only the three alternatives presented at the town meeting: Do Nothing, Citywide Compost Program, and Landfilling.
5. Students may disagree when completing the grid. The "\$ Cost/Landfill" cell is especially interesting. There is a "?" in the cell; however, some students may put a "+" since the current landfill costs in Rosedale are low. Students could logically reason that only if landfill rates increase in the future would it be logical to shift to a compost program.



Key Questions To Ask Students

1. What are the five basic methods of dealing with solid waste? (*source reduction, reuse and recycle, composting, landfilling, incineration*) Which are *not* practical for leaf disposal? (*source reduction, reuse and recycle*)
2. Which of the two basic **forms of air pollution** is the smoke from burning leaves? (*Particles*) Which of the **criteria pollutants** is smoke? (*particulate matter*)
3. What are the advantages and disadvantages of landfilling, composting, and incineration when dealing with leaf disposal? (*See advantages and disadvantages in Important Concepts To Emphasize section above.*)
4. What are some examples of scarcity in the case study? (*scarcity of landfill space, scarcity of clean air in the fall, scarcity of income*)
5. Why is smoke from burning leaves an **external cost**? (*Costs are imposed on others who do not benefit from the leaf burning.*)
6. In the case study, what are the opportunity costs of banning leaf burning and implementing a citywide compost program? (*the other things that would be purchased with the money used for the program*) What are the opportunity costs of continuing to allow leaf burning? (*increased health costs for some citizens, poorer overall air quality*)
7. What is the trade-off for Mrs. Johnson if the city adopts a landfill program? (*She gets relief from smoke, but gives up the benefits of a composting program.*)
8. What limits officials from raising taxes to implement leaf disposal programs? (*Citizens do not want a reduction in their income available for consumer purchases.*)

DECISION GRID ANSWER KEY
The Case of the Burning Leaves

CRITERIA

ALTERNATIVES	Safety	\$ Cost	Helps environment	Fairness	
Do nothing (Allow burning)	-	++	-	?	
Citywide compost program	+	-	+	?	
Leaves in landfill proposal	+	?	-	?	

Criteria Pollutants

The Clean Air Act requires the Environmental Protection Agency to set National Ambient Air Quality Standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are **particle pollution** (often referred to as particulate matter), **ground-level ozone**, **carbon monoxide**, **sulfur oxides**, **nitrogen oxides**, and **lead**. These pollutants can harm your health and the environment, and cause property damage. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats. EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. The set of limits based on human health is called **primary standards**. Another set of limits intended to prevent environmental and property damage is called **secondary standards**.

Source: EPA web site: What Are the Six Common Pollutants?
<http://www.epa.gov/air/urbanair/index.html>

<u>Pollutants</u>	<u>Symbol</u>	<u>Form</u>	<u>Type</u>
Particulate Matter	TSP	Particulate	Primary and Secondary
Ground Level Ozone	O ³	Gaseous	Primary and Secondary
Carbon Monoxide	CO	Gaseous	Primary
Sulfur Oxides	SO _x	Gaseous	Primary
Nitrogen Oxides	NO _x	Gaseous	Primary
Lead	Pb	Particulate	Primary

Landfill Tipping Fees (\$/ton)

Region	2004	1995	1990	1985
Northeast	70.53	73.17	64.76	12.66
Mid-Atlantic	46.29	45.68	40.75	16.99
South	30.97	28.50	16.92	3.24
Midwest	34.96	31.15	23.15	7.23
South Central	24.06	20.30	12.05	7.24
West Central	24.13	23.29	11.06	5.36
West	37.74	37.69	25.63	10.96
National	34.29	32.19	23.01	8.20

Regions

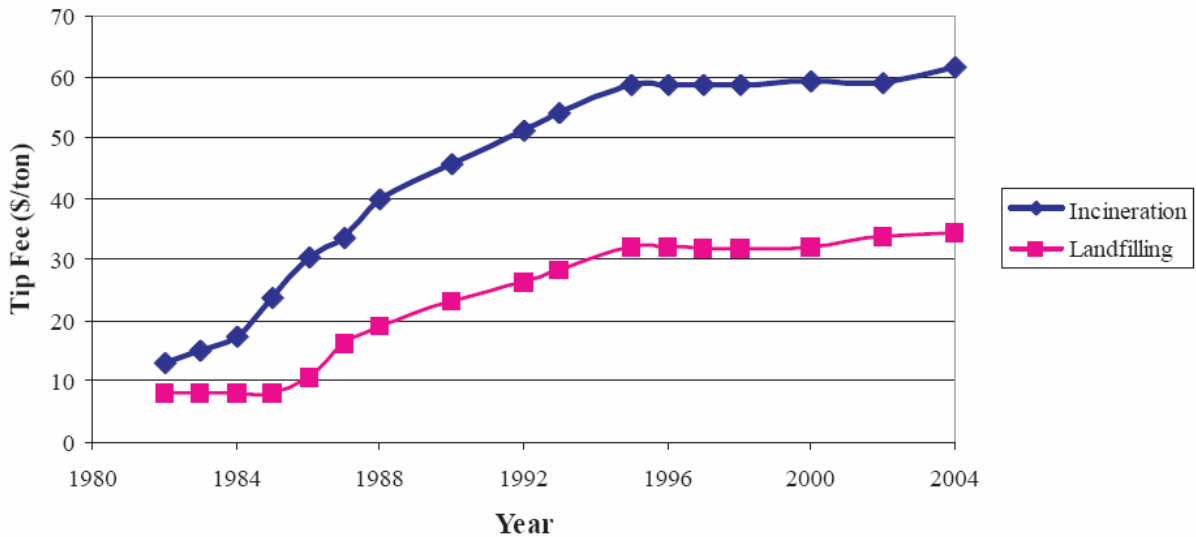
Northeast: CT, ME, MA, NH, NY, RI, VT
 Mid-Atlantic: DE, MD, NJ, PA, VA, WV
 South: AL, FL, GA, KY, MS, NC, SC, TN

Midwest: IL, IN, IA, MI, MN, MO, OH, WI
 South Central: AZ, AR, LA, NM, OK, TX
 West Central: CO, KS, MT, NE, ND, SD, UT, WY
 West: AK, CA, HI, ID, NV, OR, WA

Source: National Solid Waste Management Association (NSWMA), *NSWMA's 2005 Tipping Fee Survey*, NSWMA Research Bulletin 05-3 March 2005

National Tipping Fees for Landfills and Incinerators

Figure 3. Landfill and Incinerator Tip Fees



The average national tip fee at landfills has always been less than at incinerators. In 1982, the average landfill tip fee was \$8.07 per ton and the incinerator tip fee was \$12.91 per ton, a difference of \$4.84. In 2004, the average landfill tip fee was \$34.29 per ton and the incinerator average tip fee was \$61.64 per ton, a difference of \$27.35 (i.e., almost 80% higher than landfills).

Source: National Solid Waste Management Association (NSWMA), *NSWMA's 2005 Tipping Fee Survey*, NSWMA Research Bulletin 05-3 March 2005



The Case of the Burning Leaves

Student Directions

1. In the case study below, some citizens deal with a very real problem - how to dispose of leaves each fall. Different cities and towns have adopted different solutions to this problem.
2. Analyze the case study below and use the Decision Worksheet and the Decision Grid to help you determine a solution to the leaf disposal problem.
3. Be prepared to defend your final decision!

Scenario

It had been a beautiful fall in the growing city of Rosedale. The trees were full of color, and Mrs. Carolyn Johnson should have been in the best of spirits. There was only one problem - her asthma was acting up again, as it always did when there was smoke in the air. As usual, the smoke from burning leaves was the problem. It seemed that all her neighbors had huge piles of leaves that they burned. This year, however, Mrs. Johnson decided to do something about it.

She called the Rosedale City Hall and asked to speak with the Sanitation Department supervisor, Mr. Ralph Simmons. He was sympathetic, but warned Mrs. Johnson that people in Rosedale might not like to have to pay for other ways to get rid of leaves. "That doesn't matter," said Mrs. Johnson. "Their leaf burning is causing me health problems. Why should an innocent bystander like me be forced to pay for *their* actions? I'm also afraid that sparks might cause a fire in the neighborhood, and the smoke makes it difficult for drivers to see children playing near the streets."

That day, Mrs. Johnson investigated other ways cities and towns handle leaf disposal. She discovered that leaves are sometimes put in landfills because the leaves decompose and are not dangerous like toxic wastes. Other cities have composting programs. Leaves are collected and placed in compost sites, where they take about two years to decompose. The compost is then offered to citizens to use on their gardens



or lawns. In some places, citizens are encouraged to construct small compost piles on their own property for disposing of organic wastes. This avoids having to maintain a central compost site, but other problems occur. Incorrectly built compost piles can result in odors and can become infested with rats and mice. Finally, Mrs. Johnson learned that in larger cities, leaves and other trash are often gathered and burned in large incinerators.

At the next city council meeting, Mrs. Johnson proposed that leaf burning be banned in Rosedale and that the city start a leaf composting program. Rosedale would purchase land for the site and maintain the compost site throughout the year. Citizens would pile leaves on the street for city pick up. To pay for the program, the city would add \$3 a month to each person's sanitation bill. In her presentation, Mrs. Johnson stressed how air quality would improve in Rosedale, resulting in fewer health problems. She was, therefore, rather surprised at the opposition to her proposal.

Sylvia Williams was adamantly opposed to Mrs. Johnson's proposal. She exclaimed, "Leaf burning only takes place for a month or so. True, it hurts air quality, but it really isn't that bad. In any case, I don't have any trees on my property, and I compost the few leaves that blow on my lawn. Why should I have to pay for those who burn lots of leaves? I propose that we leave things as they are now.

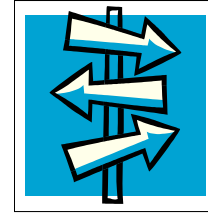


Sam Lucano, who had a yard full of trees and who didn't particularly like burning leaves each fall, was not totally opposed to Mrs. Johnson's proposal. However, he thought that instead of a composting program, the city should just put the leaves in a local landfill. "Right now, there is adequate space in our landfill, and it would be cheaper than starting a new composting program. I propose that we require citizens to put their leaves in biodegradable bags and put them out with the other garbage. Right now, that would only add about \$1 a month to each sanitation bill. Bagging leaves would be safer than piling the leaves on the street. No matter how much you warn them, children still play in the leaf piles on the street."

Mrs. Johnson responded, "It's true that it would cost more now to start a composting program, but what about the future? As our landfill fills up, the tipping fees certainly will become more expensive. And doesn't it make sense to return compost back to our lawns and gardens where it can do some good, instead of putting it into a landfill?"

The City Council decided to review all the proposals before making a decision. The vote will take place next Monday night.

Decision Worksheet



Student Directions

1. Complete this worksheet and the Decision-Making Grid to help you analyze the case study.
2. (Optional) Below the evaluation marks you place in each cell of the decision-making grid, make a brief comment explaining **why** you made a particular mark.

Step 1: Define the **P**roblem

Step 2: List **A**lternative Solutions

Step 3: List Important **C**riteria

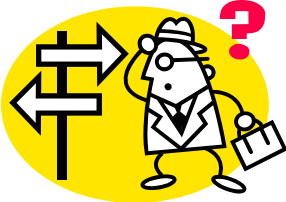
Step 4: **E**valuate Alternative Solutions

(Fill in the individual cells in the decision-making grid.)

Step 5: Make a **D**ecision

(Which alternative do you think is the best solution?)

Decision-Making Grid



Name _____ Class _____

CRITERIA					
ALTERNATIVES					