2 Why is Pollution an Environmental Issue?

OVERVIEW

Mark Twain once noted that "People always talk about the weather, but nobody ever does anything about it." People have much to say about the weather: it's too hot, too cold, we don't like thunderstorms, one person predicts drought, another predicts flooding. Weather is a problem for some people, but it is generally not an issue, because there is generally no disagreement about what is to be done about it. There is nothing we can do, other than prepare for what may come.

There are things that we can do about pollution, but people disagree about what actions to take. This is what makes pollution an issue: different people or groups of people have disagreements over what to do to solve the problem. Some people even disagree about how big the problem is, or whether it is a problem at all.

This section deals with helping students develop the skills they will need to look at issues, to solve problems, and to work with others to find common ground and solutions. These include analysis and problem solving skills. We will also look at some of the reasons why pollution is a problem, and what kinds of negative effects it can have on people, communities, and the environment.

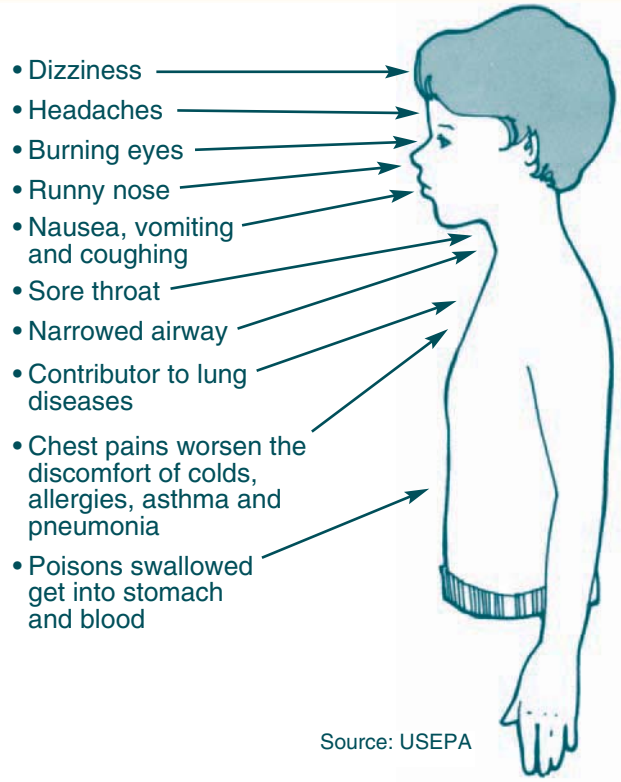
BACKGROUND

Pollution Effects on Human Health

Pollution can affect humans in a number of different ways. People exposed to air pollution for long periods of time may suffer from lung irritation, headaches or runny noses, develop asthma and allergies, or face even more serious problems such as lung cancer or reduced immune system strength. Polluted water can carry chemical or biological hazards such as lead, radon, bacteria, or other disease-causing agents.

Air pollution, invisible or not, can cause damage. Even a little air pollution can make your eyes burn and your head ache. It can blur your vision, make you dizzy, or make you tired. Many people find it difficult to breathe when pollution is in the air. Air pollution can even make it easier for you to catch a cold or the flu, and some air pollutants have been linked to serious diseases such as lung cancer and heart trouble.

Possible Effects of Air Pollution



Source: USEPA

People aren't the only things hurt by air pollution. Animals, plants and even buildings can be affected. Plants surrounded by polluted air may not grow, and fish and animals may die. Statues and building materials can be discolored or corroded.

Pollution Effects on Communities

In addition to its effects on individuals, pollution can affect whole communities. The town of Love Canal, in New York, essentially became a ghost town after hazardous waste, buried years before, began to seep up through the ground and affect local citizens. Even if individuals are not harmed, communities may endure the consequences if pollution destroys their economic base (for example, if water pollution closes a beach or if agricultural land is made useless due to a hazardous waste spill).

Pollution Effects on Economy

Pollution cleanup has become a very expensive undertaking. Millions of dollars are spent every year on toxic waste dumps, oil spills, litter collection, emission testing of vehicles and other pollution controls. When the costs are borne by businesses or individuals, they cut into profits or personal wealth; when covered by governments, they account for large tax burdens.

Pollution Effects on Ecosystems

Pollution can change or damage whole ecosystems and threaten species. The pesticide DDT, used to kill a large variety of insects and pests from 1939 to 1973, caused widespread environmental damage. Although the intent was to control harmful pests and diseases, its use resulted in the deaths of large numbers of songbirds. The chemical accumulated in the bodies of other animals, including bald eagles and peregrine falcons, who were then unable to produce young. The numbers of these species declined significantly as a result. Although it is no longer used in the United States, DDT continues to be produced here for sale to other countries.

SUMMARY

As stated in Section 1, pollution can adversely affect air, land and water. Similarly, it can affect individuals, communities, and ecosystems. The recent appearance of MTBE as an environmental issue is an example of how these are connected. MTBE (Methyl tertiary-butyl ether) was first used as a gasoline additive in 1979 as a way to improve air quality. It was later found to be a possible human carcinogen and it also has an unpleasant odor. Because it is highly soluble in water, it spreads quickly through soil if spilled on roads or leaked from underground tanks. Communities across the country, including some in Illinois, have lost some drinking water sources due to contamination by MTBE. Responding to national concerns, the United States EPA has ordered that MTBE be phased out of gasoline. This phase-out could take several years to implement.

When considering pollution, it is important to keep all possible effects in mind.

Leggo My Ozone

Subject: Art
Physical Education
Social Studies
Science

Skills:
- Measuring
- Creating Models
- Critical Thinking
- Classifying
- Role Playing

Concepts: 1. A, C, F, J
2. B, F 3. C, D, E, G

Objectives: Students will:
1) understand the different layers of the atmosphere and the importance of each,

2) understand the difference between good and bad ozone and where each is located,

3) understand how choices made on Earth affect the atmosphere.

State Standards:
Science: 11.A.2 c, 12.E.2 b, 13.B.2 b, e, f
Social Science: 17.B.2 c, 17.C.2 c
Physical Dev. & Health:22.C.2

Vocabulary:
- chlorofluorocarbons
- exosphere
- hydrocarbons
- ionosphere
- mesosphere
- Air Pollution Action Day
- ozone layer
- smog
- stratosphere
- thermosphere
- troposphere

Setting: Indoor & Outdoor

Materials:
- one sheet per student of white 1x1 meter paper
- a metric ruler
- pencil and colored pencils
- small jar lid or milk cap

Time: Two class periods

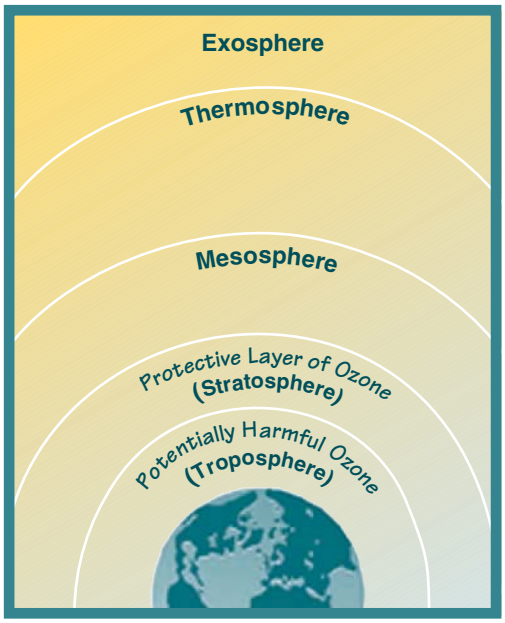
Activity Overview

Students first develop a model of Earth's atmosphere and then participate in a simulation which illustrates the difference between "good" and "bad" ozone.

Background

When trying to understand air quality, it is necessary to learn how our atmosphere operates. It is helpful to think of the Earth as being surrounded by four different layers. The first layer, the **troposphere**, is about 6-8 miles thick; it contains the air we breathe and is where we find clouds, storms and other weather events. This is also where birds fly.

The next layer is called the **stratosphere**. It is about twice as thick as the troposphere. The stratosphere is where many jet aircraft fly. In the upper Stratosphere we find a thin layer called the **ozone layer**. Ozone is a molecule made up of three oxygen atoms, and is very rare; in every million molecules of air fewer than 10 are ozone. However, the ozone layer is crucial to life on Earth because it shields us from harmful ultraviolet rays from the sun. This is commonly known as "good" ozone.



Source: Environmental Resource Guide, Air Quality, 1991.

The next layer up is the **mesosphere**. It is where we see trails left by meteors as they pass near the Earth. Above this is the **thermosphere**, which contains a region called the **ionosphere**. The ionosphere is important because radio signals "bounce off" the ions in this layer and return to Earth; this allows us to hear radio broadcasts from around the world. The final layer, the **exosphere**, is the upper limit of our atmosphere.

"Good" and "Bad" Ozone

The ozone located in the stratosphere is referred to as "good" ozone because it helps protect the Earth from ultraviolet radiation from the sun. If this layer were to be destroyed, more ultraviolet radiation would reach Earth. The results could include higher temperatures, damage to plants, and skin cancer in humans. Recently, scientists have discovered a hole in the ozone layer over Antarctica. Many scientists believe that the ozone layer is thinning or disappearing altogether. Many chemicals produced by humans are known to break down the ozone layer. These include halons and **chlorofluorocarbons** (CFCs), sometimes called freons. CFCs and related chemicals are found in or are involved in the production of many common products, including refrigerators, air conditioners, fire extinguishers, aerosol sprays, and styrofoam. Many companies now try to produce these items without using or producing CFCs.

AIR + HYDROCARBON + SUN = BAD OZONE

Some ozone is also found in the troposphere. This ozone is created by the action of sunlight on oxygen in the air in the presence of "ozone precursors"—chiefly **hydrocarbons**, and to a lesser extent, oxides of nitrogen, and carbon monoxide. Ozone is one of the primary ingredients of **smog**.

Smog can make the air look hazy. High ozone days occur chiefly on hot sunny days with little wind. Although ozone and air both contain oxygen, ozone is toxic to humans if inhaled. It is colorless and odorless at the levels you find it in the atmosphere, but can cause coughing, wheezing, shortness of breath, and irritation to the eyes and nose.

When the chance of high ozone concentrations in the air is especially great, extra steps are taken in some metropolitan areas to alert the public to the possible health risks. In Chicago, the Illinois EPA and the Partners for Clean Air declare "**Air Pollution Action Days**" and encourage people to take specific actions to reduce the amount of fossil fuels they burn. In the East St. Louis metropolitan area, the Clean Air Partnership joins the IEPA in declaring an "Ozone Alert" for the same purpose. The Partners for Clean Air organization suggests the following tips to help reduce ozone formation.

- Limit driving: combine errands, eliminate trips, rideshare, use I-Pass, carpool, bike or walk if possible.
- Take public transportation.
- If you must drive, use your newest vehicle, avoid excessive idling and abrupt starts, and keep your vehicle well-maintained.
- Refuel your car after 7 p.m., when sunlight is not strong enough to form smog.
- Delay using gasoline-powered recreational vehicles, especially on Action Days.
- Defer lawn mowing until late in the day or until the next day. The U.S. EPA estimates that 5 per cent of all air pollution nation-wide comes from our 89 million lawn mowers, garden tractors and other gas-powered equipment.
- Choose water-based paints instead of oil-based.
- Use a charcoal chimney or electric starters rather than lighter fluid when using a barbecue grill.
- Defer use of household consumer products that release fumes or evaporate easily.
- Conserve energy in your home to reduce needs from power plants.
- Do not burn leaves and other yard waste.
- Postpone burning wood in fireplaces on Action Days.

Preparation

1. Review background material.
2. Make copies of the Earth Atmosphere Model Instruction Sheet, (page 40) one per student.
3. Make two sets of Leggo My Ozone cards for the activity on day 2 (pages 41 and 42).
4. Create the outdoor playing field (page 37) for the Leggo My Ozone activity on day 2.

Procedures

Day 1

1. Ask the students if they have heard the term "atmosphere," and if they know what it refers to. Explain that the atmosphere surrounds Earth and is divided into layers. Explain some of the highlights of the different layers, for example that most of the weather occurs in the first layer, or that the ozone layer filters out the sun's harmful ultraviolet radiation.

2. Refresh (or instruct) students on the metric system and on how to use a metric ruler.

3. Provide each student with a copy of the Earth Atmosphere Model Instruction Sheet (page 40) and the necessary materials. Explain that they will be working on their own to produce models of Earth's atmosphere.

4. Allow students an appropriate amount of time to construct and decorate their models. These models could be used as an assessment and be based on accuracy, measurement, content, detail and neatness.

Day 2

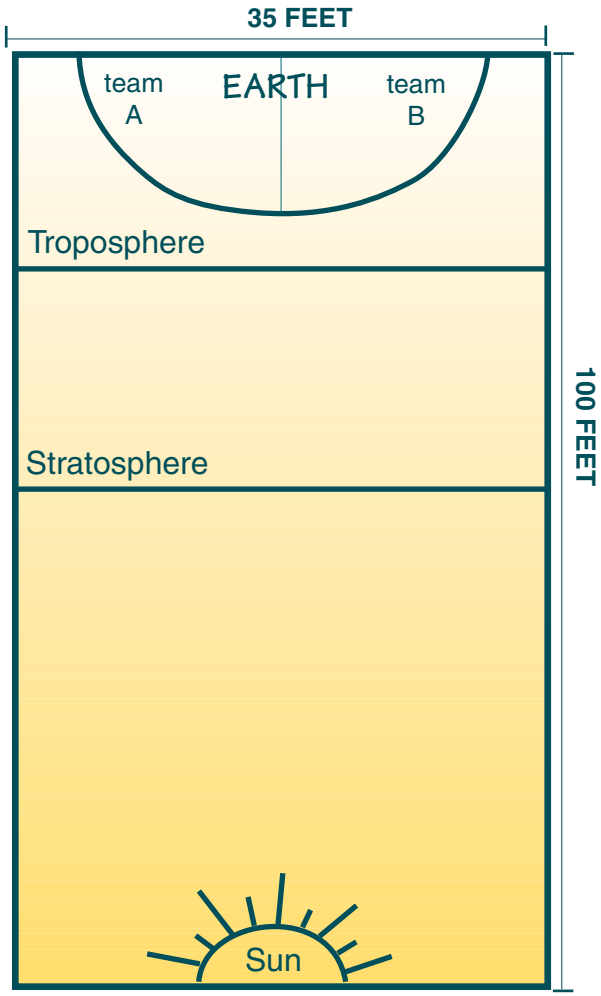
5. Review the five layers of the atmosphere with the students. Pay particular attention to the two layers closest to the earth, the troposphere and stratosphere. Inform them that today they will be focusing primarily on these two layers.

6. Introduce the concepts of "good" ozone and "bad" ozone. Explain that they are chemically the same, but are called good or bad depending on their location in the atmosphere and their effect on human health. Refer to the background information on page 35 for more information. Discuss the different human behaviors that can affect the amounts of good or bad ozone in the atmosphere.

7. Take the class outside to the prepared activity area. Point out the boundaries and features to the students:
   - Earth (different bases for teams A and B)
   - troposphere
   - stratosphere/ozone layer
   - distance (not to scale) between the stratosphere and the sun

8. Select students to fill different roles (numbers are based on a class size of 24, and can be adjusted):
   - earthlings (10, divided into two teams of five)
   - tropospherians (bad ozones) (six)
   - stratospherians (good ozones) (six)
   - ultraviolet rays (two)

Students should pay attention to the instructions for all roles, as they will have an opportunity to play most if not all roles during the simulation.



9. Explain the rules of the simulation: Each earthling team will have its own set of Action Cards (pages 41 and 42). Teams will draw cards at their own pace, independent of each other.

Each card represents a particular human action. For each action, the team must agree on the impact the action has. In this simulation, there are four possible impacts:

1) add bad ozone to the troposphere;
2) have a positive impact on the troposphere;
3) destroy good ozone in the stratosphere;
4) have a positive impact on the stratosphere.

Once the team has reached a decision, the person who drew the card will take it to the monitor (teacher) to verify the answer. If the team gets the answer wrong, they must go back to their team, insert the card back into the deck, and allow the next student on their team to pick another card. If they have answered correctly, they leave the card with the monitor and proceed as follows:

- If they do something to reduce or prevent bad ozone, they choose one person from the troposphere to join their team.
- If they do something to add bad ozone, then that person joins the troposphere.
- If they do something positive for the stratosphere, the player joins the stratosphere.
- If they do something to destroy good ozone, they select one person from the stratosphere to join their team.
  It may be helpful for the monitor to hold a small sign reminding students what answers result in what actions.

10. If someone picks an Air Pollution Action Card, the person picking the card must yell out "Air Pollution Action Day!" At this point, all action stops. However, the action taken by whatever card the other team is working on is doubled. So, if the other team was to add a player to the stratosphere, they would instead add two; if they were to take one person from the troposphere, they would take two.

11. The two Ultra Violet rays will begin at the far end of the activity area. They will begin counting off the weeks of the year, starting with December, at the monitor's signal. (For example, first week of April, second week of April, etc.) They are to recite these weeks slowly. When they reach the first week of August, they are to run towards the "Earth." Their mission is to get past the stratosphere without being tagged by the good ozone; if any of the good ozone tags them as they run through, they must return to their beginning point. If any of them makes it through, that student changes places with a member from team A or B. The team member they replace becomes an Ultra Violet ray for the next round.

The monitor writes down how many Ultra Violets got through the ozone layer, if any, and how much bad ozone is in the troposphere. Play then continues.

12. The players who begin as or who become bad ozone wait to be replaced by team members; otherwise, they are largely inactive. The players who are good ozone must also wait, but they must remain in line and be alert to stopping the Ultra Violet rays when they arrive. As the Ultra Violets run towards them, the good ozone must try to "tag" each Ultra Violet without moving from their location. The Ultra Violets only need to be tagged once to be stopped.

Wrap Up

Assessment

Have a few students share the various roles they played in the activity. Have all students reflect on the following:

• How did the stratosphere (good ozone) change during the course of the simulation?

• What effect did this have on the ability of ultraviolet rays to get through?

• What actions did they discover were either beneficial or harmful to the "good ozone"?

• How did the troposphere (containing bad ozone) change during the course of the simulation?

• What actions did they discover were either beneficial or harmful to the troposphere (where "bad ozone" resides)?

• In what ways was the activity similar to what really happens in the atmosphere? (What people do has an effect on the atmosphere; the stratosphere really does deflect most ultraviolet rays; things that people do on Air Pollution Action Days really have an impact).

• In what ways was the activity different from what really happens in the atmosphere? (Good and bad ozone don't become the opposite; ultraviolet rays don't strike Earth once a year—they are prevalent at different amounts throughout the year; and helpful activities don't take bad ozone away—they just don't produce as much or more of it.)

Extensions

Community

• Research various things that people can do to protect the "good ozone" and reduce the "bad ozone" in their community. Have students create posters of these activities that can be displayed in the public library or in store fronts.

Multidisciplinary

• Collect different media articles (a good source is to check online newspapers) about air pollution action days, the hole in the ozone and related topics. Have students analyze and compare how these topics are addressed in different sources and under different circumstances.

Technology

• Have students visit the Partners for Clean Air web site (http://www.cleantheair.org/). There they can find out if the Chicago area is having an Air Pollution Action Day. They can also get information on different ozone concentrations in different Illinois counties by going to the IEPA web site (www.epa.state.il.us/air/iaqdan/o3high.html) or they can get information from across the country at the AIRNow web site, http://airnow.gov/.

Resources

• *Cycles of the Earth and Atmosphere, A Web site for Teachers.*
Online teaching module for middle school science teachers. The content focus is climate change and issues related to both stratospheric and tropospheric ozone.
www.ucar.edu/learn/index.htm

• *Air Curriculum Resources*
A variety of online resources available for both students and teachers.
www.epa.gov/teachers/air.htm

• *Project A.I.R.E - Air Pollution Background Information(PDF Version)*
Fact sheet on air pollution and ways to detect and prevent it.
www.epa.gov/region01/students/pdfs/rd_airpol.pdf

Earth Atmosphere Model Instruction Sheet

Materials Needed

- one sheet of white paper 1 meter by 1 meter in size (bulletin board paper works well)
- a metric ruler
- pencil and colored pencils
- a round object such as a jar lid or milk cap

Activity

Check off each instruction after you have completed it. Remember, when drawing a new layer of the atmosphere, you should measure from the Earth's surface, not the layer before it.

❑ Obtain a 1 meter by 1 meter piece of paper.

❑ Use a pencil to trace a round object in the middle of the paper. This is Earth. Color Earth blue and green to represent oceans and continents.

❑ The first layer of Earth's atmosphere, the troposphere, extends 10-15 km above earth. Using a scale of 1 mm for 1 km, place a series of dots around Earth, 20 mm from the planet's surface. Connect the dots to form a circle around Earth. Label the inside of this circle 'troposphere.' Draw pictures to indicate that this is the area in which airplanes fly and weather happens.

❑ The second atmospheric layer, the stratosphere, extends 50 km above Earth's surface. Measure and draw a circle 50 mm from Earth's surface. Label this layer 'stratosphere.' The jet stream occurs between the troposphere and the stratosphere, so draw arrows to represent this fast moving current of air on the borderline between the two layers.

❑ The third layer of the atmosphere, the mesosphere, extends 90 km from Earth's surface. Measure, draw, and label this layer. This is the coldest layer, so draw a thermometer to represent the very cold weather.

❑ The ozone is between the stratosphere and mesosphere. Ozone is made of three atoms of oxygen. Along the border of the stratosphere and mesosphere, draw molecules of ozone - three connected dots - leaving a tiny area empty to represent the 'hole' in the ozone layer.

❑ The fourth layer of the atmosphere, the thermosphere, extends 480 km above Earth's surface. Measure, mark, and label this layer. A thin region in the thermosphere, called the ionosphere, contains charged atoms. Label the ionosphere and draw + and - signs to represent those atoms. (Remember, this is not a layer, just a region in the thermosphere.) When meteoroids enter Earth's atmosphere, they enter the thermosphere. Because of the heat caused by friction with molecules in the atmosphere, most meteoroids burn up. A meteoroid falling through Earth's atmosphere is called a meteor. Draw and label a meteor.

Cards for Day 2 - Leggo my Ozone - Make two sets of cards.

Shout "Air Pollution Action Day"	**Shout "Air Pollution Action Day"**
Driving a car that gets poor gas mileage.	**Riding your bike whenever possible for transportation.**
Leaving your car running when you stop at a friend's house or when running an errand.	**Using public transportation (buses or trains).**
Using gas-powered tools when hand tools will do.	**Sharing rides when going to the same place.**
Leaving cans or jars of paint, stains, glues or other solvents and chemicals open to evaporate.	**Insulating your house to save energy.**

Cards for Day 2 - Leggo my Ozone - Make two sets of cards.

Using an air conditioner that cools with freon gas containing CFCs.	**Inventing a type of styrofoam that does not contain CFCs.**
Disposing of a CFC-cooled refrigerator.	**Using CFC styrofoam peanuts to fill packages.**
Buying an air conditioner that cools with ammonia or some other non-CFC coolant.	**Avoiding fast-food that comes in CFC packaging.**
Buying and using a spray can labeled CFC-free.	**Using lighter fluid to start a barbecue.**

Playing with Food...Waste

Subject: Language Arts
Science
Social Studies

Skills:
- Analyzing
- Problem Solving

Concepts:
1. G
2. F, G
3. H
4. L, M

Objectives: Students will:
1) recognize there are costs associated with pollution remedies.

2) analyze and compare their values regarding pollution issues.

State Standards:
English Language Arts: 2.B.2 a
Science: 12.E.2 c, 13.B.2 d,f
Social Science: 15.B.2 c

Vocabulary:
- composting
- incineration
- landfilling
- non-hazardous solid waste
- recycling
- reusing
- source reduction

Setting: Indoor

Materials:
- six copies of the "Playing with Food...Waste" script (p. 46)

Time: One class period

Activity Overview

Students analyze a pollution issue dealing with the trash generated by a school cafeteria, and consider the obstacles to reducing the amount of trash and food waste.

Background

In general, there are six possible ways of dealing with **non-hazardous solid waste**. These are listed in the order that they should be considered:

- **source reduction** (limiting the amount of waste produced by an activity or not creating waste in the first place);
- **reusing** (using the waste materials over and over, or using them for another purpose);
- **recycling** (breaking the waste down into basic substances which can then be remade into other items);
- **composting** (the process of breaking down organic materials, such as fruit, vegetables, grass clippings or leaves, to be used as fertilizer for plant growth);
- **landfilling** (burying waste materials);
- **incineration** (burning waste).

Each of these options generally has some kind of cost associated with it. Incineration can result in additional air pollution, and still leaves behind residue which must be landfilled. Recycling requires energy and may produce wastes, depending on the process. Even composting has an associated cost in that it requires energy and land to maintain the decomposition process.

This does not mean that these are poor options or that they should never be used. There may be situations when each is the preferred means of handling waste. However, there is no simple formula for determining which method to choose. The choice will depend upon technology, economics, local conditions, and values. For example, one community may determine that landfilling is too risky because of frequent flooding, and may instead choose incineration or shipping its waste to another county's landfill. Another community may have ordinances against composting for fear of attracting potentially

dangerous animals or due to the fear of unpleasant odors. A poor community may choose whichever option is cheapest so that it can put more of its resources into health care or education.

Preparation

1. Make six copies of the story so that each of the volunteers has one to read.

Procedures

1. Ask students if they understand the concept of cost. Explain that when speaking of pollution, it refers not only to money, but also to the amount of water, electricity, space, or time that a process may require.

2. Explain the six methods of dealing with municipal solid waste. Make sure that they understand how they differ and what is involved with each.

3. Tell the class that they are going to hear a story about choices and decisions. Tell them that they will have to explain which decisions they agreed with, and why, following the activity.

4. Ask for six volunteers and have them read the story.

5. Have the students break into groups of four or five. Tell them that each group is to discuss the story and answer the following questions:

- Why were the students concerned about the amount of waste?
- What were the choices for dealing with the waste issue at school?
- What were the benefits of each one?
- What were the drawbacks or costs of each one?
- Which option do you feel is the best one?
- If your preferred option cannot be approved, what would be your group's second choice?
- What would your group definitely not choose?
- Can you think of any options that the school did not consider?

Remind the students that there is no right or wrong answers, but that they must be prepared to defend their choices.

6. While the groups are working, draw a chart on the board with seven rows and four columns. In the top row, write "Choice," "Benefit," "Cost" and "Rank."

7. After the groups have finished their discussions, have everybody get together and discuss their findings. Ask the class to name the different options, and write them on the board in the column labelled "Choice." (They should name: cloth napkins, reusable trays, recyclable trays, milk canisters, composting, and 'do nothing.') Ask each group to report on their discussion. Under "Rank" assign 1, 2, and 0 to the choices the groups recommend, with 0 being the options the groups would not choose.

8. Allow the class to discuss any disagreements and note any patterns in how they voted. If there are serious disagreements, ask the students to brainstorm how they might try to come to a common decision.

Wrap Up

Assessment

• Ask the students to consider what would have to happen for the list of choices to change. (Answers could include: new recycling ability in area, the landfill closing, etc.)

• Ask the students if there were any options that the students did not discuss, such as having students bring their own napkins, or requiring students to take their own trash home with them.

Extensions

Community

• Have the students arrange to weigh the amount of waste produced in their cafeteria during a typical day. Establish this as the school's baseline. Then, schedule a "waste-free lunch," where the goal is to have no waste produced in the cafeteria at all. (This will require coordination with parents, students and others.) Have students come up with ideas for minimizing their waste for this one day. They can also make the day a competition with another school, a nursing home, or a local business.

Multidisciplinary

• Have the students research how other cultures and civilizations deal or dealt with their waste: what they reused or recycled, how they disposed of it. Have them consider other contemporary cultures as well as historical ones.

Outdoor

• Identify an area on or near the school grounds where the students can construct a compost bin. Have them construct a simple design. Use the compost pile to experiment with the length of time it takes for different substances to decompose. Additionally, have students analyze the critter content of the bin to determine which microorganisms are aiding in the decomposition process.

Technology

• Identify a local business or industry that has a state-of-the-art recycling process or has been successful in reducing waste production. Arrange for a field trip to their site, or invite a guest speaker to give a presentation explaining how their program works, what technology is involved, and any plans for future improvements.

Resources

• *Environmental Education Holdings*
The EPA Region 5 library contains a variety of environmental education materials to assist teachers in the classroom. For a listing of these materials, visit online at: www.epa.gov/region5/library/collection/enved.htm

• *IEPA Bureau of Land, Landfill Capacity Report*
The site contains the annual report on the status of sanitary landfill space. www.epa.state.il.us/land/landfill-capacity/index.html

• *IEPA, Bureau of Land - Waste Management Programs*
Information is provided regarding household hazardous waste collections, used tire management, waste management requirements and open dump reporting. www.epa.state.il.us/land/waste-mgmt

• *DCEO's Vermicomposting Kit: EEEK! There's a Worm In My Room*
Contains lesson plans, a video and all the information you would need to know about setting up a vermicomposting (food composting with worms) bin of your own! (Free Rental!) To reserve an educational kit, contact Brett Ivers at DCEO, Recycling Unit, 217-524-5859 or brett.ivers@illinois.gov. www.istep.org

• *DCEO's The Case for Investigating the 4Rs:* (Grades K-adult) contains videos, lesson plans, and a variety of products made from recycled materials. (Free Rental!) To reserve an education kit, contact Rebecca Enrietto at DCEO, Recycling Unit, 217-785-7440 or rebecca.enrietto@illinois.gov. www.istep.org

Adapted From: "Case of the School Cafeteria" Energy, Economics and the Environment. Indiana Department of Education. Indianapolis, IN. 1994.

Story: Playing with Food...Waste

NARRATOR: Dean and Marlene had been through a discussion of solid waste just before lunch. As they sat in the cafeteria, they both noticed how much trash was being put into the waste baskets, just in the cafeteria alone.

DEAN: Look at that. I can't believe how full the cans are getting! Look how much we're throwing away!

MARLENE: Well, what do you expect? Everything here is disposable. The trays get thrown out, the forks and spoons are plastic, the napkins are paper. I hadn't noticed it before, but we don't reuse anything here.

DEAN: Yeah, but it's not just us. Doug brought his lunch, and he threw most of it away -the paper bag, the plastic bag his sandwich was in, and the celery sticks he never eats.

MARLENE: You'd think if they at least gave us reusable trays and silverware, we could do a lot better.

NARRATOR: Then Ahmed, who was sitting nearby, overheard their conversation and chimed in.

AHMED: Unfortunately, it's cheaper right now for them to buy things that are disposable. If they were going to wash everything, they'd have to buy dishwashers, pay people to load and unload them, and pay the cost of the water and soaps.

DEAN: And, more than likely, people would steal or lose some of the silverware, so they'd have to replace it from time to time.

AHMED: So they might have to raise the costs of the lunches here to cover the extra expense.

NARRATOR: Marlene was looking intently at the lunch tray.

MARLENE: You know, why can't they just recycle these? We recycle other plastics at home.

AHMED: I don't think this is one of the types of plastic we can recycle around here. They might have to send it a long way off to be recycled. That may not be worth the fuel it takes to transport it.

MARLENE: Then why can't they start getting trays made of recyclable plastic?

NARRATOR: Denise also overheard part of the conversation and joined in at this point.

DENISE: You know, there's something else, too. At my sister's college dorm, they have a cafeteria too. But they have big dispensers of milk instead of these little cartons. People can just line up and take as much milk as they need. And they don't have to throw away all the cartons—they just wash the cups afterward.

AHMED: Yeah, but you still need to have dishwashers.

MARLENE: Besides, you know how slowly the lines move around here. If we had to wait for people to pour themselves a glass of milk, we'd be here all day.

DENISE: So? Wouldn't it be worth it to have less litter thrown away?

MARLENE: I don't think that's the problem. Look how much food gets thrown away here. Most of this stuff could be composted.

DEAN: Why don't we ask if we can put a can or a bucket out for people to put in all the things we can compost? They did that at a camp I went to for a week.

AHMED: Yeah, and then the school could have its own compost pile.

MS. WINTHROP: Not so fast, kids, it's not that easy.

NARRATOR: It was Ms. Winthrop, the principal.

MS WINTHROP: Those are all good ideas, but you're forgetting a few steps.

DENISE: Like what?

MS. WINTHROP: Well, a lot of the food here can't go in a compost bin. You can't put in milk or meats, for instance. If any of those got into the compost bucket by mistake, because somebody wasn't paying attention or just felt like being a snot, everything in the bucket would have to be thrown out. Unless one of you wants to pick through it and sort it out...?

DEAN: Ugh, no, I think I'll pass on that.

MS WINTHROP: Besides, we don't have a good spot for a compost pile here. Our school is pretty cramped. I think the only place that we could put a compost pile would be on the south wall, right outside of your classroom window.

AHMED: That might be a problem on hot days.

MS WINTHROP: Plus, I'd need someone to turn the pile, someone would have to be responsible for taking the food wastes out after every lunch.

MARLENE: I can't believe there's nothing we can do.

MS. WINTHROP: I'm not saying you can't do something, I'm saying you have to recognize that there will be a cost. It could be more expensive lunches, longer lines, later dismissal times because lunch runs over, less room for playgrounds if we make a compost pile, detergents in the water. Are any of these worth it to you?

DENISE: But, wait, there's a cost to doing nothing, also. These paper napkins come from somewhere, and all this paper that gets thrown out is paper we can't use for other things. Besides, as it is the school pays for someone to bring new napkins, trays, and milk cartons every week, and pays someone to take all this trash away. And I know that our landfill isn't going to last forever. I know because they're already talking about using the land across from my house as a landfill when the one we're using can't take any more.

AHMED: So what do we want to do?

On Illinois Pond

Subject: Language Arts
Science
Social Studies

Skills:
- Public Speaking
- Problem Solving
- Planning
- Comparing/ Contrasting

Concepts: 2. C, D, E, H, I
3. A
4. H, I, J

Objectives: Students will:
1) understand that different land uses can affect the types of pollution in a given area.

2) recognize that people have different and sometimes conflicting interests in how land is used.

State Standards:
English Language Arts: 4.B.2 b, 5.C.2 b
Science: 13.B.2 f
Social Science: 14.D.2, 15.B.2 c, 17.C.2 b,c

Vocabulary: • water pollution • watershed • wetlands

Setting: Indoor

Materials:
- scissors • tape
- copies of the pond map (p. 51) and the town parts sheet (p. 52) for each team
- one sheet of 18X24 paper for each team

Time: One class period

Activity Overview

Students take part in a role playing exercise in order to understand the interests of different groups and different causes of pollution in a land development issue.

Background

Every human use of land affects wildlife habitat, positively or negatively. What humans do with land is a reflection of their priorities, lifestyles, and options. Some people see undeveloped areas of land as little more than raw material, a type of supermarket from which humans can take resources for their own use. Others believe that natural areas are to be preserved without regard to human needs. Some see the land as a treasure which must be cared for with a spirit of stewardship; still others try to strike a balance between economic development and habitat protection. Well-meaning people can have strong differences of opinion on how land should be developed, and even on the question of whether land should be developed at all.

Wetlands provide a good example of how different positions on growth can be. Human involvement with wetlands can be disastrous for the animals and plants that rely on this habitat. Wetland habitats are home to many species of fish, birds, frogs, insects, and plants. They play an important role in supporting migratory species and assisting in flood prevention. Their importance, however, has not always been appreciated. Historically, swamps were often drained to provide land for building or agriculture. While this continues today, wetlands are also affected by pollution and disruption in the flow of water.

Issues dealing with **water pollution** frequently result from disputes over land use. Even a parcel of land that seems far from any body of water is part of a **watershed**. A watershed is composed of all the land that drains into a river, stream or pond. How pollution gets into water depends on where the polluting source is located on the watershed, how it is structured, and how many stresses the body of water must endure at once. For that reason, land use issues may also be water pollution issues.

Preparation

1. Prepare copies of the two student worksheets (the Illinois Pond map and the land use cutouts).

2. Write the names of each of the interest groups on small pieces of paper (see procedure #3, below). Place them in a hat, box, or some other container that students can reach into without seeing the contents.

Procedures

1. Review the concept of watersheds with the students. Explain that wetlands are part of a watershed, and discuss some of their functions and benefits. Ask them to name some of the kinds of organisms that rely on wetlands for survival.

2. Hand out copies of the Illinois Pond map (p. 51). Explain to students that there are several industries and groups that are interested in developing the area, and that they will have to make some decisions about how the land is going to be used. Their overall goal will be to arrange the development in such a way as to minimize the impact on the pond.

3. Divide the class into five to seven groups, with three to five people in each. Have one person from each group pick the name of an interest group from the box or container. The interest groups should include some of the following:

- Homeowners - want to live in the area and have a good school.
- Farmers - want to use the land to raise food and livestock.
- Business Interests - want to use the land for business.
- Gas Station Owner - wants to make a living servicing the cars of residents and business people.
- Parks Department Personnel - want people to have a place for recreation.
- Hunters and Birdwatchers - want the land to be a habitat for migratory birds.
- Highway Department Personnel - want to maintain access to the area.
- Bleach Factory Personnel - want to preserve jobs and commerce.

Other interest groups can be added as well.

4. Pass out the town parts sheet and 18" X 24" paper to each group. Have them cut out the land use pieces and the diagram of the pond and the wetland. Instruct them to paste the pond onto the center of the larger sheet of paper. Tell them that they will need to find a way to put all of the land use pieces on the same piece of paper. The different cards may touch, but not overlap. Farm and parkland can be cut into smaller pieces, but all others must remain the original size. Tell them that they will have to decide what goes where based on the identity and interests of the special interest group.

5. Before they begin, have the class list the benefits of each of the land use items, along with the possible pollutants it will create. Record the answers on the chalkboard.

6. Give students most of a class period to come up with their solutions. Have them tape or paste their land-use cards to the 18" X 24" paper so that the sheets can be held up for class view.

7. Have each interest group report to the class on what they did. Remind them to be prepared to defend their placement of different items. Give other groups the chance to question and challenge the proposals. However, remind the students that they must remain in character, and they must be able to explain their comments in terms of what their interest group would want.

8. During the presentations, focus the discussions on how the land use will affect the pond, and on what types of pollution the different options will create. What are some possible consequences of this type of pollution?

9. With the groups still in character, ask them to try to agree on a plan that suits everybody. Remind the students in advance that several people, if not everybody, will have to compromise to accomplish this goal.

10. Attempt to end the activity on a positive note, thinking about solutions. Are there things that the land developers can do to minimize the pollution risks from their land use? If so, what?

Wrap Up

Assessment

Have each student write a composition stating what their character in the role play heard the other interest groups say and how their arguments were viewed.

Extensions

Community

• Learn more about environmental impact statements. Obtain an actual copy of statements prepared for your local area, if available. Identify the concerns that are addressed and discuss these with students.

Multidisciplinary

• Draw an additional version of the map showing the larger watershed, where water comes from and where it goes from the pond. Does this view change the options that are available?

Outdoor

• Trace any stream or river system that passes through your community from its source to its final entrance into the ocean. List all the sites that you can identify where the quality of the water might be lowered.

Technology

• Using the Internet or the World Wide Web, collect articles about local or state water related or land use issues.

Resources

• *Aquatic Illinois*
This CD-ROM contains lessons and activities on wetlands, rivers and streams, ponds and lakes, surface and groundwater, exotic species, aquatic history, water as resource and watersheds.

For more information and access to the CD-ROM please contact The Illinois Department of Natural Resources at (217) 524-4126 / e-mail: dnr.teachkids@illinois.gov, or visit http://www.dnr.state.il.us/lands/education/classrm/kits.htm to access online (pdf).

For an online order form for DNR's educational materials, visit http://www.dnr.state.il.us/lands/education/index.htm

• *Getting to Know Your Local Watershed*
Provides overview information on "What is a watershed?" Explains different sources of pollution that affect watersheds, and uses of watersheds' natural resources. To order call 765-494-9555 or view online at http://lanshark.ctic.purdue.edu/KYW/Brochures/GetToKnow.html.

• *Lake Notes - Determining Your Lake's Watershed*
Explains watershed boundaries and gives helpful information on reading watershed maps. IEPA (see order form in appendix)

• *Water Quality: Potential Sources of Pollution, Middle School Edition*
This 24" x 36" color poster depicts point and nonpoint sources of pollution. The reverse side contains two activities, Dispersion of Nonpoint Pollutants and How Substances Are Measured in Water. Available online at: http://water.usgs.gov/outreach/OutReach.html

• *Groundwater and Land Use in the Water Cycle*
This 24" X 36" color poster graphically displays various land use practices and geologic formations. Order online at: http://www.dnr.state.wi.us/education/

• *Water Where You Live*
Click on the state you're interested in, and find out all about the streams, rivers, and lakes. You can even find out about the beaches. www.epa.gov/OW/states.html

• *Wetland Teaching Kit*
This teaching kit was developed by the Illinois State Museum for teachers of grades fifth through eighth. It is available for lending at no charge. The resources and activities in the kit include soil and freshwater study sets, a variety of posters, original video and audio cassettes featuring songs and stories on Illinois wetlands, field guides, and activity sets. For information on borrowing "The Wetland Teaching Kit" please visit the following web link for a lending site near you: www.museum.state.il.us/ed_opp/wetland-kit.html

• *Illinois State Water Survey*
Provides a wealth of information regarding Illinois water and atmosphere. www.sws.uiuc.edu

• *Wetlands, Oceans and Watersheds*
Provides information on watersheds, different types of waterbodies and how to protect our resources. www.epa.gov/owow

• *The Water Sourcebooks*
This activity guide contains numerous activities about the water management cycle and how it affects all aspects of the environment. It is available in four sections: K-2, 3-5, 6-8 and 9-12, and each section consists of five chapters: Introduction to Water, Drinking Water and Wastewater Treatment, Surface Water Resources, Ground Water Resources, and Wetlands and Coastal Waters. www.epa.gov/safewater/kids/wsb/index.html

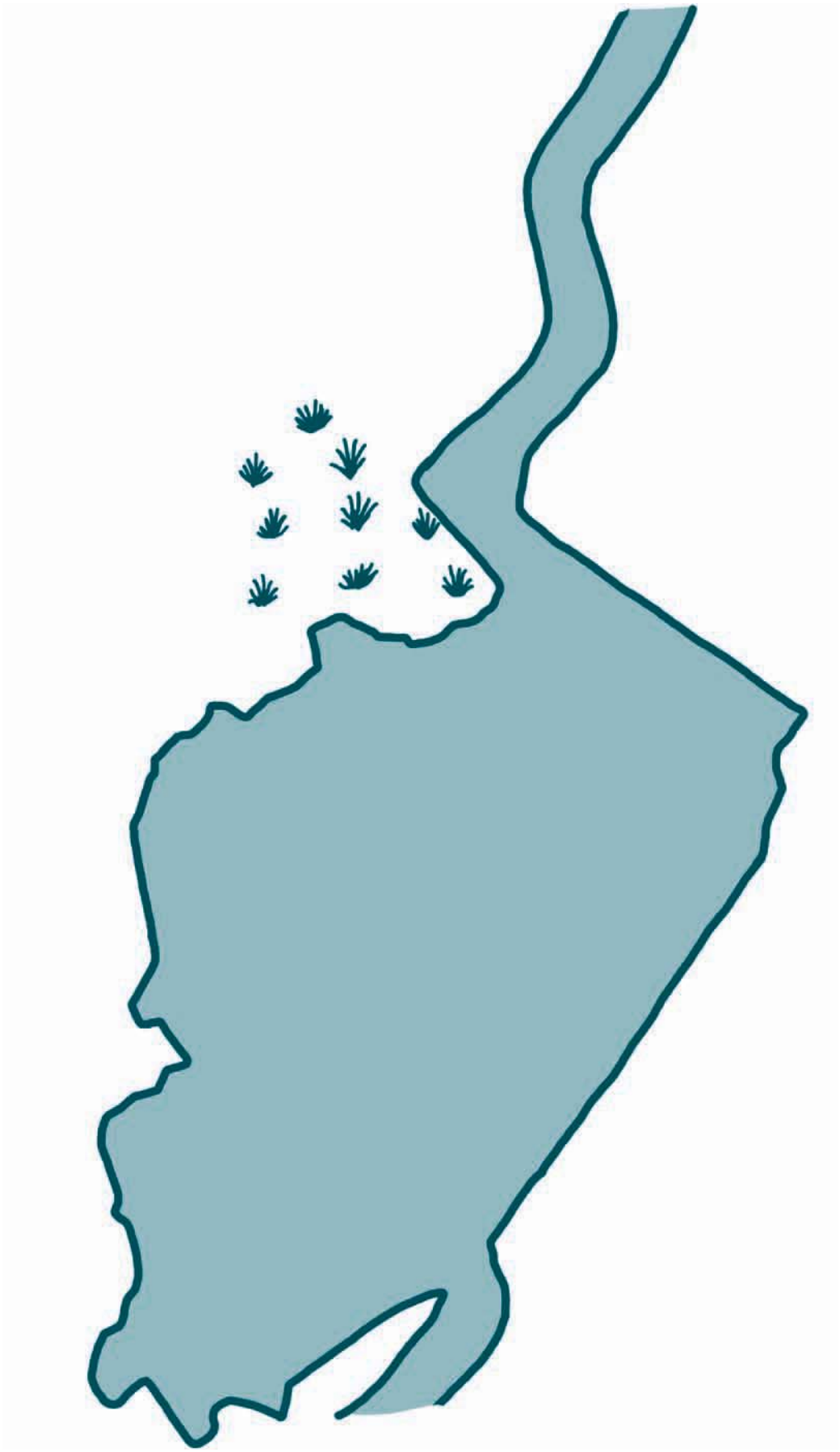
• *Lake Education Assistance Program (LEAP)*
The Illinois EPA offers a $500 grant available to all Illinois schools and not-for-profit organizations for the study of lakes/ponds and their watersheds. This money can be used to purchase lake-related educational materials, field trips, equipment and activities. Application deadlines are September 30 and January 31. www.epa.state.il.us/water/conservation-2000/leap.html. 217-782-3362

• *Educating Young People About Water*
This Wisconsin-based web site offers guides and a water curricula database to assist you in tailoring your specific water education needs. www.uwex.edu/erc/eypaw

• *The Electronic Naturalist*
This free electronic newsletter is a weekly educational series that provides information on animals, plants and environmental issues. www.enaturalist.org

• *Edens Lost and Found*
The Chicago segment of *Edens Lost and Found* showcases determined, ordinary Illinois citizens, as well as professionals and government officials, who developed innovative "best practices" that address the widespread problems facing many of America's urban environments. These "best practices" can be adapted in any size community. For this reason the Illinois Sustainable Education Project (ISTEP) is providing a DVD (Chicago, "City of Big Shoulders") to Illinois educators and community leaders wishing to promote an integrated approach to restoring and supporting the environment at a local level with broad-based community participation, and to use as an educational resource in the classroom. For more information about Edens Lost and Found, contact Brett Ivers at DCEO, Recycling Unit, 217-524-5859 or brett.ivers@illinois.gov.

Adapted From: "Dragonfly Pond," Project WILD Aquatic. Western Regional Environmental Education Council. Bethesda, MD. 1992.



Town Parts Sheet