

Micro- to Macro- Environmental Air Quality Risk Survey

Purpose

To help students identify the different and shared factors which impact air quality for them personally, for the members of their household, their school and community, their city, their country, and the Earth.

Overview

This exercise helps each student apply their research on air quality to their own daily lives. Ideally, this activity should be done after their basic air quality research has been done in groups. The worksheet provided should be taken home and filled out. The following class period, students should have a class discussion and do the assignment again as a class to make the point that students have varied and individual exposures to air quality problems both at home and in the school.

Time

2 one-hour class sessions

Key Concepts

Air quality varies person by person based on the choices individuals make, the choices their families and school administrators make, the regulations and policies of their local and national governments, and those decisions made by international political organizations.

A person's "micro-climate" can vary street by street and hour by hour, depending on where and what people do in their daily lives.

The dose of air pollutants administered on the person can be far greater than that of an industrial pollutant dispersed widely.

Skills

Recording findings
Applying research
Forming hypotheses
Understanding and describing interrelationships in nature
Identifying individual vs. community choices
Communicating observations orally

Materials

Worksheet provided
Overhead projector or Chalkboard

Facilitator Preparation

Read the enclosed article excerpt from the *New York Times* and the Teacher's Guide to Air Quality.

Background

Discuss with students the various ways that air quality can be compromised. Relate the "triggers" for asthmatics to the effects of the lungs of non-asthmatics that are less dramatic, i.e. reduced lung capacity. Encourage students to think beyond things that

smell bad (i.e. auto exhaust and industrial fumes), and to remember ozone, dust, and pollen (which don't smell) and perfume, incense and candles (which smell good). Also, point out that air quality problems can be natural or man-made, or a mixture of the two. This exercise relates the choices individuals make to the larger problem of air quality globally. It also helps students think about choices that they make that may be aggravating their own health or that of their family members.

The teacher's key provided for the worksheet contains examples of what factors impact air quality at the microclimate level to the global level. "Micro-climate" is a recently coined term for the air immediately surrounding the self. The home and school climates will be a mix of traditional outdoor and indoor air quality factors, while the community, national and global air quality factors will be general atmosphere issues.

Following from the identification of factors that effect air quality is the discussion of who has responsibility for controlling/ minimizing these factors at each level. While the student can make choices for themselves about their microclimate, they may have less control over their home environment (for example, if the parents smoke). A community may make good choices about controlling their own pollution, but if a neighboring city fails to controls its industries, it still may suffer from poor air quality. A discussion of who is harmed and who makes air quality decisions that affect others is central to this exercise. Again, see the key for help leading the discussion on responsibility and the environmental health. This exercise could serve as a lead-in to a debate.

Procedure

The teacher should introduce the concept of "micro-climate" from the provided article in a brief discussion then hand out the worksheet. Students should record their own personal air quality situation in the three innermost rings of the "bull's-eye" diagram, not factors from their research. The students should survey their home and community and the complete the worksheet as a homework assignment. The following day, lead a class discussion incorporating the students' findings, and point out the differences and similarities between students' environments. During the discussion, ask the various student research teams (atmosphere, indoor air, outdoor air, and human health) to fill in any "blanks" in the bull's-eye with their research findings. The key also suggests factors the students did not identify for themselves. Then students should use the discussion questions to think about who controls or monitors air quality at each ring of the diagram and ultimately, who has responsibility for maintaining acceptable air quality at each level.

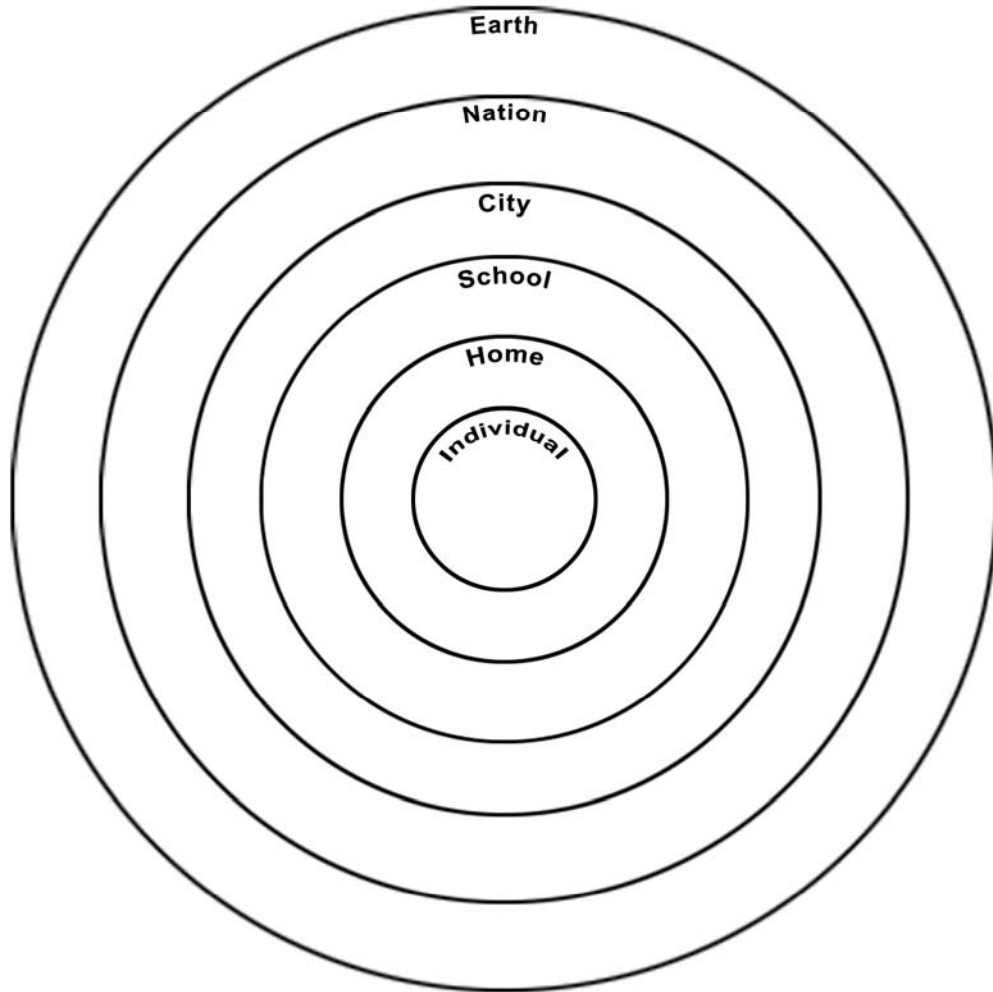
Student Assessment

Give the following components to each individual student or student team as a guide:

- ❖ In class as individuals or as teams, discuss the different factors affecting air quality ***personally, for the members of your household, your school and community, your city, country, and the Earth.***
- ❖ Fill in the diagram.
- ❖ Discuss different factors that can vary these affects.
- ❖ Discuss how you as an individual can affect these factors ***personally, for the members of your household, your school and community, your city, country, and the Earth.***

Micro- to Macro- Air Quality Risk Assessment

Fill out the diagram below with factors which affect the quality of the air you breathe at each "level" -- the air around you personally, all the way out to the air surrounding the Earth. Try to think of impacts to *your own air quality* on a daily basis. The inner circles of your diagram should be different than your classmates!



Follow-Up Questions

1. Who (or what organization) has responsibility for protecting air quality at each level of the diagram?

Individual -

Home -

School -

City -

Nation -

Earth -

2. What would you be willing to change in order to improve air quality for yourself? For others?

Worksheet Key

The following are factors that can influence a person's air quality at each of the given levels. Each student's worksheet should be different according to his or her personal exposures. However, this key can be used in the discussion to raise factors that may not have come up from the students' responses. This is not a complete list.

Individual

Perfume
Smoking
Deodorant
Hair Spray
Nail polish/remover
Cosmetics
Aftershave
Inhalants

Home

Candles
Incense
Cat litter
Gas appliances
Radon
New furniture, carpet
Carbon monoxide from heater
Secondary smoke
Fabric softeners
Air "fresheners"
Laundry detergent
Wood stove/fireplace smoke
Pets
Dust
Mold
Cleaning products
Pesticides

School

Diesel fumes
Poor ventilation
Asbestos
Mold
Carpeting, fibers
Dust, indoor, outdoor
Cleaning products
Disinfectants
Furniture off-gassing
Lab chemicals
Pesticides
Herbicides

Nation

Industrial emissions
Transportation fumes
Nuclear power
Power plants
Agricultural practices
War

Earth

Global warming
Agricultural burning
Meteor strike
Volcanic emissions
Sahara dust
Radioactive fallout

A Change Is in the Air as New Ideas on Pollution Emerge

By KIRK JOHNSON
New York Times, May 20, 2001

The air in the New York region is not what it used to be, and for the most part that's a good thing. Over the 30 years since the passage of the federal Clean Air Act, pollutants like lead, carbon monoxide and especially the gritty black soot that was long one of the region's most hallowed, if hated, symbols, have all sharply declined. The number of days each summer with the most severe ozone smog is typically no more than a third of what it was in the early 1980's.

At the same time, it became a lot easier to shift the blame elsewhere for the problems that did remain. The industrial Midwest, with its coal-burning factories and power plants, all wafting their toxic fumes east on the prevailing upper air currents, became a handy shorthand for the idea that poor little New York was the victim of someone else's excess.

But many scientists and air quality experts say that more and more, the old patterns and assumptions and lines of responsibility about air quality no longer tell the whole story. Some believe that the best years of improvement may be over. Most agree that at the very least, the picture will grow increasingly complicated, as issues ranging from power plant construction to climate change to new ways and ideas for measuring pollution all unfold in the years and decades to come.

The air that local residents are breathing this spring, the experts say, is already being considered as a kind of case study for the new air-quality equation. For example, in early May – much earlier in the year than normal - a sudden surge of hot, humid weather helped create ground-level ozone smog across the region, just as tree pollen was setting records and causing untold headaches for hay fever sufferers.

Unrelated events? The new air science says maybe not. The pollen resulted from a cool early spring followed by a blast of premature summer; the trees reacted to the heat wave with a reflexive spasm of procreation. But new research has also shown that pollen production may be linked in a perverse way to climate change because higher levels of carbon dioxide - a primary greenhouse gas blamed for planetary warming - encourage trees to produce more pollen.

If the meteorological mood swings of April and May were in fact a sign of long-term climate disruption, and not ordinary variability - still a debatable point among scientists - then suddenly, nothing about the air looks quite the same. The pollen count itself, once a natural, if annoying, rite of spring, has become tied to human dependence on fossil fuels.

As if that were not enough, recent research has also found that pollen can bind itself to diesel exhaust particles, creating a sort of bio-industrial cocktail. Health consequences of the pollen-diesel combination, if any, remain uncertain, scientists say.

"What we're seeing is a confluence of issues," said Dr. Paul R. Epstein, the associate director for health and global environment at Harvard Medical School.

Worries about air quality were only part of the agenda for President Bush as he took to the road last week to sell his energy plan to the nation. But many environmentalists say that because the president's energy plan is so weighted toward new production of electricity and petroleum, environmental consequences have been drawn into the spotlight as well, creating the opportunity for a broad public debate that did not exist before.

Meanwhile, some other, older ideas about the environment and air quality are being blown apart entirely. Much new air pollution research is based on the idea that there is no such thing as a regional air supply as it has been traditionally defined, but rather a series of microclimates, differing neighborhood by neighborhood and street by street. Each individual, some research suggests, carries around a personalized cloud of contaminants depending on his or her environment, lifestyle and consumer-products choices - dubbed the Pig Pen effect, in honor of the famously unbathed character from the "Peanuts" comic strip.

The new focus is on what people actually breathe - walking around, working, exercising, living their lives - rather than on what is measured on high-rise rooftops, where most sensors in New York City have usually been placed, even though only pigeons live there.

Two years ago, for example, scientists from Columbia University and Harvard took 40 student volunteers from A. Philip Randolph High School in Harlem and fitted them with special air-sensor backpacks.

The students were asked to wear the six-pound devices, or keep them nearby, even when they were asleep, for 48 hours, wherever they went and whatever they did. The results are still being assessed, said Steven N. Chillrud, an associate research scientist at Columbia's Lamont-Doherty Earth Observatory, who led the fieldwork portion of the study, but the early and unquestioned conclusion is that even from one block to the next, the air is different depending on where you breathe it.

"Central monitoring doesn't pick up the full range of exposures for many compounds, and personal exposures are higher still," said Dr. John D. Spengler, a professor of environmental health and human habitation at the Harvard School of Public Health, which is analyzing part of the backpack results. "It's these interactions that we're just beginning to appreciate."

Other investigators are challenging assumptions about where pollution in New York comes from. The conventional explanation of lead in the atmosphere, for example, held that it came mainly from leaded gasoline. In studies around the country, the historical curve was strikingly similar. Leaded gas reached its peak use in the late 1960's and early 1970's, and lead in the air began declining after that period as cars switched over to unleaded gas.

But a recent research project that used core samples of mud taken from the Lake in Central Park showed a different pattern altogether. The study, conducted by researchers from Columbia, Rensselaer Polytechnic Institute and the New York State Department of Environmental Conservation, concluded that garbage incineration in the city had been a major contributor to the lead problem.

The core samples showed high lead levels in New York's air dating all the way back to the 1930's. When the city halted new incinerator construction in 1964, and later federal air pollution laws pushed most existing incinerators to close, the city's lead levels began to decline. In other words, forget the upper air patterns from Ohio or the traffic jams on the New Jersey Turnpike - the city had at least partly made its own mess.

The concept of local neighborhood pollution is also emerging as a major political battlefield as residents around the region begin asking questions, and filing lawsuits, challenging plans for new power plants in their communities.

And researchers are scratching their heads over many of the same questions as the residents. How do pollutants from many different sources, especially those clustered in a single community, interact in the air and in the human body? If there are three or four factories or power plants in a neighborhood, is it possible that each one individually may be in perfect compliance on air emissions, but that collectively, they are not? How do you measure the urban world's total impact on one person? And how, especially, do you write policy rules to protect the public health when these questions begin to be answered?

"A place-based approach to air quality regulation, that's the next horizon," said Jason Grumet, the executive director of Northeast States for Coordinated Air Use management, an interstate association of the air quality control divisions of the six New England states and New York and New Jersey.

Ultimately, many scientists and public health experts say, the real risk to the New York region is that it will essentially outgrow its existing air quality system. Ray Werner, the chief of the local air programs branch at the federal Environmental Protection Agency, calls this problem "lines of tension." Like a giant ratchet, tighter air quality rules are grinding up against the reality of a region that has boomed economically and grown in population.

The impact of cleaner gasoline, Mr. Werner said, has been offset by more vehicles on the roads, including more sport utility vehicles and light trucks, which pollute the air more than ordinary cars. Cleaner technologies for making electricity using natural gas are countered by the need to build more power plants.

The concept of the tension lines repeats itself again and again. Conservation groups like the Natural Resources Defense Council have contended that if new, cleaner electrical power plants replace older oil-burning ones, they could mean cleaner air for the region. But state officials and administrators of the state power grid, who are responsible for keeping the lights on, have taken steps to allow small private diesel generators – dirtier electricity sources than anything now operating in the region – to be switched on at moments of electricity shortage beginning this summer.

"Right now we're the marble in the middle of the seesaw," said Peter Lehner, the chief of the environmental protection bureau at the New York State attorney general's office. "Our air quality could go one way or it could go the other. The answer depends on how we respond."

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