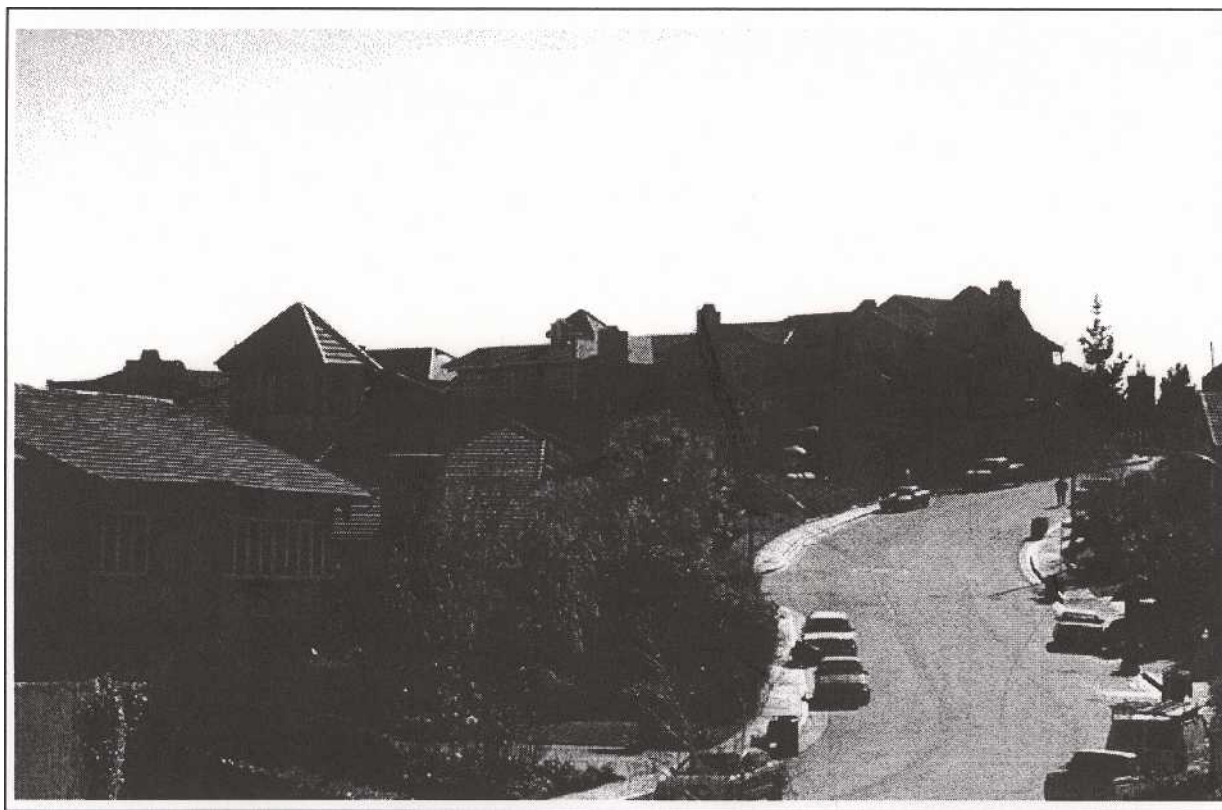


# Community Action and the Environment



Can you help save the environment?

Classroom Material Written by: Dr. Lana Aref

Content Development Team:

Eric J. Anderson and Janice Vatland  
Drs. Lana Aref and Daniel Brabander,  
Prof. Patricia J. Culligan and Heidi M. Nepf

Massachusetts Institute of Technology

This Program is supported by a Core Center Award, P30-ES02109, for the National Institute of Environmental Health Sciences and the National Institutes of Health

## **Community Action and the Environment.**

What are the environmental problems that we face as communities, as states, as a country, and as part of the global community? Of how many environmental problems are you aware? We hear about global warming and the depletion of the ozone layer in the news. We're warned against the cutting down of the rain forests, and the extinction of valuable species. We're asked to conserve energy and to recycle paper, glass and plastic. How often do you think about such environmental issues. What do you do to try to address these problems on a day to day basis?

We humans have not always recognized the importance of, and our responsibility in, safeguarding the environment. In fact, we didn't always recognize that the industries that we build and the ways in which we use our resources can be damaging to the environment, or, subsequently, that damaging the environment can directly affect our health and our well being. Scientific and public awareness of the important balance between humans and nature has increased slowly since the beginning of the industrial age, but it wasn't until the last two decades that laws have been passed in this country to protect our waterways, our air, our groundwater and the diversity of species that find their homes in the wide array of habitats existing in these 50 states.

Our understanding of how pollution affects us and our environment has improved throughout history because of work done by concerned scientists and citizens. Through their observations and investigations, these individuals have contributed to our appreciation of pollution impacts. Through their public action, these people have instigated changes in laws and public opinion. The work of these individuals has made a significant and beneficial change in the way we exist in, and treat, our environment.

One of the first individuals of the industrial age to make a link between environment and disease was Jonathan Snow, a British doctor in the early to middle 19<sup>th</sup> century (1). Snow hypothesized that cholera, an often fatal intestinal disease, was carried by fecal material in polluted water. During the 1854 cholera outbreak in London, Snow observed that, for the most part, the neighborhoods with the highest incidence of cholera were supplied by water coming from the Thames, the central waterway in London, which was heavily polluted by sewage. Whereas, he observed that the neighborhoods that were supplied by less polluted, upstream sources had fewer cholera cases. He also investigated the outbreak of 500 cholera cases in his own neighborhood. He found that the central public well for this area drew water from a subsurface layer containing a sewage pipe, which could be the source of contamination in the water. Very few people believed his hypothesis that cholera was transmitted through fecal matter in water. However, he was finally able to convince his neighborhood magistrates to remove the pump on the contaminated well, and was vindicated when the incidence of cholera in his neighborhood decreased. Based on his findings, Snow was able to recommend improved sanitation practices for the treatment of cholera. These practices included the washing of hands, the washing of soiled linens, and the boiling of drinking water. These recommendations probably seemed excessive at the time, but are standard practices today.

Another individual who improved our understanding of the environment is Rachel Carson, an American biologist from the Midwest who linked the use of pesticides to the reduced number of songbirds in her community in the 1960's. During her frequent nature walks, Carson observed that there were fewer songbirds than she remembered in previous years. She conducted her own investigation and noticed that, though the insects targeted by the pesticides were adapting to the chemicals, the birds who were eating these insects were *bio-accumulating*, or collecting the pesticides in their cells. As a result, the eggs they were laying had shells that were too thin, and fewer of the chicks survived.

In 1962, Carson published *Silent Spring*, a book detailing her observations and the impacts of pesticides on songbirds (2). Her book caught the attention of the public and raised awareness of the of environmental issues. After the publication of her book, chemical companies tried to undermine Carson's credibility and to contradict her findings, but she continued to fight for regulations that would control the quantity of pesticides sprayed and the ways in which they were sprayed. Her work was instrumental in changing the public's perception of nature. For a very long time, people thought that nature had the capacity to dilute any amount of pollution that was dumped into it, but with Rachel Carson's findings they began to see that Nature's ability to absorb and dilute pollution had limits.

In recent years, many individuals and communities have helped to change our views on the environment and on our role in it. They are making the connection between environmental and human health through their observations and investigations. They have spoken out about their findings and instigated changes in public awareness and in the laws that govern the use and disposal of chemicals. Do you know of anyone in your community who has done such work? Are you concerned about the health of the environment? Have you observed changes in your community that you think are due to environmental pollution? How would you go about improving the environmental health of your community? Is there something that you do now to support the environment?

#### References

- (1) Dictionary of Scientific Biography. Volume 11, 1981.
- (2) Encyclopedia of World Biography. Second Edition, 1998.

# Assignment #1

## Observing the local environment



## Assignment 1: Your community and its impact on the environment.

Do you know how clean your environment is? Do you ever walk around your neighborhood and notice garbage in the street, or that the air smells bad? What sort of industries are you surrounded by? Do you know where the water that drains out of your house goes? Do you know where the garbage truck takes the trash you leave by the curb once or twice a week? Does your family recycle? Does your neighborhood? How do you get to school? Do you drive or do you take the bus to school? Do you walk? If you have a yard or live by a park do you know what sort of fertilizers and other chemicals are used to keep the grass green? What chemicals do you use on a daily basis - think of what you use in the morning to get ready for school (i.e. shampoo, toothpaste, hair-spray), what you eat and drink (from pop-tarts to soda), think of the detergents used to keep your clothes and house clean. Do you know how these household products are made? Do you know how their production or use might contribute to the pollution of the environment?

For this assignment, walk around one of the following: your house, your school, your neighborhood, or your town. Make a list of all the possible sources of pollution you observe. Document any evidence of pollution that you see. Take photographs or write descriptive notes of your findings. Consider the following: how might, or how does, this pollution move in the environment? What are the hazards that might be involved with this sort of pollution - include hazards to humans, animals, plants. Suggest solutions to these pollution problems. Include in your solutions things that you can do, that your family and neighborhood can do, or things your townspeople and government can do.

*Here is a simple example.*

Walking around my neighborhood I notice that there are no 'pooper-scooper' laws for dogs. I once noticed this 'by mistake.' Not only is it very gross to see this sort of thing, and to have to worry about side stepping it all the time, but it is a form of pollution that gets into the network of city drains when the rain water washes it into the gutters. Fecal matter carries with it all sorts of bacteria like E-coli, which can make people sick, and nutrients, like in fertilizer, which can cause algae to grow in water. Growth of algae is not always desirable since it gives water a cloudy color, and sometimes can give off a bad odor. In extreme cases, algae growth can cause the aging or eutrophication of a pond or lake (see Program 3 in this series). At any rate, the dogs' fecal matter, when it is washed by the rain can get into our rivers, and lakes, and, as far as I'm concerned, this is undesirable.

What I can do about this problem is that I can call our city hall, or the mayor's office, to let them know that I would like them to consider instituting pooper-scooper laws. If I don't get much of a response. perhaps I could write a petition and go about the neighborhood getting signatures. By informing people of the problems associated with leaving fecal matter on the sidewalk, and by getting their support, I would be able to convince the mayor's office that this is an important issue to the city.

# Assignment # 2

## What is a Cluster?

See Selected Solutions at the end of the packet.



## Assignment 2: What is a Cluster?

Consider this: you have noticed that the squirrel population in your neighborhood has gone down considerably. You also notice that the acorn harvest is low. You think that the local oaks have been exposed to polluted water coming from a leaky sewage pipe, and that, as a result, they did not produce enough nuts to supply the squirrels. How do you determine, if, in fact, squirrel mortality is unusually high, and that local pollution is responsible?

An epidemiologist, a scientist who tries to link disease to a cause through statistical analysis, would compare squirrel mortality in surrounding neighborhoods. He or she would try to determine whether the local squirrel mortality is unusually high or not. If, like an epidemiologist, you make the comparison between your neighborhood and the others, and if you find that local squirrel mortality is considerably higher than elsewhere, you might be able to make the case that local pollution is the cause.

If, however, in comparing neighborhoods, you see that squirrel mortality in your neighborhood is high, but not higher than in all the surrounding neighborhoods, you would not be able to say for sure if the mortality rate is abnormal. Your theory might still be correct, but the numbers wouldn't necessarily show it. You see, even though the squirrels are dying, they are not dying at an unusually high rate, and even though the deaths might be due to pollution, the increase in squirrel mortality is still within the range of normal squirrel mortality observed in the region.

In the same way that it might not be easy to pinpoint pollution as a cause of squirrel deaths, it is not always easy to link pollution to human mortality. Epidemiologists often try to determine whether a high occurrence of disease in one neighborhood or town is abnormally high. If it is, it's considered a disease *cluster*. However, sometimes, it isn't clear whether a high incidence of disease is an abnormal cluster due to an external source, or the result of coincidence.

The following classroom activity will help you to better understand how clusters are identified, and why, sometimes, it is difficult to determine whether high rates of disease are the result of an external source.

### *Materials.*

One (empty) pasta jar, or any jar with a 2.5" diameter opening.

Pennies

### *Procedure.*

For each student:

1. Sit in a chair, and place jar between your feet.
2. Drop the penny from your nose into the jar without leaning over.
3. Repeat this 20 times and count the number of misses out of 20.

For the teacher:

1. Collect and post the number of misses from at least 30 students. If the class is smaller, some students should repeat the trial.

2. Ask the student with the least, the student with the most, and a student with an average # of misses to repeat the trial with the jar between their feet, but, this time, from a standing position.

*Analysis.*

As a class or individually:

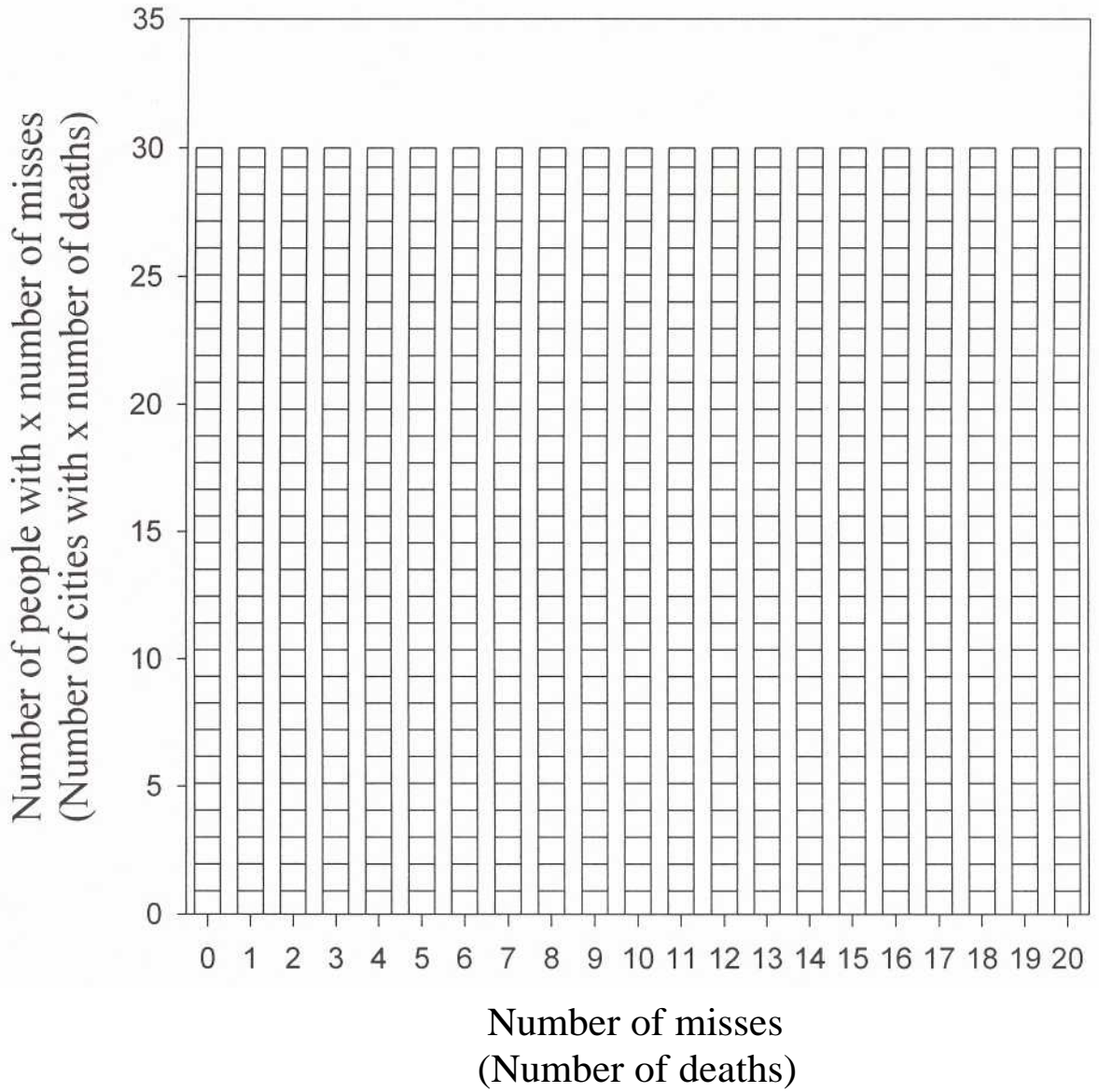
1. Using the graph paper provided, fill in a square for each person who missed x number of times, in the seated trials, in the appropriate # of misses column. For example if four students missed the jar 7 out of 20 times, fill in four boxes above the number '7' on the x-axis.
2. Using a different color or pattern, fill in a square at the appropriate # of misses column for the students who did the test standing.

*Answer the following Questions.-*

1. What do you think is a normal # of times for the penny to miss the jar out of 20 tries?
2. What do you think is a relatively high # of times for the penny to miss the jar out of 20 tries?  
A relatively low #?
3. Divide the graph into three regions, one region corresponding to the # of misses that you consider to be low, one corresponding to the # of misses you consider to be normal, and one corresponding to what you consider to be high.
4. Now, consider the # of misses for the three students who repeated the procedure while standing. Where do their results fall relative to the seated results? Do these trials fall in the low, normal, or high regions of your graph?
5. Assume that each person playing this game is a town of 100,000 people in your state, and that each time he or she misses the jar means that one person has died of cancer. What do you think is a normal # of cancer deaths per 100,000 people? What do you think is a relatively high #? A relatively low #? It might help you to look at the graph with different axes (i.e. *number of towns with x deaths per 100,000 vs. number of deaths*).
6. Assume that each of the three people who played this game while standing is a town of 100,000 whose drinking water is contaminated. Would you be able to say, based on where these three trials fall on the graph, if contaminated water might have caused a higher incidence of cancer related deaths? Said another way, would you be able to tell the sitting from the standing trials if they weren't marked differently on the graph?



# Penny experiment results



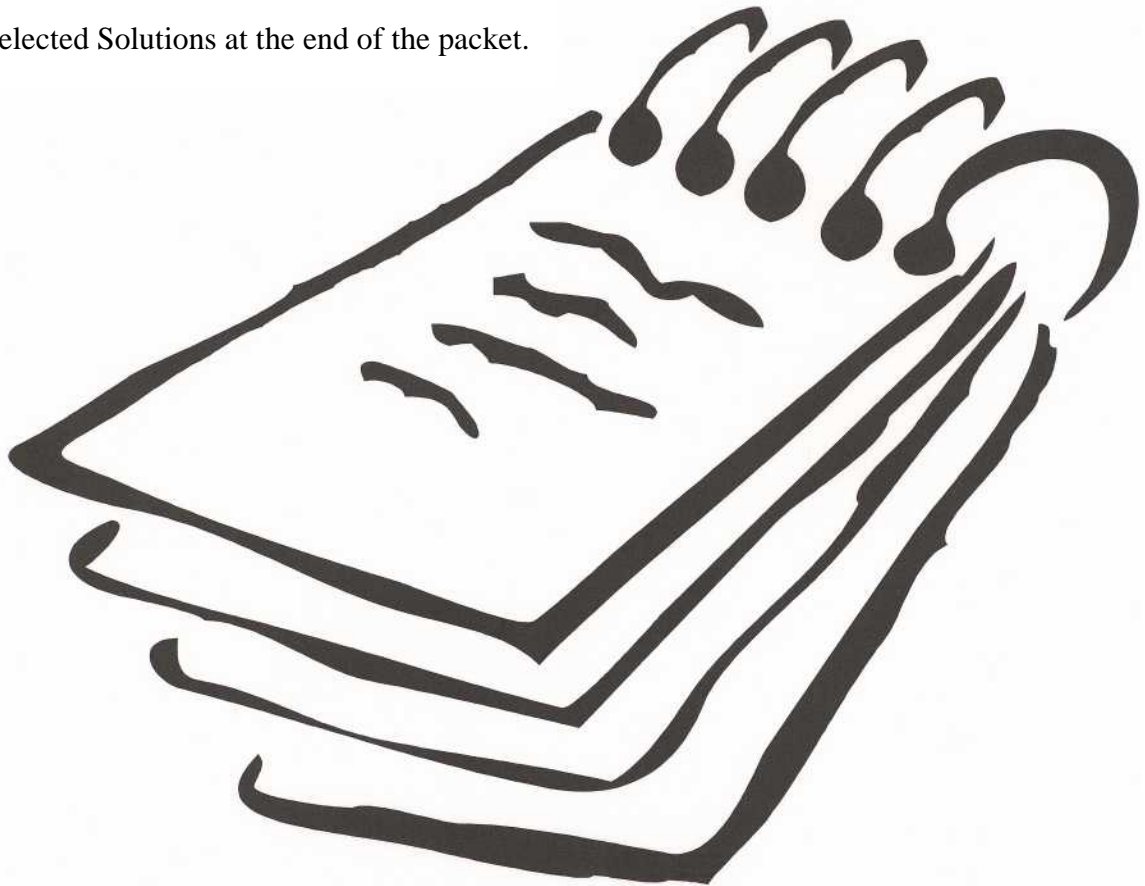
# Assignment # 3

## Analyzing the local Environment

*Suggestions to the teacher:*

To help students synthesize the ideas they formulated in the first assignment, and have them compare their viewpoints to those of their peers, the students are asked to discuss their findings from assignment I given the format outlined below. If the class is large, and time is permitting, it might be best to break the class into groups of three or four. A class discussion can be started after each group has addressed and summarized its views.

See Selected Solutions at the end of the packet.



## Assignment 3: Your community and its impact on the environment II

*Classroom activity:*

### **Materials needed: Local map**

Using the observations you made in Assignment 1, address the following with your classmates:

1. Using the map that you are given by your teacher, divide the map into regions of industry, business, agriculture, and residence. You don't have to be precise
2. Compile a list of all the water users in your town. Include industries as well as businesses, homes, and agriculture. Place these users on the map.
3. Compile a list of the types of pollution that each water user might put into the water. Which types of pollution would you consider hazardous, and why?
4. Where does this water go? Le. does this water get treated, or does it go directly into the ground or into a nearby lake? On the map, draw arrows from the sources of pollution to where they might end up.
5. Compile a list of all the solid waste (e.g. paper, plastic, glass, metal, etc.) producers in your town. Include the types of wastes that are produced and whether these wastes could be hazardous.
6. Where do these wastes go - to the local dump or somewhere further away? Again draw arrows on the map that indicate the different pollution pathways, i.e. the ways that pollution can move.
7. Consider both the waste water and solid wastes you've listed. Which types of pollution, or which sources, do you think are the most harmful?
8. Which sources produce the most waste or pollution?
9. For each pollution source come up with a strategy to reduce waste production or to minimize pollution hazard.
10. How would you go about implementing these strategies?
11. What could you do, personally, to help reduce pollution?
12. What could you do as a class?
13. What strategies are now in place, in your home, school, or town, that are, in fact, improving local environmental conditions?

*The take home questions.-*

1. Who regulates waste disposal in your town - your town, state, or the federal government?
2. Who regulates water usage?
3. Do you know what these regulations say?
4. Is your water source clean? If you don't know, how would you go about finding out?
5. To whom would you address your environmental concerns?

# Assignment # 4

## The Environmental Times

### *Suggestions to the teacher:*

This is another group assignment designed to address the different viewpoints as well as the different interests of the students. Here, the students are asked to compile a newspaper: The Environmental Times. The students can pick from any of the topics listed below, or they can come up with their own, but the ultimate goal of this assignment is to have the students think critically about any number of environmental issues that are of interest to them, and to present their ideas in a format that appeals to them. It is not necessary that the finished product be an actual newspaper. Instead, the students can use poster board for each newspaper page onto which they can cut and paste their articles and graphics.



## Assignment 4: Extra, Extra, Read all about it!

Using any of the topics or formats listed below as guidelines, report on an environmental issue that is of interest to you. You can look at environmental issues in history. You can address issues on the local, regional, state, national, or global level. You can report on ways in which the environment has been improved through new laws or regulations, or through community action. You can discuss new technologies that might reduce pollution. Or you can consider recent events that have been in the news. Feel free to play with the format of your report and to add whatever graphics or pictures that support your story.

*The front page:*

### Global Warming

What causes global warming? What are the consequences of global warming? How much of a change in global temperature averages would it take to melt the polar ice caps? What can be done to prevent the problem? What has already been done? Is the situation improving or getting worse? Start your search at: [http://headlines.yahoo.com/Full-Coverage/Tech/Global\\_Warming/](http://headlines.yahoo.com/Full-Coverage/Tech/Global_Warming/)

### The Ozone Layer

What is the Ozone layer? How is it becoming depleted? What are the consequences of a reduction in the ozone layer? What should be done to prevent further depletion? What has already been done? Is the situation improving or getting worse? Start your web search at: <http://www.cmdl.noaa.gov/ozsondes/spo/ozspo.html>, and <http://www.atm.ch.cam.ac.uk/tour>

### Disaster at Love Canal

In 1979, people in the small upstate New York town began noticing industrial waste oozing into their backyards and basements. This was the first environmental disaster of its kind in the US, and it prompted the government to start making laws governing waste disposal and liability. Research the history of this incident. What was buried at Love Canal? Who buried it there? What caused it to leach into neighboring yards and houses? What were the repercussions of this incident. What laws were precipitated? Start your research with this book: *Laying Waste*, by Michael Brown.

### Unleaded Gasoline: A success story.

In the late 1970's a law was passed that banned the use of leaded gasoline. The lead in gasoline, which traveled through the air after being exhausted from cars, was found to be extremely dangerous to the health of small children. Since the law was passed, the amount of lead found in the air has dropped considerably. Research the history of lead use in the US. How much lead was emitted by automobiles before the law was passed? How much since? What did the law dictate? How did this law impact the health of children? The health of the environment? Is unleaded gasoline in fact better for the environment than leaded gasoline? Start your search with the article in Science Magazine: *Tales Told in Lead*, by J. O. Nriagu. Volume 281, 11/9/1998.

*The local news section:*

The local issue

Report on any local environmental issue that is of interest to you. Include the history of the issue. Describe how the problem was discovered or recognized, how it was investigated, and how it was resolved. What role did citizen action play? If the issue hasn't been resolved, offer a suggestion for its resolution.

*The photo-montage*

Take photographs of local pollution sources or problems. With each photograph, include a caption that tells where and what the pollution is, what its source is, and what can be done to improve the problem.

*The editorial page:*

Write an editorial either defending or opposing the use of alternate energy sources such as solar, wind, water or nuclear power. Cite scientific evidence that supports your point of view.

Comment on whether you think any of the following regulations are sufficient to protect the environment: The Clean Water Act, The Clean Air Act, CERCLA, SARA. In your editorial, summarize the regulations given by these laws and discuss how they have been successful or inadequate. Start your search at the EPA web site: <http://www.epa.gov/>, or in your library with the Code of Federal Regulations.

*The Business Section:*

Organic Farming

Organic farmers do not use man made pesticides or chemicals to improve their crop yield. How economically viable is organic farming? If all American farmers stopped using man made chemicals would they still be able to produce enough crops to supply the public? Would the crop quality improve or worsen? How beneficial would this be to our environment? Would it be a good thing to do?

Economic Incentives

Britain has used economic incentives to successfully encourage the use of unleaded gasoline. On the other hand, the U.S. enacted a law that required the use of unleaded gasoline. What forms can economic incentives take? What benefits would such incentives have over regulation. In which situations do you think economic incentives would be useful? Consider the environmental regulation of industry; would it be better to tax factories for the waste they produce or to set limits on the amount of waste they can produce?

*The Life/Arts Section:*

Successful Recycling

What percentage of American cities and communities are recycling household products? What are the different ways that recycling is done? E.g. community drop of points, organized pick up, sorted or unsorted? Where do the recyclable materials go? Have all

recycling efforts been successful? Have some regions been more successful than others? Why? What are the economic benefits of recycling? Recommend an ideal recycling strategy for your community or for those regions where recycling has not worked before.

#### The film or book review

1. Read the book *A Civil Action* by Jonathan Harr and, or see the film. Write a review that includes the following: Do you agree with the outcome of the trial? Which evidence presented by either the plaintiffs or by the defendants do you believe? Which evidence do you find less credible? How are the film and book different? How accurate are they? Use the web or your library to read up on the story. Start with the references cited by Jonathan Harr or start at this web site: <http://www.shore.net/~dkennedy/wobum.html>.
2. Read and review *Silent Spring* written by Rachel Carson, and or read the follow up book *Since Silent Spring* by Frank Graham. What did Carson observe that prompted her to investigate the effect of pesticides on her environment? What did she hypothesize? How did she go about investigating and testing her hypothesis? What impact did her findings have on laws governing the spraying of pesticides? What impact did her book have on public awareness of environmental issues?

## List of Sources:

### *List of Books:*

Brown P., Mikkelsen, E. J., No Safe Place: Toxic Waste. Leukemia and Community Action, 1995

Carson, R., Silent Spring. Houghton-Mifflin, Boston, 1962.

Di Perna, P., Cluster Mystery: Epidemic and the Children of Woburn, Massachusetts, 1988

Goudie, A., The Human Impact on the Natural Environment. Fourth Edition. Blackwell Cambridge, 1993.

Graham, F., Since Silent Spring. Houghton-Mifflin, Boston, 1970.

Harr, J., A Civil Action. Vintage Books, NY: 1995.

Nriagu, J.O., Tales Told in Lead. Science, Volume 281, 11/9/1998: 1622-1623.

Sachs, A., Eco-Justice: Linking Human Rights and the Environment. Worldwatch Paper 127. December 1995.

Williams and Christopher, ed. Environmental Victims: New Risks, New Injustices. Earthscan Publications, LTD. London.

### *List of Websites:*

EPA: <http://www.epa.gov/>

Ozone Depletion:

<http://www.cmdl.noaa.gov/ozsondes/spo/ozspo.html>

<http://www.w.atm.ch.cam.ac.uk/tour/>

The Woburn Case:

<http://www.shore.net/~dkennedy/woburn.html>

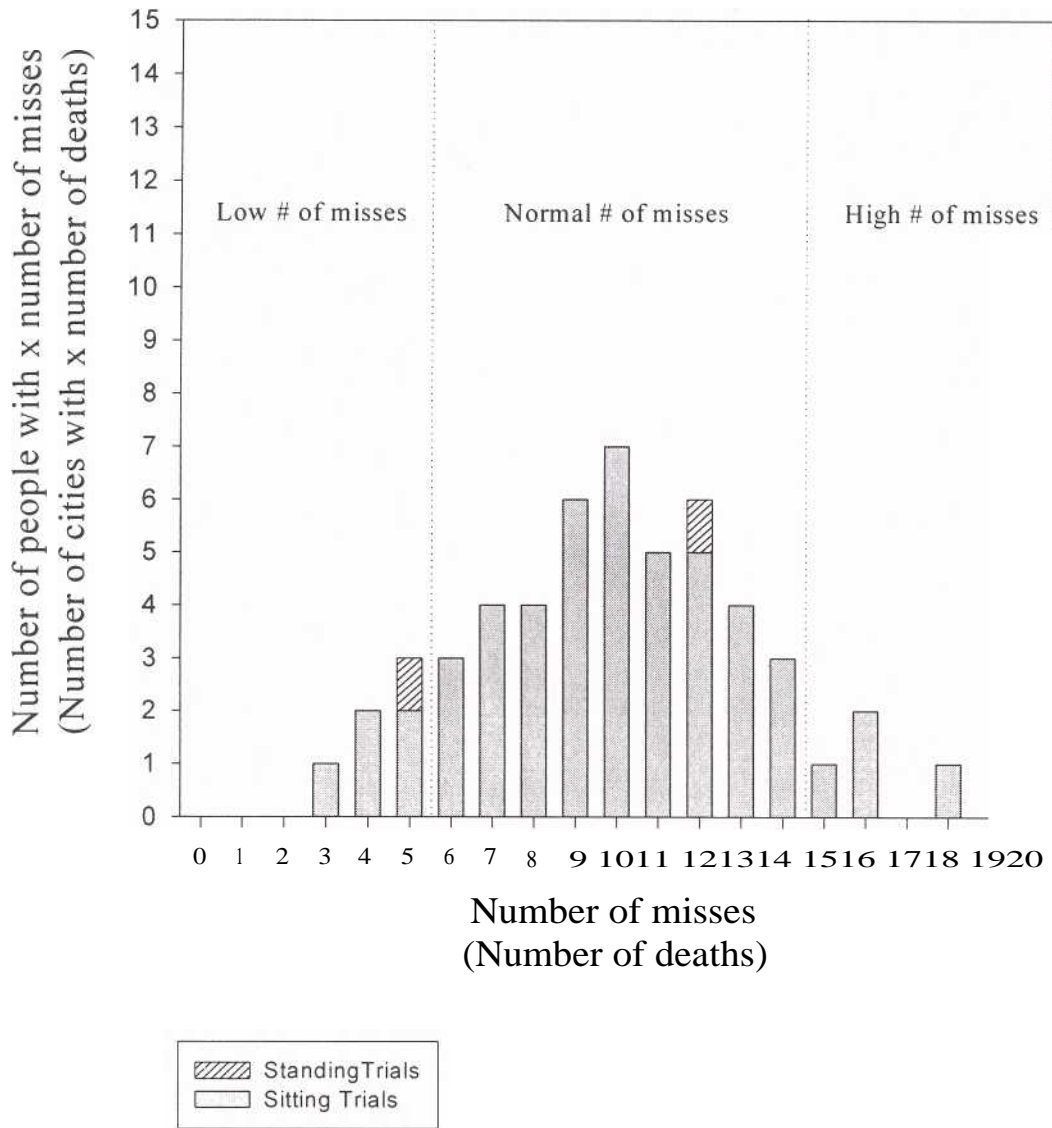


# Selected Solutions



## Assignment 2: What is a Cluster?

### Possible Outcome for Penny experiment results



Note: For two of the standing trials, the # of misses is within the low and normal regions. Therefore, it is not always easy to distinguish between standing and sitting trials, or between pollution related deaths and normal incidences of cancer.

## Assignment 3: Your community and its impact on the environment 11

To help students get some background on pollution sources and transport pathways, have them view some, or all of the following programs in this series: Program 1 - Groundwater Pollution, Program 2 - Air Pollution, or Program 3 - Surface Water Pollution.

You might want to start this assignment with a table on the blackboard with the following headings: A. Pollution Source, B. Chemicals Used Or Produced, C. Disposal Methods, D. Possible Health Hazards, E. Pathways Into Air, Groundwater Or Surface Waters.

### Column A: Pollution Sources

Consider and list all the possible polluters in your community or school district in the following categories:

1. Industry: Power production, manufacturing (chemical or mechanical), construction, mining.
2. Small business: Gas stations, autobody shops, dry cleaners, restaurants.
3. Transportation: train, automobile, airplane, boats
4. Offices
5. Agriculture
6. Residences

Once you have listed all the possible pollution sources, place each source on the map. You might do this with different colored highlighter pens. Choose different colors for the different category of pollution source.

### Column B: Chemical Use and Production

Consider all the possible chemicals produced by these pollution sources: Solvents, oils, mine tailings, nuclear waste, soot, gasoline, sewage, fertilizer, pesticides, noise, solid wastes (food wastes, plastics, glass, paper, metal, etc.).

### Column C: Disposal Methods

Discuss the possible disposal methods that these sources might use: on site treatment, on site burial, disposal in a landfill, disposal into septic system, drainage into municipal sewers.

### Column D: Possible Health Hazards

List the health hazards that might be caused by the different pollutants. This list might include: consumption of bad water containing cancer causing chemicals or bacteria, inhaling cancer causing soot, exposure to radiation from nuclear waste.

### Column E: Exposure and Transport Pathways.

Consider the different pathways that the different pollutants might follow, and where the pollutants might finally end up. Using the highlighter pens. draw arrows from the source to the pollutants final **destination. Follow these guidelines:**

Water borne pollution will travel through groundwater and surface water. In most cases, water travels from high elevations to low elevations. Identify all surface waters: rivers, ponds, lakes, oceans. Most water will drain into the central surface water body. Consider leaks from gasoline stations and nearby landfills and consider fertilizer and pesticides seeping into the ground after rainfall. These will travel in the groundwater and possibly into the central surface water body.

Air pollution is less easy to track. Most often, soot and pollution particles travel from sources such as power plants or roadways. They are carried through the air by wind, eventually settling out on to the ground.

Please note that the emphasis of this assignment is not to define precisely where the pollution is coming or going (that would take a team of scientists and engineers months or maybe more to figure out). The point of this assignment is to get the students thinking about the interaction between community, industry, business, agriculture, and the environment. The take home message is that they, and the development around them, are responsible for the overall health of their environment, and that they can improve their environment by polluting less and by becoming active citizens.

For the take home portion of this assignment, have the students look at the blue pages in the phone book and at the Code of Federal Regulations in their library to find what offices and what regulations cover surface water, groundwater, and air pollution and which cover proper waste disposal. Perhaps the students might want to write a letter to their mayor or to the EPA, voicing their concern about a particular pollution problem.