

# IN THE AIR

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[www.intheair.org](http://www.intheair.org)

### Connecting Activity #3

**"Belief Statement  
Three:** Airborne  
Toxics Are a  
Nuisance, but They  
Seriously Affect Only  
a Few People."

9-12 EDUCATION MODULE



 MISSOURI  
BOTANICAL  
GARDEN

## Correlation with Education Standards Summary

### Connecting Activity #3

**“Belief Statement Three: Airborne Toxics Are a Nuisance, but They Seriously Affect Only a Few People.”**

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

### National Standards

SOURCE: [www.education-world.com/standards](http://www.education-world.com/standards)

NPH-H.9-12.1 .3 .4 .5

NL-ENG.K-12 .3 .4

NS.9-12 .1 .4 .6

NSS-C.9-12 .5

NCSS Strands VIII, IX, X

NT.K-12 .2

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### Missouri Show-Me Standards

SOURCE: [www.dese.mo.gov/standards](http://www.dese.mo.gov/standards)

Performance Standards:

GOAL 1: 2, 3, 4, 6, 7, 8

GOAL 2: 3

GOAL 3: 1, 4, 6

GOAL 4: 3

Knowledge Standards:

CA 6

HPE 5, 6

SC 4, 5, 8

SS 2, 5

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# IN THE AIR

## Connecting Activity #3

“BELIEF STATEMENT THREE: AIRBORNE TOXICS ARE A NUISANCE, BUT THEY SERIOUSLY AFFECT ONLY A FEW PEOPLE.”

### OVERVIEW

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Probably one of the reasons people believe airborne toxics affect only a few is because media coverage generally focuses on dramatic events such as pesticide plant leaks and nuclear core meltdowns. Everyday airborne toxics problems that affect the most people rarely make headlines. This leaves a false impression that airborne toxics problems are localized, accidental, and temporary. To correct that false impression, the projects and experiments in this activity focus on the more gradual and subtle effects of airborne toxics. The pervasiveness of air pollution problems is explored through a multimedia approach involving the hydrologic cycle: air, water, and soil.

**Grade Level:**

9-12

**Preparation Time:**

Approximately 30 minutes to make copies and review suggested projects and experiments.

**Presentation Time:**

One 45-50 minute class period for discussion of the belief statement; variable time for completing suggested extension ideas as noted with the instructions for each.

### GOALS

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- To introduce the concept of environmental justice
- To investigate unexpressed fears behind the belief statement
- To emphasize the connectedness of nature wherein one change triggers a whole series of changes
- To demonstrate how pollutants carried through the hydrologic cycle put everyone at risk

### OBJECTIVES

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

- Explain the meaning of environmental justice.
- Discuss how people deal psychologically with potential risks to their safety and well-being.
- State how the results from the Indian Ocean Project (INDOEX) challenge the validity of the belief statement.
- List the steps in the hydrologic cycle and give an example of how the introduction of airborne pollutants may affect the cycle.
- Define transpiration, evaporation, condensation, precipitation, infiltration, runoff, and acid rain.

## MATERIALS

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- Student Worksheet: The Hydrologic Cycle/Unlabeled, or The Hydrologic Cycle/Labeled, one copy per student.
- Tools and materials for experiments and projects listed on instruction sheets.

## VOCABULARY LIST

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### **Acid rain or acid deposition:**

A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either wet or dry form. The wet form, popularly called acid rain, can fall to earth as rain, snow, or fog. Dry deposition refers to particles that fall out of the atmosphere.

### **Environmental justice:**

The fair treatment for people of all races, cultures, and incomes regarding the development of environmental laws, regulations, and policies.

### **Hydrologic cycle:**

Natural processes that work together to keep the Earth's water moving in a cycle. Many processes are at work in the hydrologic cycle: condensation, precipitation, infiltration, runoff, evaporation, and transpiration. These occur simultaneously and, except for precipitation, continuously.

### **Multimedia approach to airborne toxics:**

USEPA refers to air, land, and water as different environmental media. Because airborne toxics affect water and soil through fallout, environmentalists study all air pollution cycle phases (a multimedia approach) to reduce health risks and environmental damage.

## PROCEDURES

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1. Decide which of the Hydrologic Worksheets you would like to use and make copies.
2. Begin the classroom presentation by discussing the meaning or meanings of the Belief Statement. Emphasize two possible interpretations of the statement:
  - a. An expression (or absence of) environmental justice in which the risks from airborne toxics are unevenly distributed. For examples of the unequal distribution of airborne toxics and what is being done about it, see For Further Reading and Research, Environmental Justice. Also see article "Environmental Justice: Incinerator in Moss Point, Mississippi."
  - b. Failure to recognize the prevalence of worldwide air pollution problems either from lack of knowledge or to minimize personal fears. For an example of the pervasiveness of airborne toxics, see Indian Ocean Project under Supplemental Information.

**When we teach about the environment we cannot help but teach about connections. I believe the idea of connections needs to be a focus, rather than an incidental message of environmental education.**

**~Darlene Dutton~  
Science teacher at Camden  
Rockport High School,  
Camden, Maine.**

3. Use data from INDOEX (see Supplemental Information on the following pages) about the effects of air pollution on the hydrologic cycle to introduce the multimedia approach to airborne toxics problems (air, water, and soil connections). Stress the importance that whatever affects one part of the cycle inevitably affects the others as well.
4. Hand out copies of The Hydrologic Cycle  
If your class has had previous exposure to the hydrologic cycle, hand out the unlabeled diagram for a review. If more is needed, hand out the labeled diagram and go over it with the class.
5. Make the connection between the hydrologic cycle and airborne toxics. Ask students to give examples of how the life sustaining hydrologic cycle may disperse life-threatening toxics. An excellent example is acid rain. For a summary of the causes and effects of acid rain see Supplemental Information on the following pages.

## CONCLUSION

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The belief statement for this activity may be interpreted to mean that the risks of being affected by airborne toxics are unevenly distributed—an environmental injustice so to speak. More than likely, however, those who hold this belief are unaware (or choose not to recognize) the pervasiveness of worldwide airborne toxics. Studies such as the Indian Ocean Project show that massive air pollution has reached some of the most remote areas of the planet through the atmosphere and the hydrologic cycle.

## FOR FURTHER READING AND RESEARCH

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### Hydrologic (Water) Cycle: General Information and Study Aids

- [http://www.pacificislandtravel.nl/nature\\_gallery/hydrologicalcycle.html](http://www.pacificislandtravel.nl/nature_gallery/hydrologicalcycle.html)
- <http://www.quia.com/fc/55312.html>

### INDOEX Project: The following information sources concern the INDOX Project, a study to monitor air pollution over the Indian Ocean:

- <http://www.climateark.org/articles/2001/4th/airpredu.htm>
- [http://www.abc.net.au/science/news/enviro/EnviroRepublish\\_436889.htm](http://www.abc.net.au/science/news/enviro/EnviroRepublish_436889.htm)
- <http://europe.cnn.com/NATURE/9906/10/indian.ocean.enn/>
- <http://www-indoex.ucsd.edu/>

### Environmental Justice

- This USEPA website provides definitions and links to further information. See <http://www.epa.gov/compliance/environmentaljustice/index.html>.
- This USEPA website contains history of environmental justice legislation and accomplishments under the legislation. See <http://www.epa.gov/swerosps/ej/aboutej.htm>
- For examples, go to this website and click on “Recent Environmental Justice Cases”. See <http://www-personal.umich.edu/~jrajzer/nre/>.

### Acid Rain

- Canada has been hard hit by acid rain, particularly in the northeast. This website discusses the issues and tells what is being done about it in Canada and the United States where much of the fallout originates.  
See <http://www.ec.gc.ca/acidrain/done-canada.html>.

## EXTENSION IDEAS

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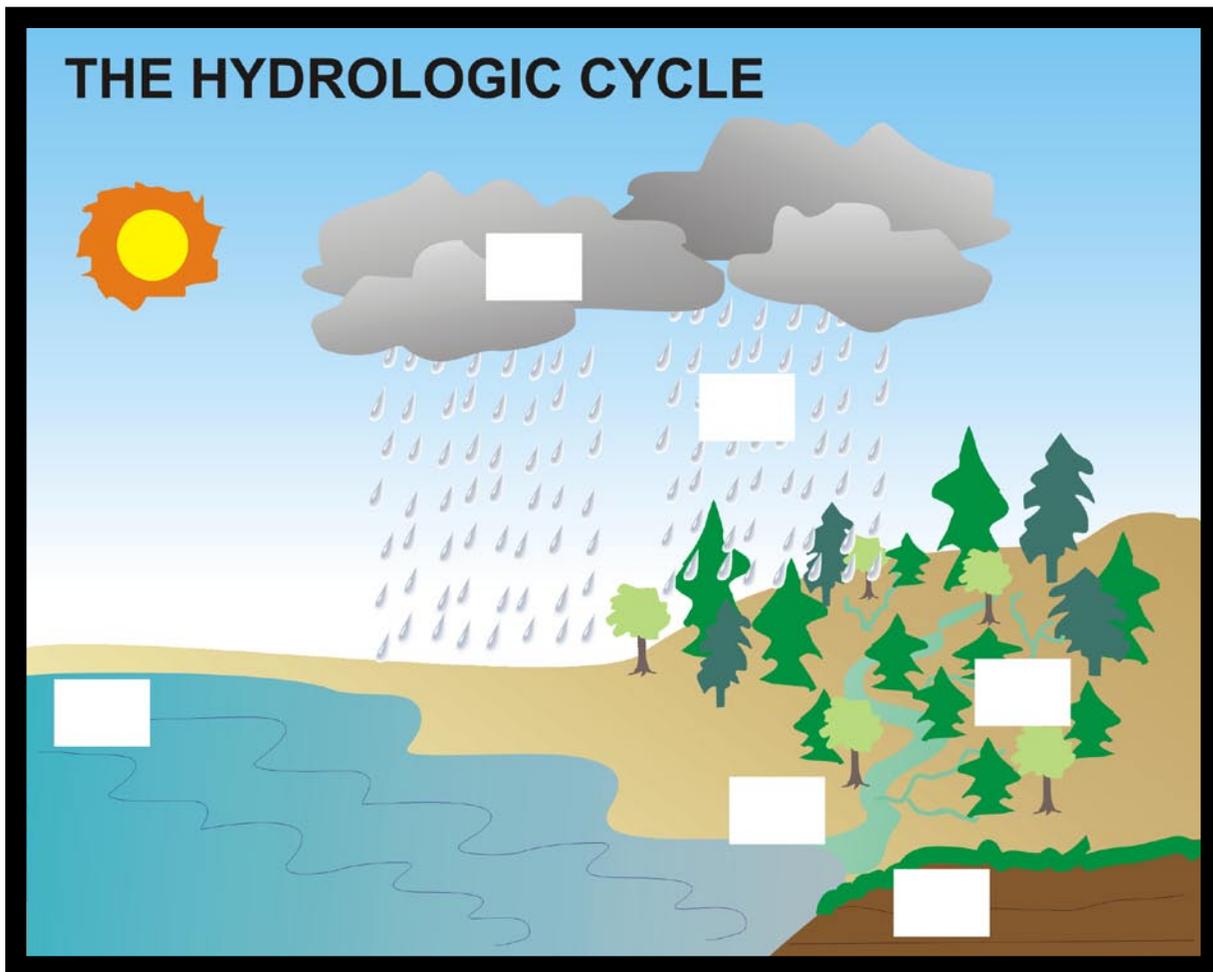
- **Classroom Experiment: Making Clouds--The Water Cycle**  
Developed by Clearinghouse On Mathematics, Engineering, Technology and Science (COMETS). See <http://www.rit.edu/%7Ecomets/pages/lessonplans/cloud.html>.  
Target Audience: High School general science class introduction: This activity focuses on weather and the water cycle.
- **The Water Cycle and Sources of Pollution:**
  - a. For a basic project on this subject for general science classes, see <http://www.sitesalive.com/tg/ol/private/oltgCycle.htm>.
  - b. The USEPA provides nine experiments relating to various aspects of acid rain. See <http://www.epa.gov/airmarkets/acidrain/experiments/index.html>.
- **Acid Rain**
  - a. For learning activities on acid rain from the U.S. Environmental Protection Agency, see <http://www.epa.gov/airmarkets/acidrain/activities.html>.
  - b. Provinces in northeastern Canada have been especially hard hit by acid rain. The Canadian national government offers some interesting hands-on experiments in testing the acidity of local water sources. See <http://www.ec.gc.ca/acidrain/kids-9-12.html>.
- **Build Your Own Watershed (Advanced Project)**  
This project from the U.S. Environmental Protection Agency provides instructions for making a model of a watershed to demonstrate how pollutants enter the water cycle. This can be done as a learning task or as a more “polished” project to use for demonstrations in other classes, at science fairs, or for community education. See <http://www.epa.gov/airmarkets/acidrain/index.html>.

## MASTERS

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- Hydrologic Cycle (Unlabeled and Labeled)

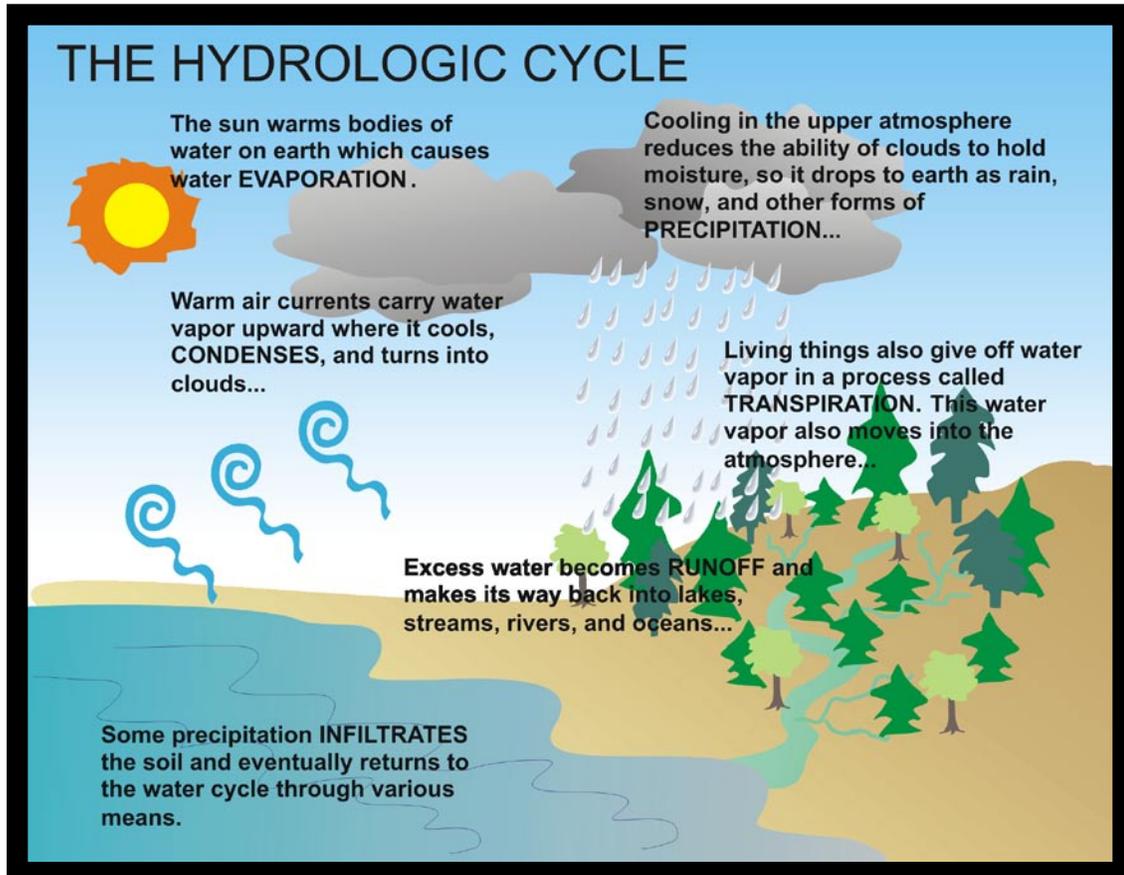
## The Hydrologic Cycle (Unlabeled)



How much do you remember about the water cycle and how it operates? Test yourself by defining each of the six hydrological terms below and then write the number beside each term in the appropriate box on the diagram.

1. Infiltration \_\_\_\_\_
2. Precipitation \_\_\_\_\_
3. Transpiration \_\_\_\_\_
4. Evaporation \_\_\_\_\_
5. Condensation \_\_\_\_\_
6. Runoff \_\_\_\_\_

# The Hydrologic Cycle (Labeled)



**Evaporation**  
**Condensation**  
**Precipitation**  
**Transpiration**  
**Runoff**  
**Infiltration**

## SUPPLEMENTAL INFORMATION

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### Indian Ocean Project (INDOEX)

In 1998, scientists from several nations including the United States began an intensive, long-term study of the atmosphere over the Indian Ocean between India and Africa. They undertook the study, called the Indian Ocean Experiment (INDOEX) to determine to what extent air pollution has accumulated in an area far removed from the industrialized regions of Europe and America.

To their great surprise, the researchers found a layer of brown haze covering almost four million square miles (ten million square km) over the Indian Ocean. They were further astonished that the point sources (origin) for the haze were over 600 miles (1,000 km) away. Although several hazardous chemicals were detected in the haze, the pollutant having the most serious consequences was microscopic carbon particles. The majority of these pollutants did not come from heavy industry, but from slash and burn agricultural practices and the use of wood for fuel in India and other Asian nations.

Further atmospheric experiments revealed that the dark carbon particles are diminishing the amount of sunlight that reaches the ocean surface. Less sunlight results in less evaporation, which in turn decreases the normal amount of rainfall throughout a vast region. Another effect of carbon and other aerosol particles is that they prevent raindrops from becoming large enough to fall.

If the water cycle is weakening as the INDOEX research indicates, climate changes will occur, and people far from the source of the pollution will be adversely affected.

For Internet references to INDOEX, see For Further Reading And Research.

### Acid Rain

Airborne chemical residues such as sulfur dioxide and nitrogen oxides (from autos, factories, power plants, etc.) mix with water vapor to form clouds.

Wind currents transport the clouds to other places—sometimes hundreds of miles away—where highly acidic precipitation falls, called acid rain. The term acid rain includes all precipitation, e.g., rain, snow, sleet, dew. Rainwater is normally slightly acidic, but with the addition of certain airborne pollutants, it becomes much more so. Over time, acid rain upsets the normal pH balance of the water and soil wherever it falls, slowly killing trees and vegetation. When acid rain mixes with water in lakes and streams, further chemical reactions upset the delicate balance for aquatic life. Fish and other aquatic animals and plants can die as a result.

In addition to acid rain (wet deposition), dry deposition (in the form of minute particles) falls out of the air onto land. From there, it runs off into streams and rivers or sinks into the ground to become part of the groundwater system.

In the human world, acid rain erodes buildings and statuary. Acid rain and airborne chemicals are defacing the world's greatest architectural and art treasures. In fact, many statuary treasures have been replaced with replicas and the originals stored for safekeeping.



Human health is affected by acid rain. Inhaling minute particles of sulfur dioxide and nitrogen oxide from polluted air can cause serious respiratory problems, and nitrogen oxides are involved in the production of dangerous ground level ozone.

Moreover, loss of forests and wildlife habitats has aesthetic, psychological, and economic impacts on human beings.

### **Environmental Justice: Incinerator in Moss Point, Mississippi**

“Town Fights Waste Plan” by Marcia Coyle

On the banks of the Escatawpa River on Mississippi’s Gulf Coast lie Moss Point and Pascagoula. Moss Point is a poor, black, middle-class town, and Pascagoula is mostly white and more affluent. In the late 1970s, Pascagoula experienced waste disposal problems, so its city council decided to build an incinerator. But Pascagoula residents vehemently protested the siting of the incinerator in their community, and a chemical company in Moss Point eventually was awarded the rights to the incinerator. The incinerator was located in Moss Point, but owned by Pascagoula. Within three miles of the site are a number of schools and homes. For many years, the situation between the two cities was peaceful, but in December of 1991, the Pascagoula City Council voted to send medical waste to be burned at the Moss Point incinerator in addition to the other waste. That sent Moss Point residents into an uproar and claims of environmental racism resounded throughout the Mississippi Gulf Coast.

The most striking problem about the incinerator is its odor. Although not hazardous, the smell is extremely bothersome to local residents. But other, more serious, concerns have been raised as well and that is why Moss Point filed suit to prevent any more medical waste from being burned at the incinerator. Environmentalists in Moss Point claim the incinerator is antiquated and even if its pollution controls are improved, it would not be able to eliminate all released toxins. These toxins include dioxin, mercury, and cadmium. Local doctors worry that the burning of the medical waste will worsen the high incidence of respiratory ailments and would also cause long-term problems such as birth defects.

The demographics of both cities and the location of the incinerator provide one of the most glaring looks at an area environmental justice needs to address. The white residents of Pascagoula did not want the incinerator, so they located it in Moss Point instead and Pascagoula merely shipped its waste there. “The people of Pascagoula didn’t want the incinerator,” says Moss Point physician Dr. Charles Allen. “Look where it is. It is surrounded by poor people with no money for health care or legal bills.” But environmental justice has helped minorities stand up for their rights and soon situations like Moss Point may well be a thing of the past.

Source: Marcia Coyle. “Town Fights Waste Plan” *The National Law Journal*, 21 September 1992.

See <http://www-personal.umich.edu/~jrajzer/nre/moss.html>.

For additional cases, see <http://www-personal.umich.edu/~jrajzer/nre/laws.html>.