THE SCIENCE OF
Air

There's Something in the Air

from *The Science of Air Teacher's Guide* and for *Mr. Slaptail's Secret*

Written by
Nancy P. Moreno, Ph.D.
Barbara Z. Tharp, M.S.
Judith H. Dresden, M.S.

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The activities described in this book are intended for school-age children under direct supervision of adults. The authors and Baylor College of Medicine cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

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Authors: Nancy P. Moreno, Ph.D., Barbara Z. Tharp, M.S., and Judith H. Dresden, M.S.
Editor: James P. Denk, M.A.
Designer and Illustrator: Martha S. Young, B.F.A.

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BCM
Baylor College of Medicine

Center for Educational Outreach
Baylor College of Medicine
One Baylor Plaza, BCM411
Houston, Texas 77030
713-798-8200 | 800-798-8244 | edoutreach@bcm.edu
www.bcm.edu/edoutreach | www.bioedonline.org | www.k8science.org

Baylor College of Medicine
www.bcm.edu

BioEd Online
www.bioedonline.org

Center for Educational Outreach
www.bcm.edu/edoutreach

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National Heart, Lung, and Blood Institute, NIH
www.nhlbi.nih.gov

U.S. Environmental Protection Agency
www.epa.gov

Indoor Air Pollution

Secondhand smoke is also called environmental tobacco smoke (ETS). Exposure to ETS is sometimes called involuntary or passive smoking.

ETS contains more than 4,000 substances, several of which are known to cause cancer in humans or animals.

Children are particularly vulnerable to the effects of ETS because they are still developing physically, have higher breathing rates than adults, and have little control over their indoor environments.

Exposure to ETS can cause asthma in children who have not previously exhibited symptoms, and trigger asthma attacks or make symptoms more severe in those already diagnosed with asthma.

Asthma is the most common chronic childhood disease, affecting, on average, 1 in 13 school-aged children.

http://www.epa.gov/smokefree/

The "environments" in which we spend the most time are our homes, schools and offices. And although we tend to associate air pollution with outdoor environments, in many cases, levels of contaminants are higher indoors. Energy-efficient designs can cause certain substances in the air to become concentrated inside buildings. The Environmental Protection Agency (EPA) estimates that 30% of all buildings and homes in the U.S. contain enough pollutants to affect people's health. For example, indoor air pollutants can be responsible for allergic reactions, infectious diseases, chronic irritation of parts of the airways, and toxic reactions (including damage to tissues and organs, such as the liver, central nervous system and the immune system).

Air pollutants are carried into our airways and lungs when we breathe. Our respiratory systems have a variety of defense mechanisms against pollutants. For example, particles can be filtered out in the passages of the nose. When particles are inhaled into the lungs, some are trapped in mucus and transported into the esophagus; others are surrounded and destroyed by special cells. Sneezing and coughing help prevent irritating gases and dusts from entering the rest of the respiratory system. Some gases that are inhaled into the lungs and absorbed into the bloodstream can be detoxified by the body.

Despite all of these defense mechanisms, some pollutants enter and remain in the body. Those that stay within the lungs can cause ongoing or periodic irritation. Materials absorbed into the bloodstream can be carried to other parts of the body, where they can damage organs, such as the kidneys or liver.

Prevention is the best way to avoid the build-up of harmful airborne substances in our indoor environments. Careful use of pesticides, cleaning compounds and other chemicals in the home reduces our exposure to potentially toxic gases and vapors. Maintaining cooling and heating systems properly, making sure that sufficient fresh air flows into buildings, and eliminating damp places where mold and bacteria grow all contribute to a healthier indoor environment.

COMMON INDOOR AIR POLLUTANTS

- Particles and chemical by-products of combustion (heating, cooking or smoking)
- Mites and parts of dead insects, like cockroaches
- Mold spores
- Animal dander
- Formaldehyde (chemical used in building materials, fabrics and foam insulation)
- Household chemicals (cleaners, pesticides, paints, etc.)
- Personal care products (hairspray, acetone in products like nail polish remover, etc.)
- Lead dust (from old paints)

There's Something in the Air

Environment and Health

Indoor air pollution can occur in many ways. Some indoor pollutants are produced when something burns. These include gases, such as carbon monoxide, as well as particles, like those in soot. Tobacco smoke introduces these pollutants and many other chemicals into the air. Other indoor pollutants, such as pollen, spores, insect parts and droppings, and dust mites come from biological sources. Formaldehyde, a poisonous chemical, can be given off by particle board, carpeting, insulating foam, some cleaners, permanent-press fabrics and tobacco smoke. These and many other sources (such as solvents and cleaners, paints, glues and dry-cleaning fluids) add potentially harmful chemicals to the air.

Unit Links

Mr. Slaptail's Secret
Science box, p. 24

Explorations
Tips for Healthy Living, p. 3; We Can Make a Difference! p. 6

The concentration of such compounds is much higher indoors than outdoors, in part because many modern, energy-efficient buildings are designed to prevent air leaks or the introduction of outside air into heating or cooling systems. With inadequate ventilation, chemicals and other substances become concentrated in these closed environments.

To reduce indoor air contamination, heating and cooling systems should by serviced regularly. Humidifiers and air conditioners should be cleaned frequently to reduce places where molds and bacteria can multiply. New buildings should be ventilated thoroughly before being occupied. Other measures that can reduce the build-up of harmful indoor pollutants are given on page 3 of this unit's *Explorations* magazine.

SETUP

Before conducting the activity, measure and cut string or yarn into eight 6-meter pieces (one piece per group). With a marker or pieces of tape, make lines at 2-meter, 4-meter and 6-meter points (adjust distances depending on the size of your classroom) on each piece of yarn. Older students can mark their own string segments.

This is a whole-class activity that can be carried out as a discovery lesson without prior introduction.

PROCEDURE

Part 1: Indoors

1. Arrange the pieces of string on the floor like spokes of a wheel around a central point in the room (see illustration, p. 3).

Continued

CONCEPTS

- Many kinds of gases and particles travel through, and become dispersed in air.
- Substances in air become concentrated in enclosed spaces.

OVERVIEW

To model the movement of pollutants through indoor and outdoor air, students will compare the dispersal of odors indoors and outdoors.

SCIENCE, HEALTH & MATH SKILLS

- Observing
- Measuring
- Comparing data
- Drawing conclusions

TIME

Preparation: 20 minutes
Class: 15 minutes indoors; 15 minutes outdoors; 20 minutes to compare results

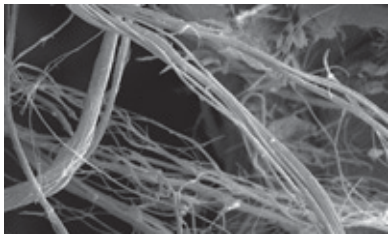
MATERIALS

Teacher (see Setup):

- 48 meters of string or heavy yarn (6-meter length piece per group of 3 students)
- 3/4-in. roll of masking tape
- Marker
- Orange
- Stopwatch with a second hand, wristwatch or classroom clock

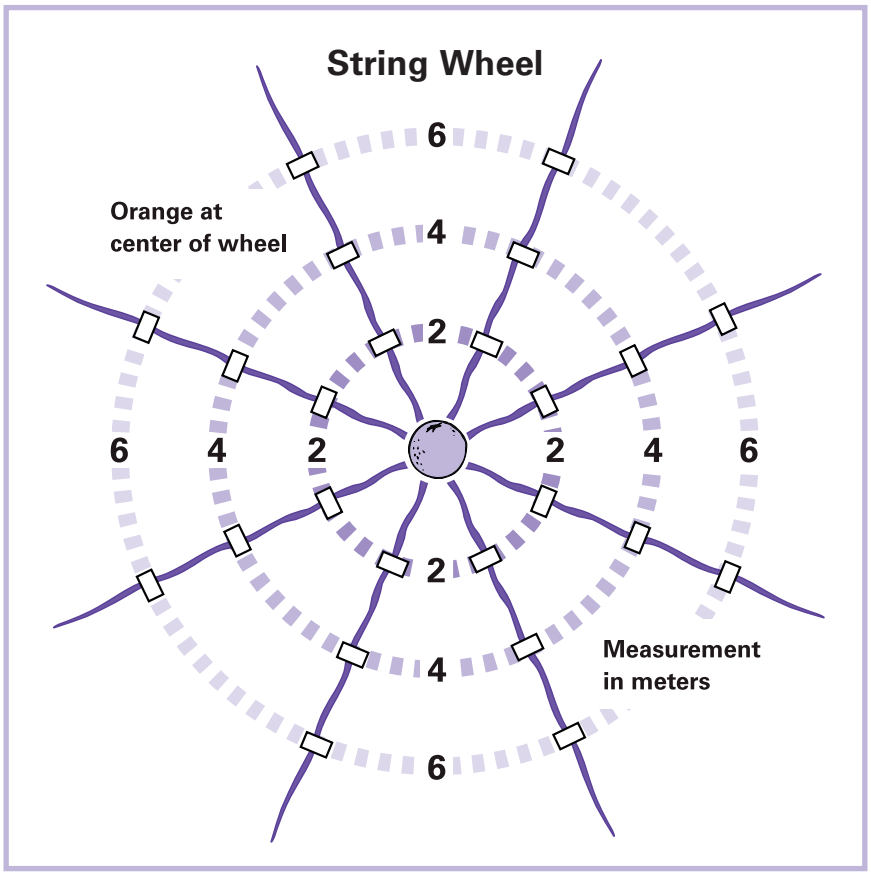
Optional:

- 8 metric tape measures or meter sticks
- Sharp knife



Microscopic asbestos fibers (1500X).

Asbestos is an indoor pollutant often discussed in relation to schools. A naturally-occurring mineral, asbestos is fireproof, a good insulator and virtually indestructible. It was used in many buildings until 1980. Unfortunately, asbestos fibers have been linked to lung disease when they are inhaled over long periods of time. However, people living or working in buildings with asbestos need to be concerned only if the asbestos is shedding or if asbestos panels are cracked or shredded.



Divide the class into three groups. Tell the members of one group to sit on the 2-meter marks on the various pieces of yarn. Tell the second group to sit on the 4-meter marks, and the third group to sit on the 6-meter marks.

2. Stand in the center of the "wheel" holding the orange. Before you proceed, tell the students that they should raise their hands as soon as they smell the scent from the orange.
3. Begin to peel the orange, hold it in your hand and turn around slowly. Record (or have one or more students observe and record) the times when approximately three-fourths of the students at each distance have raised their hands.
4. On the board, create a graph showing the time it took for the group at each distance to smell the orange. (Leave the graph on the board until after you have conducted the outdoor portion of the activity.)
5. Use the graph to talk about odors traveling through the air. Ask questions such as, *Which group smelled the orange first? Which one smelled it last? Why do you think that happened?*

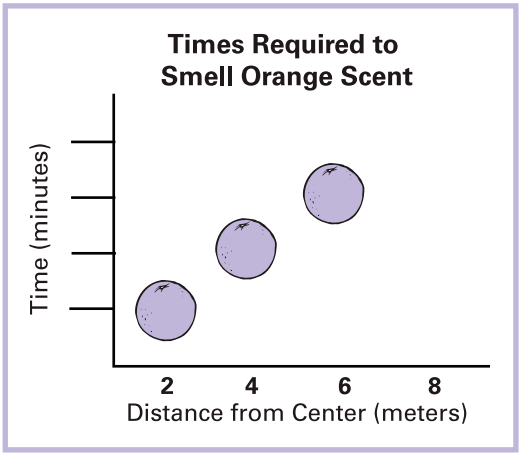
Part 2: Outdoors

1. Ask students, *What do you think will happen if we peel the orange outside? Will you smell it more quickly or more slowly?*

Scanning electron micrograph by CDC/John Wheeler, Ph.D., and Janice H. Carr. Illustration by M.S. Young © Baylor College of Medicine.

Have students record their predictions.

2. Repeat steps 1 through 3 from Part 1 in an outdoor location.
3. After returning to the classroom, make a second graph, using the same scale as on the first, to show the time required for odors to travel outdoors. Compare the two graphs, and discuss differences. Ask, *In which environment did you smell the odor more quickly? Was the odor stronger in either place? Could everyone smell the scent in both locations? Why do you think that happened?* (In most cases, the scent will be noticed more quickly indoors. However, air currents indoors and breezes outdoors may affect the results. Discuss these variations with the class.)



Part 3: Compare and contrast

In a class discussion, relate this experiment to the movement of particles through air (see the activity, "Moving Air"), and lead students to understand how pollutants can become concentrated in indoor environments. Ask, *What do you think an odor is?* (It can be a gas or tiny particles of liquid floating in the air. Explain that many gases and particles float in air all the time.) Ask, *What happens when things floating in air get trapped inside a room? What if it were a harmful gas? How could pollutants in air enter our bodies?*

VARIATIONS

- About 30 minutes after finishing this activity, have students return to the outside location where they conducted their test. Ask, *Can you still smell the orange? What about inside the classroom? Is the orange scent still detectable?*
- Stand in front of a fan or other source of moving air while peeling the orange. Have students predict whether and how this will affect the distribution of orange scent in the room.
- Try this activity with different scents, such as those from perfumes, air fresheners, vinegar, etc.

QUESTIONS FOR STUDENTS TO THINK ABOUT

- Do different odors disperse at different rates?
- What are some things we could do to prevent harmful substances (for example, dust, chemicals, pollen) from building up inside our classrooms or homes?