THE SCIENCE OF
Air

Dust Catchers

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

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Indoor Air Pollution

Environment and Health Basics

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)

Dust Catchers

Environment and Health

Dust and other particles found indoors can come from a variety of sources and may include cigarette smoke, animal dander (flakes of dead skin), insect parts, mold spores, fibers, and/or dust mites and their droppings.

Indoor dust can pose a significant health problem to individuals who are allergic to any one of the particles it contains. Animal dander, mold spores and dust mites are especially common indoor allergens (allergy-causing agents). They can cause simple allergies of the upper respiratory system ("hay fever" symptoms). Dust mites also have been linked to allergic diseases of the airways, such as asthma.

Several measures can help to control dust in indoor environments. Filters remove larger particles from the air. Keeping living areas dry and well ventilated also helps to limit the growth of molds (and dust mites that can feed on molds), which prefer damp places. Eliminating curtains and other materials that hold dust may be necessary, in some cases, to control allergies in susceptible individuals.

Unit Links

Mr. Slaptail's Secret
Science boxes, pp. 3 and 7

Explorations
Cover; Not Such a New Issue, p. 5

SAFETY

Be aware of risks to students with respiratory illnesses, such as asthma. Make sure students understand that all activities are to be carried out in an orderly fashion. Always follow district and school laboratory safety procedures.

SETUP

Assemble a "dust catcher," as described on the "Make a Dust Catcher" student page, for the students to use as a model when they construct their own. To facilitate sharing of materials, organize students into groups of four. Each student should make his or her own dust catcher.

Cut the construction paper (9 in. x 12 in.) in half horizontally to make 4-1/2 in. x 12 in. sheets.

PROCEDURE

Session 1: Dust Catchers

1. Create a small cloud by shaking a cotton ball dipped in baking soda (or cornstarch or baby powder, or use a dusty eraser; see Safety, above). Shine a flashlight through the dust cloud. Ask, *What are we seeing? Do you think this always is in air? How could we find out?*

Continued

CONCEPTS

- Dust consists of individual particles of different substances.
- Even air that appears to be clean may contain dust and other pollutants.

OVERVIEW

Students will make a simple device to collect particles from the air at home or in the classroom.

SCIENCE, HEALTH & MATH SKILLS

- Observing
- Measuring
- Estimating
- Graphing
- Drawing conclusions

TIME

Preparation: 30 minutes
Class: 30 minutes to make collectors; 30–45 minutes to observe particles; 30–45 minutes to make graphs

MATERIALS

Teacher (see Setup):
- Baking soda (or cornstarch, baby powder, or dusty eraser)
- Cotton balls
- Flashlight with batteries

Each group will need:
- Glue sticks
- Knife, plastic (or spreader)
- Petroleum jelly
- Wax paper

Each student will need:
- Hand lens (magnifier)
- Pair of scissors
- Rubber band, large
- Prepared sheet of construction paper
- Sheet of marked graph paper, 10 cm x 10 cm
- Copy of student sheet

Dust mites are too tiny to be seen even with a magnifying glass or low power microscope. More than 5,000 of them can fit on a fingernail!

Chips of old paint containing lead or lead-contaminated dust are major sources of lead exposure for U.S. children. Although leaded paint was banned in the 1970s, existing paint in older housing poses a serious health threat.

Paints can be tested for the presence of lead using a home test kit or by sending samples to a lab. Contact your city, county or state health department if you have questions about lead and paints.

2. Show students the dust catcher that you have made and explain that they each will make a similar one to take home. They will place the dust catchers in areas of their homes they predict will have the most air pollution. After one or two weeks, they will bring the dust catchers back to school and examine them for particles.
3. Guide students as they construct their dust catchers, following steps described on the "Make a Dust Catcher" student sheet.
4. Have students take their dust catchers home and place them on a flat surface to catch dust for one or two weeks.

Session 2: Observing

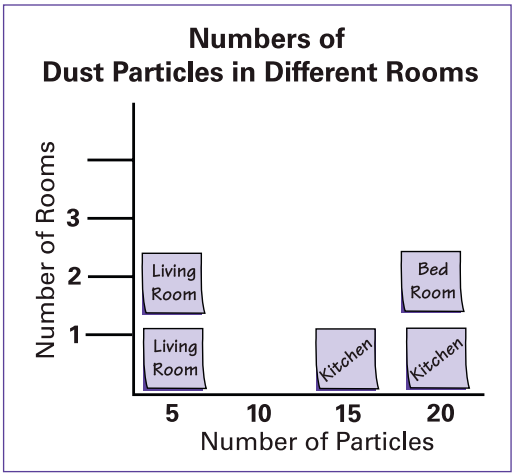
1. When all students have brought their dust catchers back to school, open a general discussion about the appearance of the dust catchers. (Some will have a visible sprinkling or layer of particles; others will have few or no visible particles.)
2. Have the Materials Managers collect enough hand lenses for their groups. Each student should examine the overall appearance of the dust on his or her collector and, if time permits, on the collectors of other members of the group.
3. Have each student use a magnifier to count the number of particles in 10 squares chosen randomly on the grid. (You may need to vary the number of squares counted, depending on the type of graph paper used. Paper with a grid size of approximately 1 cm works well.)
4. Have each student record the number of particles he or she counted in the appropriate place on the "Make a Dust Catcher" sheet (if you have made a copy for each student), or have students write the number in their journals or notebooks.
5. If you have one or more microscopes available, help students to examine their grids under higher magnification. You may want to trim the construction paper around the graph paper square to help it fit under the microscope.
6. Ask, *What kinds of particles did you capture?* Students are likely to find small hairs, tiny pieces of ash, crumbs and bits of thread or lint. With the aid of microscopes, students also may see pollen grains, pieces of molds and very small insect parts. Have them draw some of the particles they have observed.
7. For further discussion, refer students to the various sources of household dust pictured on the front cover of this unit's *Explorations* magazine.

Session 3: Graphing results

1. Conduct a brief survey of the values that students obtained for their dust counts. Create a chart on the board similar to the one on the right, taking into consideration the range of counts reported by the students.

Photo of man removing paint: CDC\11328\Dawn Arlotta, Cade Martin. Photo of mite: CDC\5447.

2. Help each student place a dot or "sticky note," labeled with the type of room tested, on the appropriate place on the graph.
3. Discuss the survey results with the class. Ask students to identify areas in their homes that have more or less dust. Also ask, *Did different kinds of dust collect on dust catchers in different rooms?* Talk about ways in which dust can be reduced or eliminated.



VARIATIONS

- Older students may enjoy making two or more dust catchers each, so that they can compare the number and kinds of particles captured in different rooms of their homes, or between indoors and outdoors.
- Young students may prefer making the dust catchers as a class project and positioning catchers in different places in the classroom.
- If anyone in the class has allergies to dust or any other substances, invite them to share their experiences with the rest of the class.

QUESTIONS FOR STUDENTS TO THINK ABOUT

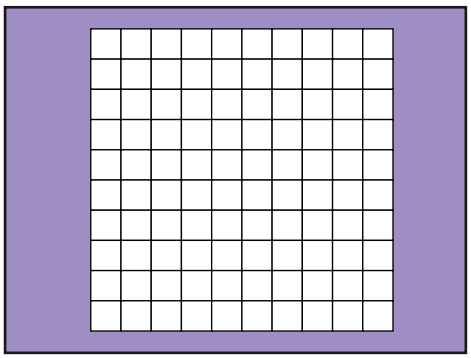
- One character in the story, *Mr. Slaptail's Secret,* suffers from several common allergies. Ask students, *Who is she? What does she do to control her allergies? Does anyone else in the story have allergy problems?*
- Open a discussion on indoor air pollution elsewhere in the world. Indoor air pollution in the form of particles is a much greater problem in developing countries, where wood and coal still are used for cooking. Ask students, *Why do you think things are different in some other countries?*
- Have students conduct a survey of asthma and allergy sufferers at school or at home. Ask, *What types of allergens* (substances that cause an allergic response) *trigger each person's asthma or allergy symptoms? Are their symptoms more or less severe during certain times of the year?*

Make a Dust Catcher

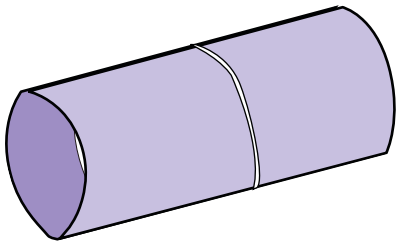
Name _____

You will need a glue stick, one-half sheet of construction paper, a 10-cm x 10-cm sheet of graph paper, petroleum jelly, a sheet of wax paper, a plastic knife or spreader, one large rubber band and a hand lens.

1. Glue the graph paper onto the center of the construction paper. Cover the grid with a piece of wax paper. Glue the outside edges of the wax paper to the construction paper. Spread a very thin layer of petroleum jelly over the wax paper.



2. Roll the construction paper into a large tube, with the graph paper on the inside. Be careful not to overlap the petroleum jelly onto the construction paper. Fasten the tube with a rubber band.



3. Carefully take your tube home.

4. Remove the rubber band and spread out the dust catcher. Place it somewhere in your house where you think there might be dust.

5. After one or two weeks, roll up your dust catcher. Take it to school.

6. Using a hands lens, look at the specks on the graph paper. Can you recognize any of them? Draw one of them in the space below.

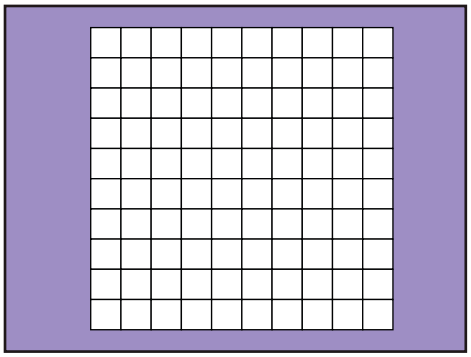
7. Count the particles inside 10 squares. Write this number here. _____

Haz un Atrapa-Polvo

Mi *nombre* _____

Vas a necesitar media hoja de papel de construcción, una liga grande y un pedazo de papel cuadriculado de 10 cm x 10 cm.

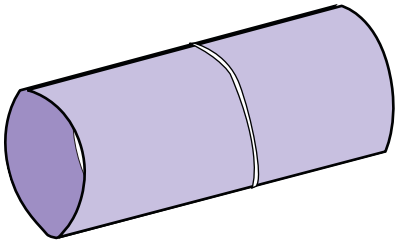
1. Usa pegamento para colocar el pedazo de papel cuadriculado en medio de la otra hoja de papel. Cubre el papel cuadriculado con un pedazo de papel encerado y usa pegamento o cinta transparente para fijarlo. Aplica una capa muy delgada de petrolato al papel encerado.



2. Enrolla el papel para formar un tubo grande, dejando el lado con el papel cuadriculado adentro. Ten cuidado de no sobreponer la cinta o el petrolato encima del papel de construcción. Ata el tubo con una cuerda o liga.

3. Lleva el tubo a tu casa con cuidado.

4. Quita la cuerda y desenrolla el Atrapa-Polvo. Ponlo en algún sitio en tu casa donde crees que haya polvo.



5. Después de una o dos semanas, enrolla el Atrapa-Polvo y llévalo a la escuela.

6. Usa una lupa para examinar las partículas que fueron atrapadas en tu Atrapa-Polvo. ¿Puedes identificar algunas de ellas? Dibuja una de ellas en el espacio abajo.

7. Cuenta el número de partículas dentro de diez de los cuadritos del papel. Escribe este número aquí. _____