EPA

"An ounce of prevention is worth a pound of cure"

—*Benjamin Franklin*

Indoor Air Quality Tools for Schools Program:

Benefits of Improving Air Quality in the School Environment

The* IAQ Tools for Schools *Kit helps schools across the nation improve their indoor air quality. This one-stop resource provides step-by-step guidance to ensure a healthy, comfortable environment for students and staff. To order this EPA publication at no cost, call the IAQ INFO Clearinghouse at (800) 438-4318.

"IAQ Tools for Schools *develops awareness for evaluating mold problems in schools. Early intervention is the key to preventing a problem like mold growth from spiraling out of control."*

—Dr. Bill Smith, Program Director for Facilities, Okaloosa County School District, FL

"The **IAQ TfS** *Kit prompted us to track our student health problems, like asthma and allergies, and try to relate them to our past IAQ improvements. We've really noticed the number of student absences decreasing since the IAQ improvements were initiated."*

—Art Benton, Facilities and Maintenance Supervisor, Clear Creek School District, CO

INTRODUCTION

IAQ is increasingly an important issue in our nation's schools. Approximately 20 percent of the U.S. population—nearly 55 million people—spend their days inside elementary and secondary schools. In 1999, indoor air quality (IAQ) was reported to be unsatisfactory in about one in five public schools in the United States, while ventilation was reported as unsatisfactory in about one-quarter of public schools, according to the National Center for Education Statistics of the Department of Education. The health of students and staff in these schools is a cause for great concern, particularly the negative effects of poor IAQ on asthma and other respiratory illnesses.

The U.S. Environmental Protection Agency (EPA) developed the *Indoor Air Quality Tools for Schools (IAQ TfS*) Program to help schools prevent, identify, and resolve their IAQ problems. Through simple, low-cost measures, schools can:

- **Reduce IAQ-related health risks and triggers for asthma.**
- **Identify sources of mold.**
- **Improve comfort and performance levels.**
- **Avoid costly repairs.**
- **Avoid negative publicity and loss of parent and community trust.**
- **Avoid liability problems.**

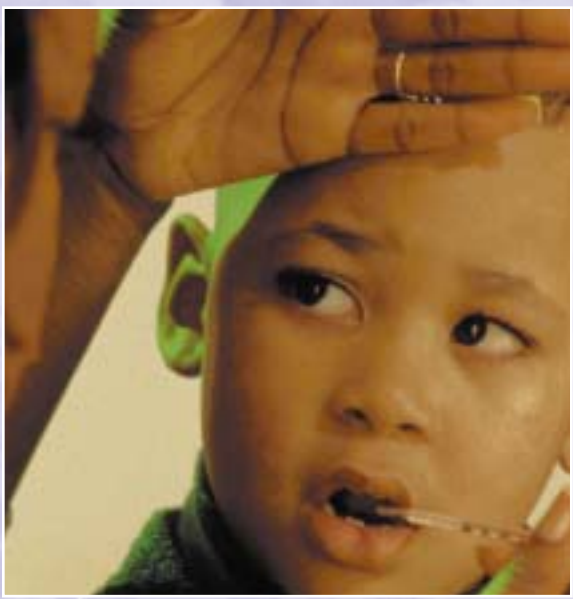
Economic data and scientific studies on the health impacts of poor IAQ provide additional evidence of the benefits that may be associated with implementing the *IAQ TfS* Program.

"Good indoor air quality contributes to a favorable learning environment. The **IAQ Tools for Schools** *Program is a common-sense guide to help prevent and solve the majority of indoor air problems affecting many of our nation's schools."*

—Christie Whitman, Administrator, U.S. Environmental Protection Agency

IAQ AND SCHOOLS

Poor IAQ can lead to a large variety of health problems and potentially affect comfort, concentration, and student and staff performance. Sources of poor IAQ in school facilities range from inadequate air ventilation systems to fumes from pesticides and cleaning agents. The *IAQ Tools for Schools* Kit helps schools pinpoint the sources of poor IAQ that often have simple and cost-effective remedies.



Successful Schools

Schools across the country have observed many health-related benefits from implementing the *IAQ TfS* Kit:

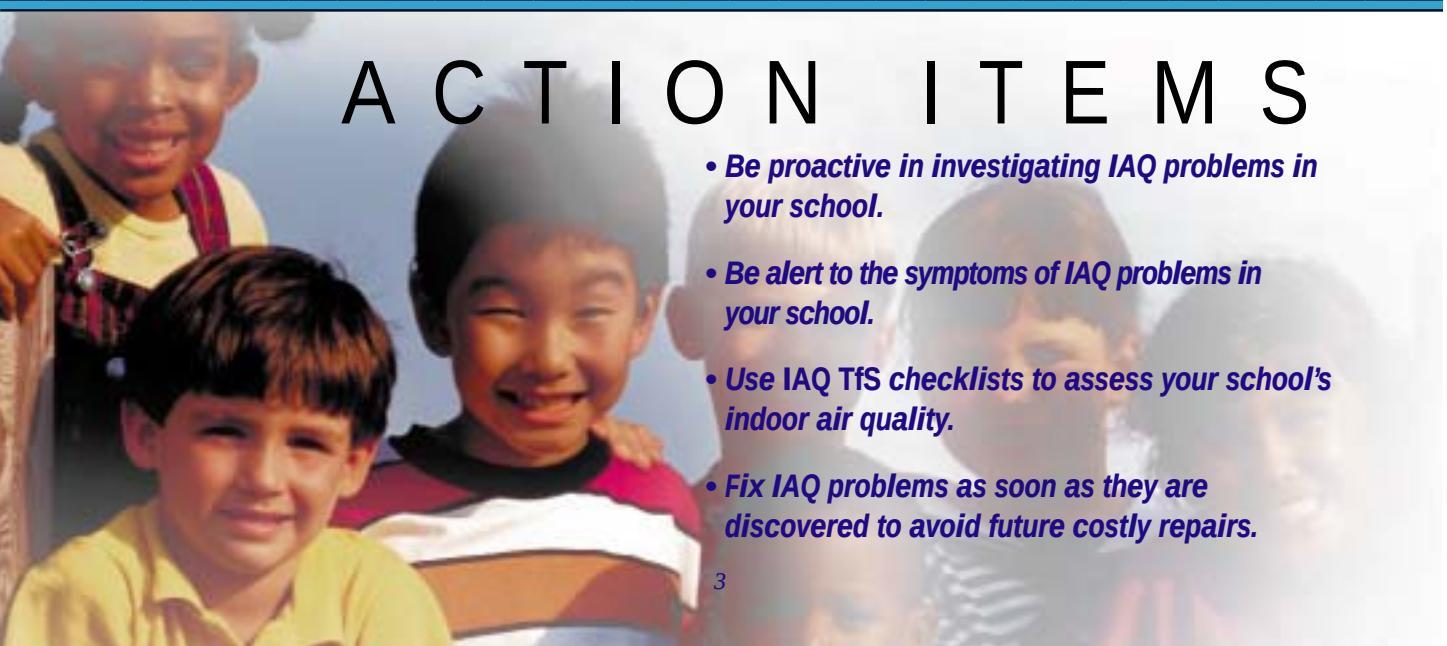
- Improvements in comfort levels and a decrease in IAQ-related complaints (King-Murphy Elementary School, Colorado).
- A reduction in IAQ complaints from one per month to three per year since 1997 (Shamona Creek Elementary School, Pennsylvania).
- A dramatic decrease in absenteeism, fewer reported bronchitis cases reported by school staff, an increase in comfort, and a 25-percent reduction in the number of visits to the school nurse with complaints of stomachaches and headaches within the first 5 months of implementing the Kit (Little Harbour School, New Hampshire).
- A decrease in the number of complaints from staff and students of headaches and sinus infections, the number of trips to the school nurse for asthma and asthma treatments, the use and storage of student inhalers at school, and symptoms of chronic respiratory illnesses (Hamden Public Schools, Connecticut).
- A 50-percent reduction in visits to the office for the use of asthma inhalers (G.W. Carver Elementary School, California).
- A reduction from 75 complaints related to health and faulty equipment in 1994 to fewer than 15 in 1999 (Okaloosa County School District, Florida).

In addition to health benefits, schools have saved thousands of dollars with the help of the *IAQ TfS* Program:

- Since implementing the program in 1998, the Hillsborough County Public School District in Florida has spent only $400 on IAQ consultants, as compared to an estimated $250,000 prior to 1997.
- The Janvier Elementary School in New Jersey spent nearly $100,000 to correct mold and flooding problems before beginning the program, after which minimal investment solved IAQ problems uncovered while implementing the *IAQ TfS* Kit.
- Nearly all IAQ complaints were resolved in-house at Monmouth Junction Elementary School in New Jersey at a total cost of less than $1,000. The improvements focused on preventive maintenance, integrated pest management, and the use of environmentally preferable cleaners.

"We received some great press from implementing the Kit—the local newspapers wrote several articles about our Healthy Schools Team."

—Robin Chappell, District Health Official, Boston, MA



ACTION ITEMS

- ***Be proactive in investigating IAQ problems in your school.***
- ***Be alert to the symptoms of IAQ problems in your school.***
- ***Use IAQ TfS checklists to assess your school's indoor air quality.***
- ***Fix IAQ problems as soon as they are discovered to avoid future costly repairs.***

*"**IAQ Tools for Schools** is the driving force of our preventive maintenance program in the Plano School District."*

—Robert Sands, Executive Director of Facilities, Plano Independent School District, TX

Cost Savings and Maintenance

The *IAQ TfS* Program can help schools maintain their facilities and good IAQ to avoid expensive repairs.

- In a demonstration project in the District of Columbia, an analysis showed that if an elementary school had spent $364 per year on preventive maintenance, $1.6 million in repairs could have been avoided.
- The General Accounting Office reports that one-third of schools (housing about 14 million students) have one or more buildings in need of extensive repair or replacement.
- The average public school is 42 years old, and school buildings begin rapid deterioration after 40 years if not properly maintained.[1]

Studies on the Effects of Poor IAQ

Studies have shown that poor IAQ can have a negative impact on the health of students and faculty members. By implementing the *IAQ TfS* Program, schools can minimize problems associated with poor IAQ.

- Schools using unit ventilators, which produce higher particulate levels* than variable air volume systems, also have an elevated prevalence of nasal congestion, sore throat, headache, and dustiness.[2]
- Higher levels of nitrogen dioxide (a byproduct of combustion sources**) in schools have been associated with increased student absences, even at levels within existing health standards.[3] Similarly, increased absences were also found to be associated with higher levels of outdoor pollution.[4, 5, 6]

* Particulate matter refers to solid particles found in the air that may travel into a person's lungs and cause a variety of respiratory problems.

** Combustion sources can include kerosene heaters and unvented gas stoves and heaters.

Mold on joist, photo by Daniel Friedman

"We keep a log of student visits to our health room and, even during allergy season, student visits declined dramatically. We attribute this to the IAQ TfS *Kit."*

—Leigh Abbott, Principal, Shamona Creek Elementary School, PA

- Respiratory effects have been associated with chemical pollutants that can be found in schools, such as formaldehyde[7] and chemicals in cleaning compounds.[8, 9]

Studies on Performance

Studies have shown that schools can help maintain or even improve the comfort and performance levels of students and faculty members by enhancing IAQ.

- For students, lower concentrations of carbon dioxide (higher ventilation rates) were associated with higher scores on computerized tests for reaction time.[10]
- There is a significant relationship between facility condition and student achievement, based on test scores in 139 public schools in Milwaukee, Wisconsin, in math, science, language, and social studies.[11]
- A statistically significant reduction in perceived mental performance among students was associated with increased indoor pollutant concentrations and lower ventilation rates.[12]
- Office workers perceived a reduction in their performance with two or more symptoms of discomfort. Average performance reduction: 3 percent with three symptoms, 8 percent with five symptoms.[13]
- Controlling pollutant concentrations by removing pollutant sources or by increasing ventilation improved the measured performance of office workers.[14]

Studies on Temperature and Humidity

Studies suggest that fluctuations in temperature and humidity can have an impact on comfort and concentration levels of students and staff.

- Indoor air is perceived to be better when temperature and/or humidity are toward the low end of the comfort zone.[15, 16, 17]
- While evidence is mixed, it tends to suggest an association between improved performance and lower temperatures within the comfort zone.[18, 19, 20]

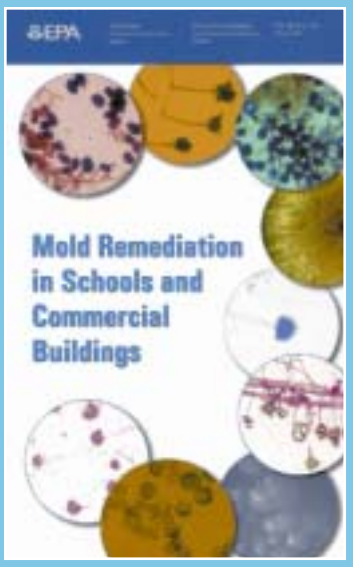
"The most noticeable improvements [as a result of implementing the **IAQ TfS** *Kit] came from our portable classrooms. The CO_2 levels dropped considerably, and the school nurse noticed fewer complaints from students that were housed in those outside classrooms."*

—Mike Riddle, Facilities and Grounds Manager, Sedro-Woolley School District, WA

"The Kit's information helped to identify and explain potential IAQ problems while also providing legitimacy to the complaints submitted to the Board of Health."

—Todd Dresser, Environmental Engineer, Burlington Board of Health, MA

Mold behind wallboard and water damage to subflooring in a New York City building, photo by Daniel Friedman



While the* IAQ TfS *Kit helps schools learn how to prevent mold growth, EPA's "Mold Remediation in Schools and Commercial Buildings" document provides detailed information on how to investigate, evaluate, and remediate moisture and mold problems. To order this EPA publication at no cost, call the IAQ INFO Clearinghouse at (800) 438-4318.

MOLD AND SCHOOLS

Schools have become increasingly concerned about indoor exposure to mold, which can lead to a variety of health effects, including allergic reactions. Not isolated to "humid" states, mold problems have caused school closings across the nation from Arizona to Maine, California to Florida. The *IAQ Tools for Schools* Program can help schools identify potential sources of mold before they become severe.

Schools with Mold

- El Paso Independent School District in Texas used the *IAQ TfS* Program to identify and eliminate a significant mold problem, including mold in the heating, ventilation, and air conditioning ducts.
- St. Cloud Area School District in Minnesota found mold infestations in some schools during the walkthroughs, which are a key aspect of the *IAQ TfS* Program. The schools are cleaner and healthier after implementing the Kit and repairing water-damaged areas.

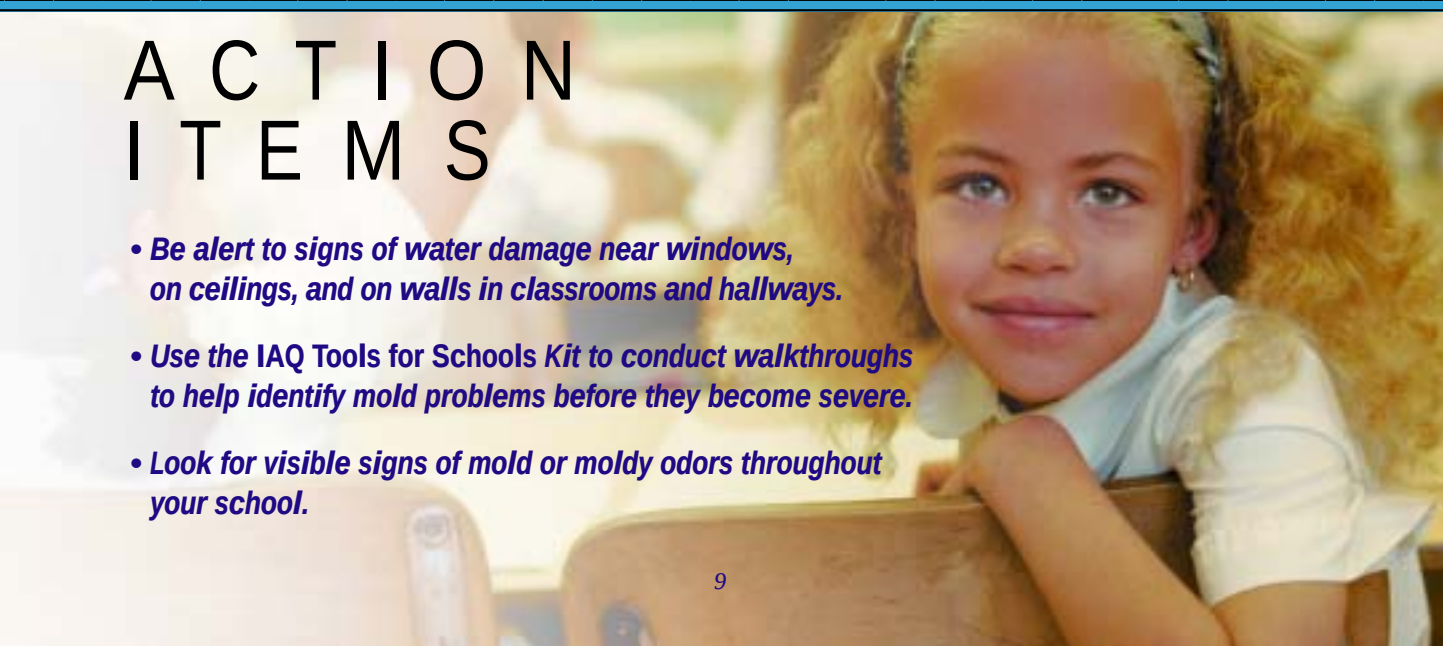
"If we'd had **IAQ Tools for Schools** *in place for the past ten years, none of [our severe problems with carbon dioxide and mold] would have happened."*

—Diane Ethier, Co-Chair of the *IAQ Tools for Schools* Team, Plainfield High School, CT

Minimizing Cost of Mold Remediation

Schools can avoid significant, costly repairs by implementing the *IAQ TfS* Program to help prevent mold problems or address them before they become severe.

- School districts have spent from $200,000 to $13.1 million to remediate a school with a severe mold problem, so it is important to identify the problem in its early stages when damage is limited.
  - An elementary school in El Paso Independent School District, Texas, spent $300,000 in repair work due to mold.
  - Saline Middle School in Washtenaw County, Michigan, spent $500,000 to solve the mold problem associated with their ceiling tiles.
  - District 303 spent $13.1 million on the mold cleanup and repair project at St. Charles East High School, Illinois, after closing the school due to mold problems.
  - Bedford County School Board in Florida spent $750,000 to replace Jefferson Forest High School's roof, but another $1.6 million was needed to remediate the mold problem at the school.
  - Yuma High School, Arizona, spent more than $5 million to clean up its mold problem.
  - Washington Elementary School, Michigan, spent more than $200,000 to clean up its mold problem.
- To relocate students from moldy schools in Portland, Maine, the school district spent $100,000 every three months to rent rooms in downtown buildings.



ACTION ITEMS

- ***Be alert to signs of water damage near windows, on ceilings, and on walls in classrooms and hallways.***
- ***Use the* IAQ Tools for Schools *Kit to conduct walkthroughs to help identify mold problems before they become severe.***
- ***Look for visible signs of mold or moldy odors throughout your school.***

Schools can reduce triggers for asthma by following the guidance presented in EPA's document, "IAQ Tools for Schools—Managing Asthma in the School Environment." To order this EPA publication at no cost, call the IAQ INFO Clearinghouse at (800) 438-4318.

Mold on ceiling in a Georgia elementary school, photo by Daniel Friedman

Studies on Mold and on Dampness

Studies have found an association between mold and a variety of adverse health effects. For example, mold is a known asthma trigger.

- Controlling dampness in buildings is extremely important in that dampness has been consistently associated with respiratory symptoms, asthma, and allergies, and therefore represents a risk factor for respiratory problems. [21, 22]
- Dampness or mold in the home have been associated with wheezing, prolonged cough, fatigue, and headache among children without diagnosed asthma.[23]

ASTHMA AND SCHOOLS

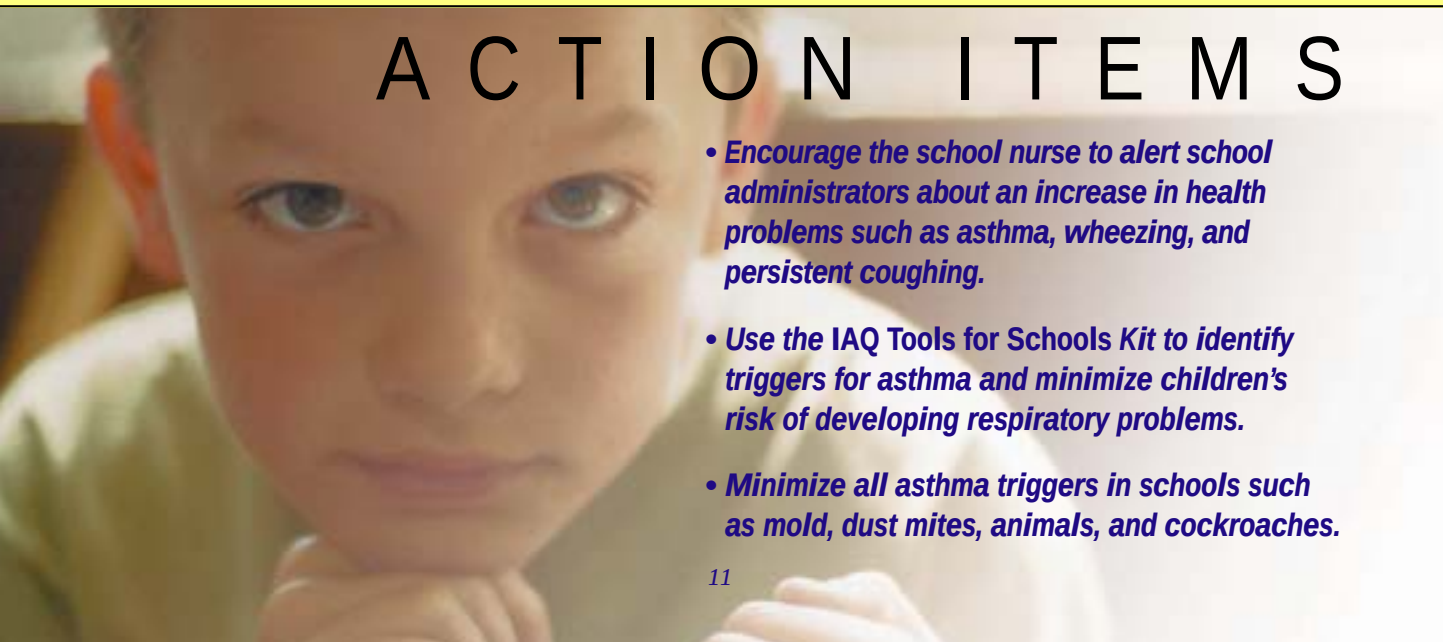
Asthma affects about 15 million people of all ages, including 1 out of every 13 school-age children. Asthma has become increasingly common in children, particularly in 5- to 6-year olds. Schools can decrease children's exposure to triggers for asthma, such as animal dander, cockroaches, mold, and dust mites, by implementing the *IAQ Tools for Schools* Program.

Economics

- Asthma is a primary cause of school absenteeism, accounting for 10 million missed school days per year. Absenteeism directly affects school funding, which is often based on attendance.
- Asthma is the most common and costly chronic illness in the United States, estimated at $11.3 billion in 1998.

Studies on Asthma

- Exposure to mold has been associated with increased severity of asthma symptoms. [24]
- Asthma prevalence in schools has been associated with higher relative air humidity, higher concentrations of volatile organic compounds, and mold or bacteria. [7]
- Reported asthmatic symptoms were less common in schools that had installed a new ventilation system. The new system resulted in higher air-exchange rates, lower concentrations of several airborne pollutants, and lower relative humidity.[25]

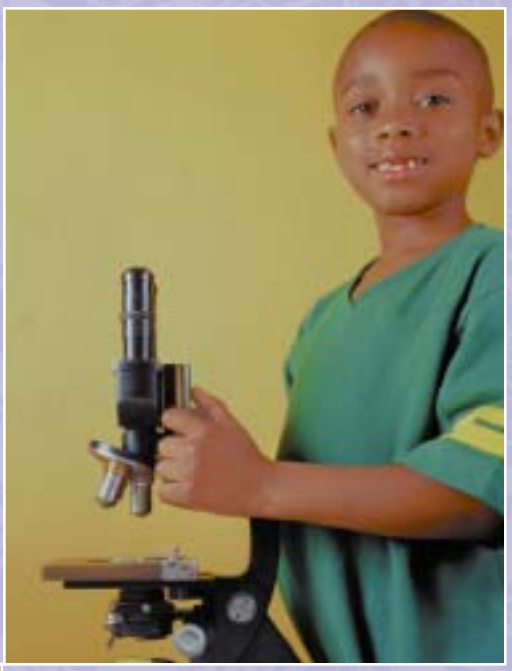


ACTION ITEMS

- ***Encourage the school nurse to alert school administrators about an increase in health problems such as asthma, wheezing, and persistent coughing.***
- ***Use the* IAQ Tools for Schools *Kit to identify triggers for asthma and minimize children's risk of developing respiratory problems.***
- ***Minimize all asthma triggers in schools such as mold, dust mites, animals, and cockroaches.***

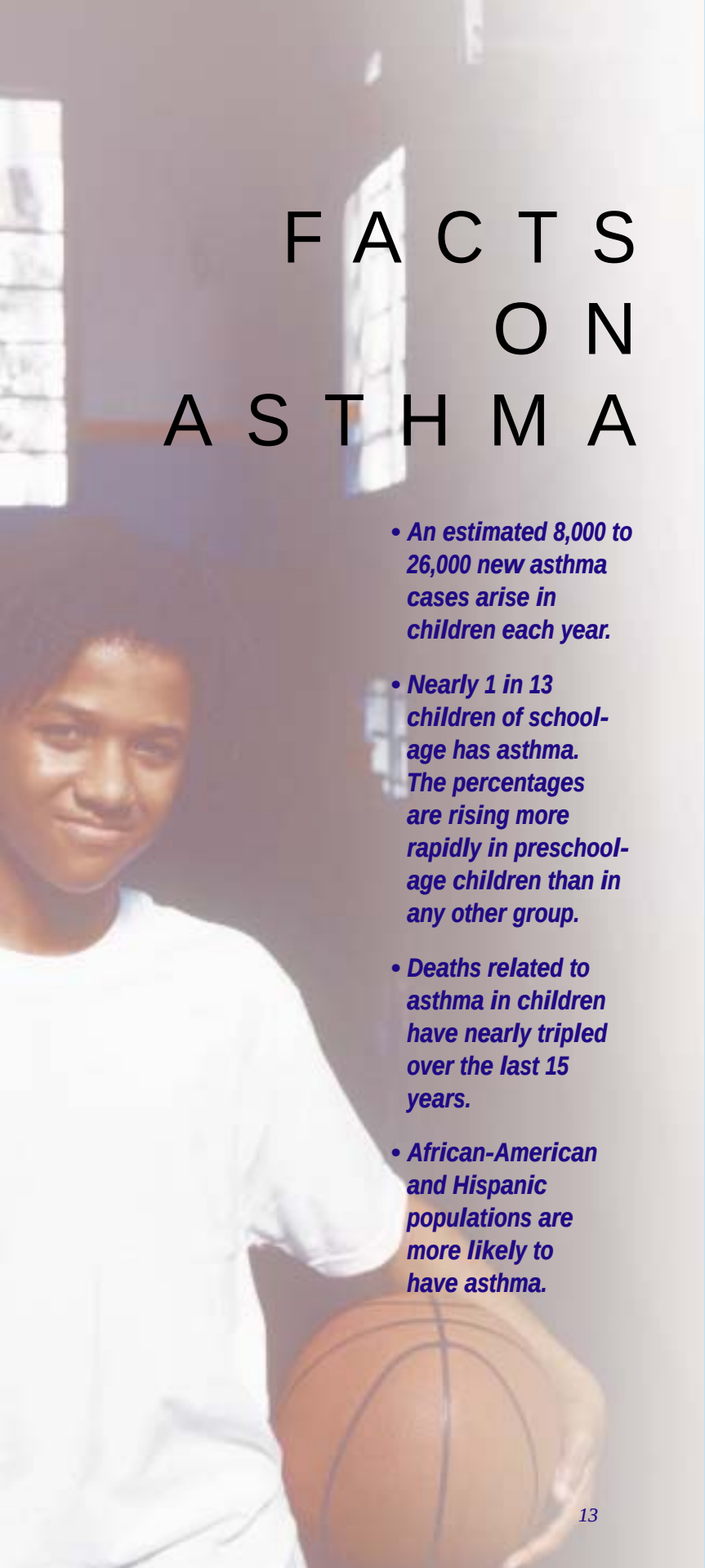
"We saw a significant decrease in the absenteeism rates of children, especially for a child with severe asthma attending the school, since we completed the IAQ upgrades."

**—Priscilla Santiago,
School Nurse, Little Harbour School, NH**



"Fewer students keep asthma medicine and inhalers at school, and asthma episodes are less frequent even though the number of students with asthma has not changed."

**—School Health Programs
Department, San Francisco
Unified School District, CA**



FACTS ON ASTHMA

- ***An estimated 8,000 to 26,000 new asthma cases arise in children each year.***
- ***Nearly 1 in 13 children of school-age has asthma. The percentages are rising more rapidly in preschool-age children than in any other group.***
- ***Deaths related to asthma in children have nearly tripled over the last 15 years.***
- ***African-American and Hispanic populations are more likely to have asthma.***

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Other useful resources for schools (available at no cost) include:

Indoor Air Quality:

- *Indoor Air Quality and Student Performance*
- Indoor Air Quality Tools for Schools *Case Studies*
- Indoor Air Quality Tools for Schools *Roadmap*
- Indoor Air Quality Tools for Schools *Bulletins*
- *Pesticides: Uses, Effects and Alternatives to Pesticides in Schools*

Health:

- *Clear Your Home Of Asthma Triggers: Your Children Will Breathe Easier*
- *Children and Secondhand Smoke*
- *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders*
- *Setting the Record Straight: Secondhand Smoke is a Preventable Health Risk*
- *Secondhand Smoke: What You Can Do As Parents, Decisionmakers, and Building Occupants*

Radon:

- *Radon in Schools Brochure*
- *Reducing Radon in Schools: A Team Approach*
- *Radon Measurement in Schools*
- *Radon Prevention in the Design and Construction of Schools and Other Large Buildings*

For a complete listing of available resources, or to order any of these documents, call the IAQ INFO Clearinghouse at (800) 438-4318.

EPA offers many resources at no cost. Some of these include:

- ***The* IAQ Tools for Schools *Kit***
- ***Mold Remediation in Schools and Commercial Buildings***
- ***Managing Asthma in the School Environment***

For a complete list of EPA's resources, visit http://www.epa.gov/iaq. To order a document, call the IAQ INFO Clearinghouse at (800) 438-4318, fax (703) 356-5386, or e-mail iaqinfo@aol.com.

United States
Environmental Protection
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Office of Air and Radiation
Indoor Environments Division
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