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## **NIOSH HEALTH HAZARD EVALUATION REPORT**

**HETA # 2004-0138-2967  
Samuel Staples Elementary School  
Easton, Connecticut**

**May 2005**

**Sandra K. White, M.S.  
Jean M. Cox-Ganser, Ph.D.**

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**DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health**



## PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Sandra White and Jean Cox-Ganser of the Field Studies Branch, Division of Respiratory Disease Studies (DRDS). Field assistance was provided by Terry Rooney and Nancy Sahakian. Analytical and technical support was provided by Nicole Edwards and Tiffany Gump. Desktop publishing was performed by Terry Rooney.

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## Highlights of the NIOSH Health Hazard Evaluation at Samuel Staples Elementary School

In February 2004 the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the Easton Health Director on behalf of employees at Samuel Staples Elementary School in Easton, Connecticut. Concerns included health effects related to possible microbial contamination and poor indoor environmental quality.

### What NIOSH Did

- Reviewed previous environmental and health reports.
- Developed a health questionnaire and administered it to all faculty and staff at Samuel Staples Elementary School, as well as volunteers and staff in the Senior Center.
- Analyzed questionnaire responses and provided comparisons of the results .

### What NIOSH Found

- Work-related respiratory and non-respiratory symptoms occurring at least once a week in the last four weeks were significantly higher among participants, in comparison to office workers in a national study.
- Asthma prevalences (ever diagnosed and current) were approximately two times greater than expected based on national prevalences and 1.2 times greater than expected based on state rates.
- Over two thirds (68%) of participants reported symptoms they thought may be related to the school, with a large majority (86%) reporting that these symptoms were current.

- Elementary school staff working in the lower wing reported higher prevalences of work-related nasal symptoms, shortness of breath, and headaches in the last four weeks.
- The most frequently reported complaints were little air movement, moldy or musty odors, and the temperature being too hot occurring one or more times per week in the previous four weeks.

### What the School District Can Do

- Promptly identify and repair all water incursions.
- Ensure proper housekeeping procedures and establish regular maintenance schedules.
- Use proper containment measures during water damage remediation and building repairs.
- If the building continues to be occupied, further investigation and repair of the building is needed to protect the health of the building occupants.

### What the Employees Can Do

- Promptly report water incursions and other building problems to management.
- Seek medical evaluation for persistent symptoms.



**What To Do For More Information:**  
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## **SUMMARY**

Samuel Staples Elementary School is a pre-kindergarten to 4<sup>th</sup> grade school in Easton, Connecticut, consisting of an older, one-story building completed in 1931, and a newer wing which was completed in 1970. A computer room, library, and other classrooms were completed in 1989 along with a ramp connecting the older wing with the newer wing. Concerns regarding water leakage and indoor air quality in the school have been on-going for a number of years.

In February 2004, the National Institute for Occupational Safety and Health received a Health Hazard Evaluation (HHE) request from the Easton Health Director to design, administer, and analyze a health questionnaire of employees at Samuel Staples Elementary School. We administered the questionnaire to all employees, as well as staff and volunteers from the Senior Center located in the basement of the school, on June 2-3, 2004. The health survey included questions on respiratory and non-respiratory symptoms occurring in the last four weeks and previous 12 months, work-related patterns, selected physician-diagnosed conditions, perceptions of environmental conditions in the building in the previous four weeks, demographic questions, and a work history (see Appendix B).

We compared the prevalence of symptoms and self-reported physician-diagnosed asthma observed in participants to U.S. adult prevalences, and the prevalence of physician-diagnosed and current asthma to Connecticut prevalences. We also compared work-related patterns in the previous four weeks to a study of office workers in non-problem buildings and compared prevalences of persons working in the lower wing or both wings to the upper wing of the school.

Compared to national prevalences, participants were approximately two times more likely to have ever been diagnosed with asthma or to currently have asthma. When compared to state prevalences, respondents were 1.2 times as likely to have ever been diagnosed with asthma or to report current asthma. Participants also reported respiratory and non-respiratory symptoms which improved when away from work more frequently than a study of office workers in 41 buildings with no known problems. When symptom prevalence in the last four weeks was linked to current work area, there was a higher prevalence of work-related stuffy, itchy, or runny nose, shortness of breath, and headaches among Elementary School staff who worked in the lower wing when compared to the upper wing. The most frequently reported environmental complaints were little air movement, moldy or musty odors, and the temperature being too hot occurring one or more times per week in the previous four weeks.

We recommend that employees receive medical care for persistent symptoms. Water incursion should be promptly repaired, and all wetted materials should be replaced if they cannot be dried within 24 hours.

Since the current building is to be vacated at the close of the school year, we recommend that when the new school is occupied that proper housekeeping practices are followed and regular maintenance schedules are established. If the current school building continues to be occupied in the future for other purposes, further investigation and repair of the building is needed in order to improve building conditions and protect the health of the building occupants.

A health questionnaire was conducted by NIOSH at Samuel Staples Elementary School in June 2004. The building had a history of water leakage and indoor air quality problems. Analyses conducted on the questionnaire data indicated an excess of respiratory and non-respiratory health conditions in the participants from the school. Persons with persistent symptoms should receive medical evaluation. Proper housekeeping practices should be followed and a regular building maintenance schedule should be established.

Keywords: SIC 8211 (elementary and secondary schools), indoor air pollution, indoor air quality

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## INTRODUCTION

In February 2004, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the Easton Health Director on behalf of employees at Samuel Staples Elementary School, located in Easton, Connecticut. Employees from both the upper and lower wings had made numerous complaints with respect to environmental conditions inside the school. Health concerns included: headaches, allergy-type symptoms, stuffy or runny nose, congestion, breathing difficulties, rashes, cough, lethargy, eye irritation, and sinus problems. These symptoms reportedly improved when away from the school.

The Easton Health Director requested that NIOSH design, administer, and analyze a health questionnaire of employees at Samuel Staples Elementary School. NIOSH conducted a site visit from June 1-3, 2004. At that time, we invited all faculty and staff of the school, as well as Senior Center staff and volunteers, to participate in the health survey.

## BACKGROUND

Samuel Staples Elementary School is a pre-kindergarten to 4<sup>th</sup> grade school in Easton, Connecticut, with 108 faculty and staff members and 627 students. A Senior Center is located in the basement of the school and has 20 employees and volunteers who occupy the Center on a regular basis. The school building is approximately 73,000 square feet, and consists of an upper wing, a lower wing, and a portable classroom unit. The lower wing consists of rooms in the original school building constructed in 1931, as well as rooms constructed in 1988-89, including the media center, computer lab, music room, nurses' office, and special education rooms. The upper wing was built in 1970 and includes the large gym and stage, faculty lounge, cafeteria and kitchen, main office area, and several classrooms (see Appendix A). Concerns about

indoor air quality have arisen as the school has experienced water leaks through the building envelope numerous times in the last several years.

### *Evaluations prior to the HHE request*

Outside consultant reports were provided to NIOSH for review. The first evaluation report was prepared in July 1995, when complaints were made about a sewer gas odor in the Senior Center basement. Testing did not indicate the source of the odor; however, the consultant recommended capping floor drains to see if the problem abated. In April of 1998, an environmental consulting firm performed a walk-through of the building, inspected the air-handling units (AHU), administered a health questionnaire to all employees, and conducted limited air monitoring (carbon dioxide, temperature, relative humidity) throughout the school. Carbon dioxide levels ranged from 600 parts per million (ppm) in unoccupied classrooms to 2400 ppm in occupied rooms. Levels above 1000 ppm are generally considered to exceed the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)<sup>1</sup> recommendations that indoor levels of carbon dioxide be no more than 700 ppm greater than outdoor levels (generally in the 300-350 ppm range). The consultants concluded that inadequate amounts of outside air were being introduced in the school and recommended that the AHU be set to ensure that at least 15 cubic feet per minute of outside air was supplied for each occupant. Follow-up sampling in September 1998 showed carbon dioxide levels had decreased and were between 450 ppm in unoccupied rooms to 850 ppm in occupied classrooms. The visual walk-through in April 1998 found several areas in the lower grade classrooms where the carpet was stained and dirty, visible water damage and mold growth on several ceiling tiles in the lower wing, and that the AHU in the Senior Center was infested with pigeons. Thirty questionnaires were completed and returned by staff. Of those, 29 reported problems with the school. The consultant provided several recommendations to the school, including replacing carpet with tile flooring,

replacing water damaged ceiling tiles, and eliminating sources of water leaks.

An additional evaluation was conducted in November 2000, which included employee interviews, airborne fungal sampling, and measurements of environmental parameters. During the employee interviews, several staff members complained of headaches, eye irritation, allergies, and flu-like symptoms. The consultant also identified areas in the school which were a concern among employees, including the Computer Room and Classroom 21C. The report stated that carbon dioxide levels exceeded 1000 ppm in four classrooms and provided recommendations for supplying a greater amount of fresh air to occupants by opening windows or increasing the amount of outdoor air from the HVAC unit. Air sampling was also done to identify types and levels of molds and fungi in the building. In general, most samples did not identify fungal levels exceeding outdoor levels. However, a few samples found fungal levels which equaled or exceeded outdoor levels. In particular, Classroom 24 was found to have levels approximately two times higher than outdoor air levels. The report noted areas in the school with water leaks and water-stained ceiling tiles. Recommendations included correcting all water leaks in the school and providing several cleaning and preventative maintenance recommendations for administration and maintenance to follow.

A follow-up evaluation was conducted in early 2003 in response to a complaint in which several concerns were noted, including the health of employees, water damage and mold in several areas of the school, drinking water problems, and pigeon and vermin droppings. Air sampling was done in January and February 2003 for environmental parameters and fungal levels in the school. The report indicated that carbon dioxide levels exceeded 1000 ppm in three classrooms. Carpet sampling was done to identify possible fungal contamination in the carpet. Fungal spores, including Basidiomycetes and other unidentified species, were detected, which indicated that the carpets needed to be cleaned. However, air sampling did not show

elevated airborne mold levels in the school. Follow-up sampling in February 2003 also did not indicate elevated mold levels in the school, although *Stachybotrys chartarum* was identified in Room 28, and there were slightly elevated levels of Basidiomycetes in two rooms.

In March 2003, an indoor air quality evaluation was performed by a consultant which included a walk-through of the school, interviews with staff and parents, and sampling of environmental parameters (temperature, relative humidity, carbon dioxide and carbon monoxide levels). Interviews with staff and parents identified areas in both the upper and lower wings of the school where symptoms became exacerbated. The symptoms reported included lower and upper respiratory problems, headaches, heart palpitations, sinus and staphylococcus infections, pneumonia, conjunctivitis, and bloody nose. Environmental parameter measurements for carbon dioxide were within ASHRAE standards. In the preliminary report provided to the school in May 2003, the consultant provided several recommendations to the school.

A follow-up evaluation was conducted in July 2003 by the consultant to determine if the ceiling tiles in the upper wing were reservoirs for microbial growth. The evaluation consisted of bulk and air sampling for fungal and endotoxin levels in three classrooms in the upper wing. Overall results indicated very low levels of culturable fungi and bacteria. Room 23 had endotoxin levels two times higher than outdoor levels, which the consultant interpreted as indicative of previous water incursion in this area. Carbon dioxide levels were within the acceptable range.

#### ***Corrective actions prior to the HHE request***

In 1999, a Director of Facilities was hired by the Board of Education to oversee management and upkeep of the building. During the past five years, the school has implemented several changes in maintenance and repair procedures. For classrooms and other areas of the school where high carbon dioxide levels were measured, the HVAC system was balanced. A preventative maintenance plan was implemented

for regular inspection and service of the HVAC system. For areas in which there was no mechanical ventilation, teachers were instructed to keep doors or windows open to provide more fresh air. Changes were made in cleaning practices, which included hiring staff in the summer months for extra cleaning in the building and purchasing new cleaning supplies and a carpet extractor which allowed carpets to be dried within 24 hours with floor fans. In 1999, seams in the roof membrane were found to have extensive failure. Between 2000 and 2001, repairs were made to correct seam failure in the roof. The school also underwent thorough cleaning and maintenance in the Summer of 2001. In 2003, all carpet in the school was replaced by tile flooring.

#### ***On-going evaluations and remediation during the HHE request***

In the summer of 2004, the roof of the lower wing and sections of the roof in the upper wing were removed and replaced. In addition, a new ceiling grid was installed and all ceiling tiles were replaced in the upper wing.

In July 2004, an outside consultant conducted an evaluation of the school which included a visual inspection, as well as air and surface tape sampling. No visible signs of mold growth were reported, with the exception of a small area in Room 31, which was later removed by a contractor. Air sampling indicated that levels of airborne fungi were lower than outdoors, and tape sampling from surfaces identified mold spores which are commonly found in indoor environments.

A follow-up consultant visit in September 2004 included air and surface sampling, as well as a visual inspection in the ceiling plenum in the lower wing. During this visit, the consultant observed several roof leaks occurring in classrooms, hallways, and restrooms in the lower wing. There were also several mold contaminated areas in the ceiling of lower wing classrooms. Some air samples for total mold were higher than outdoor levels in this area as well. Relative humidity levels ranged between 53% and 76% which could facilitate microbial

growth. Carbon dioxide levels ranged from 501-1200 ppm. The consultant recommended repairing all roof leaks and lowering relative humidity levels, as well as remediating areas with mold contamination. In September 2004, the music room, media center, and computer rooms were closed. In October 2004, the remainder of the lower wing was closed and all students and teachers were relocated from the area.

## **METHODS**

NIOSH staff conducted a site visit from June 1-3, 2004. We invited all faculty and staff of the school, as well as Senior Center staff and volunteers, to participate in a health survey. A written health questionnaire was administered in small groups, with NIOSH staff present to explain and clarify the survey questions. In addition, we left mail-in questionnaires with postage-paid envelopes for building occupants who were not able to take part in the survey while NIOSH was on-site.

The health survey included questions on symptoms occurring at least once a week in the last four weeks and anytime in the last 12 months, work-related patterns, selected physician-diagnosed conditions, perceptions of environmental conditions in the building in the previous four weeks, demographic questions, and a work history (see Appendix B).

We compared the prevalences of symptoms and self-reported physician-diagnosed asthma observed in participants to the U.S. adult prevalences obtained from the 3<sup>rd</sup> National Health and Nutrition Examination Survey (NHANES III)<sup>2</sup>, the 2003 data for the state from the Behavioral Risk Factor Surveillance System (BRFSS)<sup>3</sup>, and data for U.S. office workers in 41 office buildings without known indoor air quality problems.<sup>4</sup>

For the NHANES III analysis, we compared study participants to the U.S. adult population, and used indirect standardization for gender, race, cigarette smoking status (current, former, or never smoker), and age (17 to 39 years old,

40 to 69 years old, and 70 to 89 years old). For comparisons with BRFSS, we standardized for gender only. The comparison to the U.S. office workers was not adjusted for any demographics. We derived 95% confidence intervals (CI) using a method which assumes that the observed data are from a Poisson distribution.<sup>5</sup>

We calculated incidence density rates of physician-diagnosed adult-onset asthma for building occupants. For each participant, we calculated person-time at risk for two time periods: from age 16 to building occupancy and from building occupancy to the June 2004 survey date. For subjects with physician-diagnosed adult-onset asthma, time at risk ended on the date of diagnosis. Time at risk for each participant was summed to give person-years at risk. Participants with childhood asthma did not contribute any time at risk.

To investigate within-building differences, we calculated prevalence ratios by current work area for symptoms occurring at least once a week in the last four weeks (overall) and if these symptoms improved when away from work (work-related). A prevalence ratio is calculated by dividing the prevalence in one group by the prevalence in another. We also compared the prevalence of perceived building environmental conditions by current work area. We grouped participants into three categories based on reported work area in the school in the past four weeks. The three categories were: 1) Lower Wing: participants who worked only in the lower wing (one group included Elementary School staff and Senior Center staff and volunteers, and the second group only included Elementary School staff); 2) Upper Wing: participants who either worked only in the upper wing or worked in both the upper wing and the portable classroom units; and 3) Both Wings: participants who worked in both the lower and upper wings, or participants who worked in the lower and upper wings, as well as the portable classroom units. The lower and upper wings were designated as different work areas for this analysis, since they are considered to be distinct wings of the building which were built separately and have individual heating and cooling systems. Participants who did not report

working in the building in the last four weeks were excluded from this analysis.

Questionnaire data was double-keyed to ensure data accuracy. All analyses were performed using SAS® System for Windows, version 8.02.<sup>6</sup> Results of the analyses were communicated to the requestor and other key stakeholders as an interim letter in October 2004.

## RESULTS

### *Participation and Demographics*

The participation rate for the questionnaire was 92% (99/108) among Samuel Staples Elementary School staff and 80% among Senior Center workers (16/20). However, since not all respondents answered all questions, percentages may be based on less than 115 participants. Respondents were primarily female (87%), white (99%), and had been in the building for an average of 6.7 years (SD=7.0 years) (see Table 1). The mean age among Samuel Staples Elementary School staff was 44.6 years (SD=11.6 years) and 68.7 years (SD=12.4 years) for Senior Center staff and volunteers. Overall, 4% of participants reported being current smokers. Two-thirds (66%) of participants had never smoked. Among Samuel Staples staff, 42% of participants were teachers, 7% were administration or office staff, 29% were paraprofessionals, and 21% were custodians, technical support staff, cafeteria workers, speech pathologists, and other job positions.

### *Lower Respiratory Symptoms and Work-Related Patterns*

Participants were asked about the prevalence of lower respiratory symptoms occurring in the last four weeks, and if these symptoms were the same, worse, or better while away from the school. Cough was the most prevalent symptom (35%, 40/115), followed by shortness of breath (20%, 23/114), wheezing or whistling in the chest (20%, 23/115), and chest tightness (15%, 17/115) (see Table 2). Almost half (46%, 53/115) of the participants reported at least one

or more lower respiratory symptoms occurring in the past four weeks. Twenty-nine percent (33/115) of participants reported that lower respiratory symptoms improved while away from the school. In general, overall and work-related symptom prevalences for lower respiratory symptoms were higher among Elementary School participants than Senior Center participants. Participants were three to four times as likely to report work-related wheeze, chest tightness, shortness of breath, and cough occurring one or more times per week in the last four weeks than U.S. office workers<sup>4</sup> (see Table 3). Overall, participants were over three times as likely to report wheezing or whistling in the chest in the past 12 months as compared to U.S. adults<sup>2</sup> (see Table 4).

### ***Upper Respiratory Symptoms and Work-Related Patterns***

Three-quarters (77%, 87/113) of participants reported one or more upper respiratory symptoms occurring at least once a week in the last four weeks (see Table 5). Half of the participants (52%, 59/113) reported having upper respiratory symptoms which improved when away from the school. Stuffy, itchy, or runny nose was the most prevalent reported symptom, both overall (62%, 71/114) and with improvement when away from the school (34%, 39/114). Elementary School participants were more likely to report overall and work-related upper respiratory symptoms in the past four weeks than Senior Center participants (see Table 3). Sore or dry throat was 3.4 times greater among respondents than U.S. office workers (95% CI: 2.4-5.0) (see Table 3). Self-reported sinusitis or sinus problems, stuffy, itchy, or runny nose, and watery, itchy eyes in the last 12 months were 1.2-1.5 times greater among participants when compared to U.S. adults; all were statistically significant at  $p < 0.05$ , with the exception of watery, itchy eyes (see Table 4).

### ***Non-Respiratory Symptoms and Work-Related Patterns***

Unusual tiredness, fatigue or drowsiness, as well as headaches, were the most common non-respiratory symptoms reported (48%; 55/115)

(see Table 6). About one-third of all participants reported that unusual tiredness, fatigue or drowsiness or headaches improved when away from the school (32% or 37/115 and 30% or 35/115, respectively). In general, overall and work-related non-respiratory symptoms were higher for Elementary School participants. When compared to U.S. office workers, total participants were about twice as likely to report unusual tiredness, fatigue, or drowsiness, headache, and dry or itchy skin that improved when away from work (see Table 3).

### ***Physician-Diagnosed Conditions***

We asked participants about physician-diagnosed sinusitis, pneumonia, and bronchitis occurring in the last 12 months, as well as ever being diagnosed with asthma or hypersensitivity pneumonitis. About half (48%) of all participants reported being diagnosed with sinusitis or sinus trouble, and about one-quarter (24%) had been diagnosed with bronchitis in the past 12 months (see Table 8). One person reported hypersensitivity pneumonitis, with a diagnosis date prior to starting work at the school. Physician-diagnosed asthma was reported by 17% of Elementary School participants, compared to 6% of Senior Center participants. Twelve (12%) of Elementary School participants reported that they still had asthma, and seven of these were diagnosed after school occupancy. When compared to U.S. adults, participants were twice as likely to have ever been diagnosed with asthma and 2.2 times more likely to have current asthma (see Table 4). When compared to Connecticut adults, respondents in our survey were 1.2 times more likely to have ever been diagnosed with asthma or to still have current asthma, which was not statistically significant at  $p < 0.05$ .

Among the 18 participants who reported physician-diagnosed asthma, 13 had been diagnosed at age 16 or older. Adult-onset asthma in the school was 2.8 times greater than U.S. adults. Nine of the adult-onset asthma cases (69%) were diagnosed after school occupancy. The asthma incidence density rate after school occupancy was 12.7 cases per 1,000 person-years. Prior to school occupancy, this

rate was 1.5 cases per 1,000 person-years, showing an 8.5-fold increase.

### ***Prevalence of Symptoms by Current Work Area***

Fifty-nine participants reported being only in the lower wing in the last four weeks and comprised the Lower Wing group; among the Upper Wing group, 31 participants were only in the upper wing and four were in the upper wing and portable classroom units; among the Both Wings group, 11 reported being in the lower and upper wing and seven had been in the lower and upper wings, as well as the portable classroom units, in the last four weeks.

Prevalence ratios of overall lower (Table 8) and upper (Table 9) respiratory symptoms and non-respiratory symptoms (Table 10) were calculated by comparing the Lower Wing group (including and excluding the Senior Center) and Both Wings group to the Upper Wing group (as defined above). For lower respiratory symptoms, there was no consistent pattern in any one of the three work areas. For upper respiratory symptoms, the Both Wings group reported higher prevalences of overall nasal and eye symptoms when compared to the Upper Wing group. For non-respiratory symptoms, overall dizziness or lightheadedness, unusual tiredness or fatigue, and headaches tended to be reported more frequently among Elementary School staff in the Lower Wing group compared to the Upper Wing group. Overall dizziness or lightheadedness was also reported significantly more often among persons working in both wings.

For work-related symptoms, the Lower Wing group tended to report a higher prevalence of lower, upper, and non-respiratory symptoms when compared to the Upper Wing group (see Tables 11-13). There was a trend toward increased work-related wheeze and shortness of breath in the Lower Wing group when compared to the Upper Wing group. Work-related stuffy, itchy, or runny nose and headaches were also reported significantly more often among participants in the Lower Wing group.

### ***Symptoms Reported Being Related to the School***

Over two-thirds (78/115, 68%) of participants reported symptoms that were related to the school, with the majority currently having these symptoms (67/78, 86%). Of these 78 participants, 73 reported full information on locations where they had the symptoms. Over three-quarters of the 73 people reported locations in the lower wing (78%, 57/73). The upper wing was reported by 42% (31/73), and 5% (4/73) listed locations in the portable classroom units. These percentages sum to more than 100%, since participants often reported more than one location in the school. A majority of participants (45/77, 58%) reported their symptoms began in the year 2001 or later (see Figure 1). The highest number of participants reporting building-related symptoms was in 2003, in which 16 reported symptoms beginning in this year.

### ***Perceptions of Environmental Conditions***

Pertaining to conditions occurring at least once a week in the last four weeks, participants were most likely to observe that there was too little air movement, a musty, moldy odor in the building, or the temperature being too hot. Overall, 11% (12/109) reported frequent photocopier emissions. These photocopier emissions were reported more often by people who worked in the upper wing (21%, 7/34). Engine fumes were not experienced frequently in any of the work areas (5%, 5/109). Further details of perceptions of environmental conditions stratified by current work area are shown in Table 14.

## **DISCUSSION**

A number of analyses conducted on the questionnaire data indicated an excess of respiratory health conditions in the participants from the school. First, we found that participants were three times as likely to report wheezing in the last 12 months when compared to U.S. adults.<sup>2</sup> Second, the prevalence of work-related

lower respiratory symptoms, including wheeze, shortness of breath, chest tightness, and coughing, were three to four times higher when compared to U.S. office workers.<sup>4</sup> Another NIOSH investigation conducted in a water-damaged office building reported similar results when comparing health outcomes to NHANES and BASE data.<sup>7</sup> One limitation of comparing prevalences reported by participants in a school setting to those reported by office workers is that we are not comparing similar occupational groups. Other factors, such as the more frequent incidence of contagious illnesses (ie., colds or flu) occurring in school settings, may have contributed to the higher prevalence of symptoms. However, since we focused on comparing the prevalence of symptom improvement when away from the school building, if contagious illnesses were occurring more frequently among school employees, this would be an unlikely factor. At this time, no comparison data is available from studies of school employees. However, a review of 55 teachers in Connecticut who had visited an occupational health clinic reported that the teachers from more water-damaged schools had a higher prevalence of upper respiratory symptoms and asthma than those in “dry” schools.<sup>8</sup>

We found the prevalence of physician-diagnosed asthma and current asthma to be 2.0 to 2.2 times greater than expected when compared to U.S. adults, and 1.2 times greater when compared to Connecticut adults. Two reasons may explain the observed difference. First, according to the 2003 Behavioral Risk Factor Surveillance System survey, Connecticut has a higher prevalence of asthma than the overall U.S. average. The percentage of Connecticut adults reporting lifetime asthma was 12.2%, compared to the nationwide average of 11.7%. For current asthma, it was 8.3% among Connecticut adults and 7.6% nationwide.<sup>3</sup> Second, participation rates differed between the two studies, with 86% completing the household interview portion of the NHANES III survey between 1988-1994, and 39% of Connecticut adults completing the telephone interview of the 2003 BRFSS study.<sup>9,10</sup>

In our study, the incidence of physician-diagnosed adult-onset asthma was 1.5 cases per 1,000 person-years prior to building occupancy and 12.7 cases per 1,000 person-years after building occupancy. This increase of asthma incidence indicates a relationship between building occupancy and adult-onset asthma. The pre-occupancy incidence rate was similar to adult asthma incidence rates reported in previous studies.<sup>11-13</sup>

The prevalence of symptoms and physician-diagnosed medical conditions was lower among Senior Center participants in comparison to participants in the school. This difference may be explained by age-related factors, amount of time spent in the building, or the location in the building.

NIOSH did not conduct environmental assessment of the school. We reviewed outside consultant reports and information from management. Interpreting the linkage between the health outcomes documented by the NIOSH health survey and the environmental conditions in the building is hampered by the lack of established standards for concentrations of contaminants, such as mold, bacteria, or other microbials, in schools. However, the health data does indicate that the symptoms reported by participants are building-related.

We did not confirm work-related asthma by objective medical testing. Persons who have been determined to have work-related asthma should be monitored closely by a physician or other health care provider.<sup>14</sup>

There is some indication that the occupants of the lower wing had a higher prevalence of work-related shortness of breath, nasal symptoms, and headaches. This association became more evident when only Samuel Staples Elementary School participants (not including Senior Center participants) were included in the analysis. These findings, in conjunction with the Fall 2004 environmental consultant reports which identified mold contamination in the lower wing, are consistent with previous studies that associated water-damage with health complaints.<sup>15, 16</sup>

## CONCLUSIONS

Participants in the NIOSH survey conducted at Samuel Staples Elementary School in June 2004 reported work-related respiratory and non-respiratory symptoms and a higher prevalence of asthma, including asthma that was diagnosed after starting work in the building. These results are consistent with those documented by NIOSH and other researchers in prior studies of damp buildings. Previous consultant evaluations documented a history of water incursion and damp and/or moldy building materials. If the building continues to be occupied in the future, further investigation and repair of the building is needed in order to improve building conditions and protect the health of the building occupants.

## RECOMMENDATIONS

1. Employees with on-going symptoms should seek medical evaluation and treatment.
2. Promptly address water incursions and replace all wetted materials that cannot be properly dried in 24 hours or any materials containing visible mold.
3. If the upper wing continues to be occupied, a qualified, licensed contractor should be hired to evaluate the HVAC system to ensure that the system is functioning properly and providing adequate amounts of fresh air to building occupants in accordance with ASHRAE standards.
4. Previous consultants reports and other building evaluations should be reviewed to ensure that all recommended changes or corrections to the building have been made.
5. Use containment measures during renovations to prevent exposures to construction dusts and other contaminants.<sup>17,18</sup>
6. Ensure proper housekeeping and establish regular building maintenance schedules.

## REFERENCES

1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers [2001]. ASHRAE 62-2001: Ventilation for Acceptable Indoor Air Quality. Atlanta, GA: ASHRAE.
2. CDC [1996]. Third National Health and Nutrition Examination Survey, 1988-1994, NHANES III Examination Data File [CD-ROM]. Hyattsville, MD: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. (Public use data file documentations No. 76300).
3. CDC [2003]. Behavioral Risk Factor Surveillance System Survey Data. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.
4. Apte MG, Fisk WJ, Daisey JM [2000]. Associations Between Indoor CO<sub>2</sub> Concentrations and Sick Building Syndrome Symptoms in U.S. Office Buildings: An Analysis of the 1994-1996 BASE Study. *Indoor Air* 10(4):246-257.
5. Kahn HA, Sempos CT [1989]. *Statistical Methods in Epidemiology*. New York, NY: Oxford University Press.
6. SAS Institute Inc. [2001]. SAS Version 8.02. Cary, NC: SAS Institute Inc.
7. Cox-Ganser JM, White SK, Jones R, Hilsbos K, Storey E, Enright PL, Rao CY, Kreiss K [2005]. Respiratory morbidity in office workers in a water-damaged building. *Environ Health Perspect* 113:485-490.
8. Dangman KH, Bracker AL, Storey E [2005]. Work-Related Asthma in Teachers in Connecticut: Association with Chronic Water Damage and Fungal Growth in Schools. *Conn Med* 69(1):9-17.

9. CDC [1996]. Analytic and Reporting Guidelines: The Third National Health and Nutrition Examination Survey, NHANES III (1988-94). Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.
10. CDC [2004]. 2003 Behavioral Risk Factor Surveillance System Summary Data Quality Report. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.
11. McWhorter WP, Polis MA, Kaslow RA [1989]. Occurrence, Predictors, and Consequences of Adult Asthma in NHANES I and Follow-Up Survey. *Am Rev Resp Dis* 139:721-724.
12. Sama SR, Hunt PR, Cirillo CP, Marx A., Rosiello RA, Henneberger PK, Milton DKA [2003]. Longitudinal Study of Adult-Onset Asthma Incidence Among HMO Members. *Environ Health* 2:10.
13. Reed CE [1999]. The Natural History of Asthma in Adults: The Problem of Irreversibility. *J Allergy Clin Immunol* 103:539-547.
14. Friedman-Jiménez G, Beckett WS, Szeinuk J, Petsonk EL [2000]. Clinical Evaluation, Management, and Prevention of Work-Related Asthma. *Am J Ind Med* 37:121-141.
15. NIOSH [2001]. Hazard Evaluation and Technical Assistance Report: Benefis Healthcare, Great Falls, MT. Cincinnati, OH: National Institute for Occupational Safety and Health, HETA Report No. 2001-0255-2868.
16. NIOSH [2003]. Hazard Evaluation and Technical Assistance Report: Hilton Head Elementary School, Hilton Head Island, SC. Cincinnati, OH: National Institute for Occupational Safety and Health, HETA Report No. 2003-0039-2914.
17. SMACNA [1995]. IAQ Guidelines for Occupied Buildings under Construction. Chantilly, VA: Sheet Metal and Air Conditioning Contractors' National Association, Inc.
18. EPA [2001]. Mold Remediation in Schools and Commercial Buildings. Washington, DC: Environmental Protection Agency. Available at: [http://www.epa.gov/mold/mold\\_remediation.html](http://www.epa.gov/mold/mold_remediation.html)

**Table 1. Demographic information (Samuel Staples Elementary School, June 2004)**

	School faculty and staff (%)	Senior Center staff and volunteers (%)	Total (%)
Age (Mean ± SD)	44.6 ± 11.6**	70.3 ± 12.3	48.2 ± 14.7
Race (% White)	99/99 (100)	15/16 (94)	114/115 (99)
Gender (% Female)	88/99 (89)	12/16 (75)	100/115 (87)
Building tenure in years (Mean ± SD)	5.7 ± 6.4**	13.2 ± 7.3	6.7 ± 7.0
Smoking status			
Current smoker (%)	4/98 (4)	0/16 (0)	4/114 (4)
Former smoker (%)	30/98 (31)	5/16 (31)	35/114 (31)
Never smoker (%)	64/98 (65)	11/16 (69)	75/114 (66)
Job category			
Teachers	42/99 (42)	--	42/115 (37)
Office Staff/Administration	7/99 (7)	--	7/115 (6)
Paraprofessionals	29/99 (29)	--	29/115 (25)
Senior Center Worker	--	16/16 (100)	14/115 (12)
Other	21/99 (21)	--	23/115 (20)

\*\*p<0.05, based on t-test

**Table 2. Prevalence rates of current lower respiratory symptoms (Samuel Staples Elementary School, June 2004)**

Symptoms present at least once a week in the last four weeks	Prevalence rates of symptoms without regard to work-relatedness (%)		Prevalence rates of symptoms which improved away from work (%)	
	School faculty and staff	Senior Center staff and volunteers	School faculty and staff	Senior Center staff and volunteers
Wheezing or whistling in chest	21/99 (21)	2/16 (13)	10/99 (10)	1/16 (6)
Chest tightness	17/99 (17)	0/16 (0)	10/99 (10)	0/16 (0)
Shortness of breath	23/98** (23)	0/16 (0)	10/98 (10)	0/16 (0)
Cough	37/99 (37)	3/16 (19)	17/99 (17)	2/16 (13)
Awakened by an attack of breathing difficulty	7/99 (7)	0/16 (0)	4/99 (4)	0/16 (0)
At least one or more of the above symptoms	49/99 (49)	4/16 (25)	30/99 (30)	3/16 (19)

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 3. Prevalence rate ratios of current work-related symptoms for all participants compared to U.S. office workers (June 2004)**

Symptoms present at least once a week in the last four weeks and improved away from work	Building prevalence (%)	Prevalence ratio	95% CI**
Wheeze	10	4.0	2.2-7.1
Chest tightness	9	3.6	2.0-6.7
Shortness of breath	9	4.2	2.3-7.7
Cough	17	3.0	1.9-4.7
Sore or dry throat	24	3.4	2.4-5.0
Unusual tiredness, fatigue, or drowsiness	32	2.0	1.4-2.7
Headache	30	1.8	1.3-2.5
Dry or itchy skin	10	2.0	1.2-3.5

\*\* All were statistically significant at  $p < 0.05$

**Table 4. Prevalence rate ratios of selected health outcomes for all participants compared to U.S. adults (June 2004)†\***

Condition	Building prevalence (%)	Prevalence ratio	95% CI
Ever diagnosed with asthma	16	2.0	1.3-3.2**
Adult-onset asthma	11	2.8	1.6-4.8**
Current asthma	11	2.2	1.3-3.7**
Wheezing or whistling in your chest in the last 12 months	45	3.2	2.4-4.2**
Sinusitis or sinus problems in the last 12 months (self-reported)	61	1.5	1.2-1.9**
Stuffy, itchy or runny nose in the last 12 months	80	1.3	1.1-1.7**
Watery, itchy eyes in the last 12 months	53	1.2	0.9-1.5

† One participant excluded due to missing information

\* The prevalence ratios were adjusted for age, gender, race, and smoking status.

\*\* Statistically significant at  $p < 0.05$

**Table 5. Prevalence rates of current upper respiratory symptoms (Samuel Staples Elementary School, June 2004)**

Symptoms present at least once a week in the last four weeks	Prevalence rates of symptoms without regard to work-relatedness (%)		Prevalence rates of symptoms which improved away from work (%)	
	School faculty and staff	Senior Center staff and volunteers	School faculty and staff	Senior Center staff and volunteers
Stuffy, itchy, or runny nose	66/99** (67)	5/15 (33)	36/99 (36)	3/15 (20)
Sneezing	60/98* (61)	5/15 (33)	28/97 (29)	1/15 (7)
Watery, itchy eyes	50/99** (51)	3/16 (19)	27/99 (27)	3/16 (19)
Burning eyes	28/98 (29)	2/16 (13)	23/98 (23)	2/16 (13)
Sore or dry throat	38/99* (38)	2/16 (13)	26/99 (26)	2/16 (13)
At least one or more of the above symptoms	81/98** (83)	6/15 (40)	55/98* (56)	4/15 (27)

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 6. Prevalence rates of other current non-respiratory symptoms (Samuel Staples Elementary School, June 2004)**

Symptoms present at least once a week in the last four weeks	Prevalence rates of symptoms without regard to work-relatedness (%)		Prevalence rates of symptoms which improved away from work (%)	
	School faculty and staff	Senior Center staff and volunteers	School faculty and staff	Senior Center staff and volunteers
Episodes of fever and chills	8/99 (8)	0/16 (0)	2/99 (2)	0/16 (0)
Flu-like achiness or achy joints	24/99 (24)	1/15 (7)	8/99 (8)	0/15 (0)
Unusual tiredness, fatigue, or drowsiness	54/99** (55)	1/16 (6)	36/99** (36)	1/16 (6)
Difficulty remembering things or concentrating	29/99 (29)	2/16 (13)	16/99 (16)	0/16 (0)
Dizziness or lightheadedness	28/99 (28)	2/16 (13)	21/99** (21)	0/16 (0)
Headaches	53/99** (54)	2/16 (13)	34/99** (34)	1/16 (6)
Dry or itchy skin	36/99 (36)	3/16 (19)	10/99 (10)	2/16 (13)

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 7. Physician-diagnosed medical conditions (Samuel Staples Elementary School, June 2004)**

<b>Diagnosis confirmed by physician</b>	<b>Samuel Staples faculty and staff (%)</b>	<b>Senior Center staff and volunteers (%)</b>	<b>Total (%)</b>
Sinusitis or sinus problems in last 12 months	51/99 (52)*	4/16 (25)	55/115 (48)
Pneumonia in last 12 months	7/99 (7)	0/16 (0)	7/115 (6)
Bronchitis in last 12 months	26/99 (26)	1/16 (6)	27/115 (23)
Asthma	17/99 (17)	1/16 (6)	18/115 (16)
Current	12/99 (12)	1/16 (6)	13/115 (11)
Post-occupancy	9/99 (9)	0/16 (0)	9/115 (8)
Post-occupancy, current	7/99 (7)	0/16 (0)	7/115 (6)
Hypersensitivity pneumonitis	1/99 (1)	0/16 (0)	1/115 (1)

\* $p < 0.10$ , based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 8. Prevalence rate ratios for recent lower respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Wheezing or whistling in chest	1.7	1.9	1.6
Chest tightness	0.6	0.8	0.8
Shortness of breath	1.5	2.0	0.7
Cough	0.9	1.1	1.5
Awakened by an attack of breathing difficulty	1.5	2.0	‡

† Upper wing included four persons that worked in portable units and upper wing.

‡ Could not calculate since cell size was zero

**Table 9. Prevalence rate ratios for recent upper respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Stuffy, itchy, or runny nose	1.1	1.3	1.5*
Sneezing	1.2	1.3	1.5
Watery, itchy eyes	0.9	1.1	1.7*
Burning eyes	0.9	1.0	1.0
Sore or dry throat	1.2	1.5	1.6

† Upper wing included four persons that worked in portable units and upper wing.

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 10. Prevalence rate ratios for recent non-respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Episodes of fever and chills	2.4	3.2	5.8
Flu-like achiness or achy joints	1.6	2.0	1.0
Unusual tiredness, fatigue, or drowsiness	1.2	1.6**	1.2
Difficulty remembering things or concentrating	1.1	1.2	0.9
Dizziness or lightheadedness	2.0	2.4*	3.1**
Headaches	1.3	1.6**	1.3
Dry or itchy skin	0.8	1.0	0.6

† Upper wing included four persons that worked in portable units and upper wing.

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 11. Prevalence rate ratios for recent work-related lower respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks and which improved away from work	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Wheezing or whistling in chest	4.7	5.6*	3.9
Chest tightness	1.0	1.3	1.3
Shortness of breath	5.3*	7.2**	‡
Cough	0.7	0.7	1.1
Awakened by an attack of breathing difficulty	1.8	2.4	‡

† Upper wing included four persons that worked in portable units and upper wing.

‡ Could not calculate since cell size was zero

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 12. Prevalence rate ratios for recent work-related upper respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks and which improved away from work	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Stuffy, itchy, or runny nose	2.1*	2.4**	1.9
Sneezing	1.0	1.3	0.9
Watery, itchy eyes	1.1	1.2	1.2
Burning eyes	0.8	0.9	0.9
Sore or dry throat	1.3	1.5	1.4

† Upper wing included four persons that worked in portable units and upper wing.

\*p<0.10, based on continuity-adjusted chi-square or Fisher's Exact Test

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 13. Prevalence rate ratios for recent work-related non-respiratory symptoms, lower and both wings compared to upper wing (Samuel Staples Elementary School, June 2004)**

Symptoms which occurred at least once a week in the last 4 weeks and which improved away from work	Prevalence Rate Ratios†		
	Lower Wing (Including Senior Center) vs. Upper Wing	Lower Wing (Excluding Senior Center) vs. Upper Wing	Both Wings vs. Upper Wing
Episodes of fever and chills	‡	‡	‡
Flu-like achiness or achy joints	3.6	4.8	1.9
Unusual tiredness, fatigue, or drowsiness	1.3	1.7	1.0
Difficulty remembering things or concentrating	0.9	1.3	1.2
Dizziness or lightheadedness	1.8	2.4	2.4
Headaches	1.5	1.9**	0.6
Dry or itchy skin	1.0	1.0	‡

† Upper wing included four persons that worked in portable units and upper wing.

‡ Could not calculate since cell size was zero

\*\*p<0.05, based on continuity-adjusted chi-square or Fisher's Exact Test

**Table 14. Perception of environmental conditions in the last four weeks—lower, upper, or both wings (Samuel Staples Elementary School, June 2004)<sup>a</sup>**

<b>Environmental condition—at least once a week in the last four weeks</b>	<b>Lower Wing (%)</b>	<b>Upper Wing<sup>b</sup> (%)</b>	<b>Both Wings<sup>c</sup> (%)</b>
Too little air	34/58 (59)	17/33 (52)	12/18 (67)
Temperature too hot	26/58 (45)	10/35 (29)	10/18 (56)
Musty or moldy odor	27/58 (47)	12/34 (35)	8/18 (44)
Air too humid	15/57 (26)	12/34 (35)	11/18 (61)**
Temperature too cold	16/58 (28)	1/34 (3)	5/18 (28)
Air too dry	17/57 (30)	5/34 (15)	3/18 (17)
Other unpleasant odors	13/56 (23)	6/34 (18)	3/18 (17)
Photocopier emissions	4/57 (7)	7/34 (21)	1/18 (6)
Unpleasant chemical odors	4/57 (7)	2/34 (6)	0/18 (0)
Too much air	3/58 (5)	1/34 (3)	0/18 (0)
Engine fumes	1/57 (2)	3/34 (9)	1/18 (6)
Tobacco odor	0/56 (0)	0/34 (0)	0/18 (0)

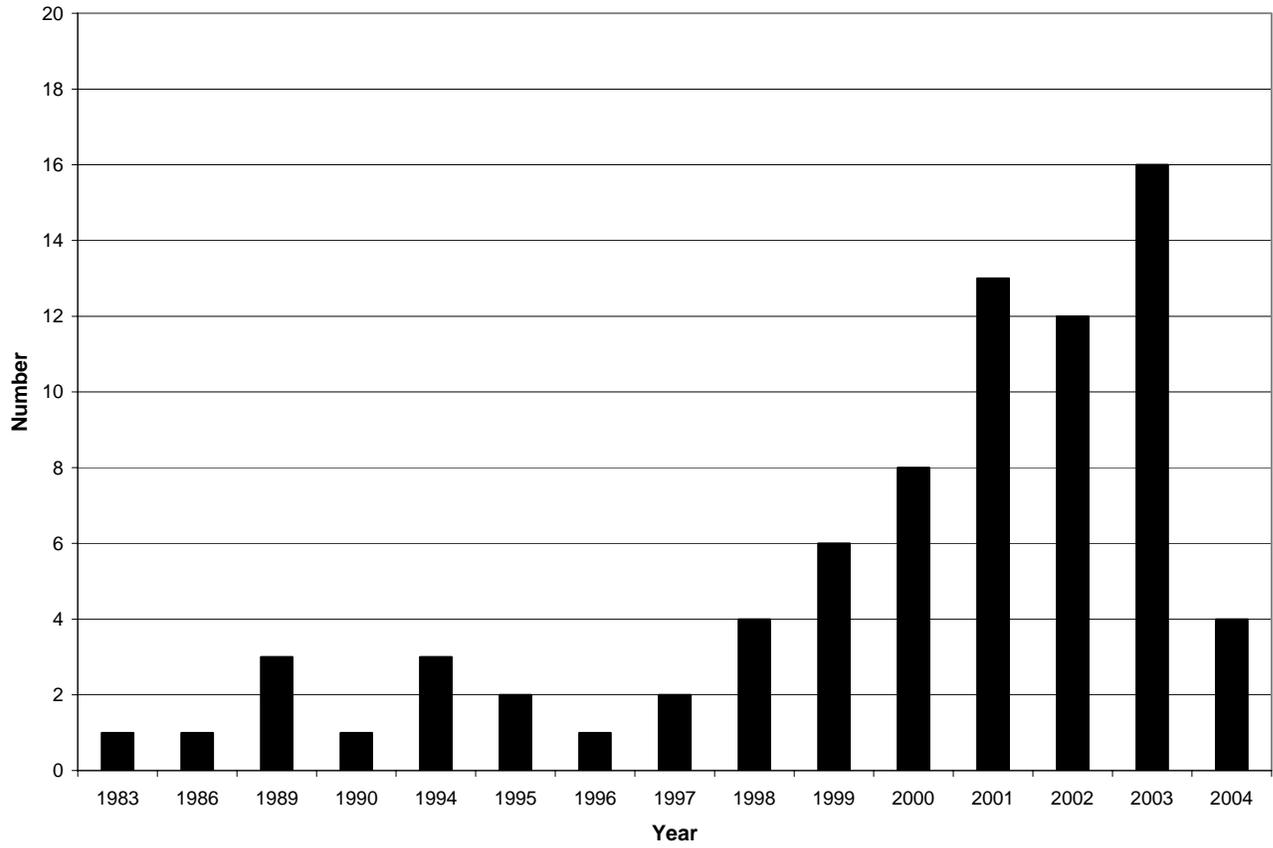
<sup>a</sup>One person excluded due to missing information; two were excluded that worked exclusively outside the building (either outside or portable units)

<sup>b</sup>Four persons worked in the upper wing and portable units (see definition on p. 4)

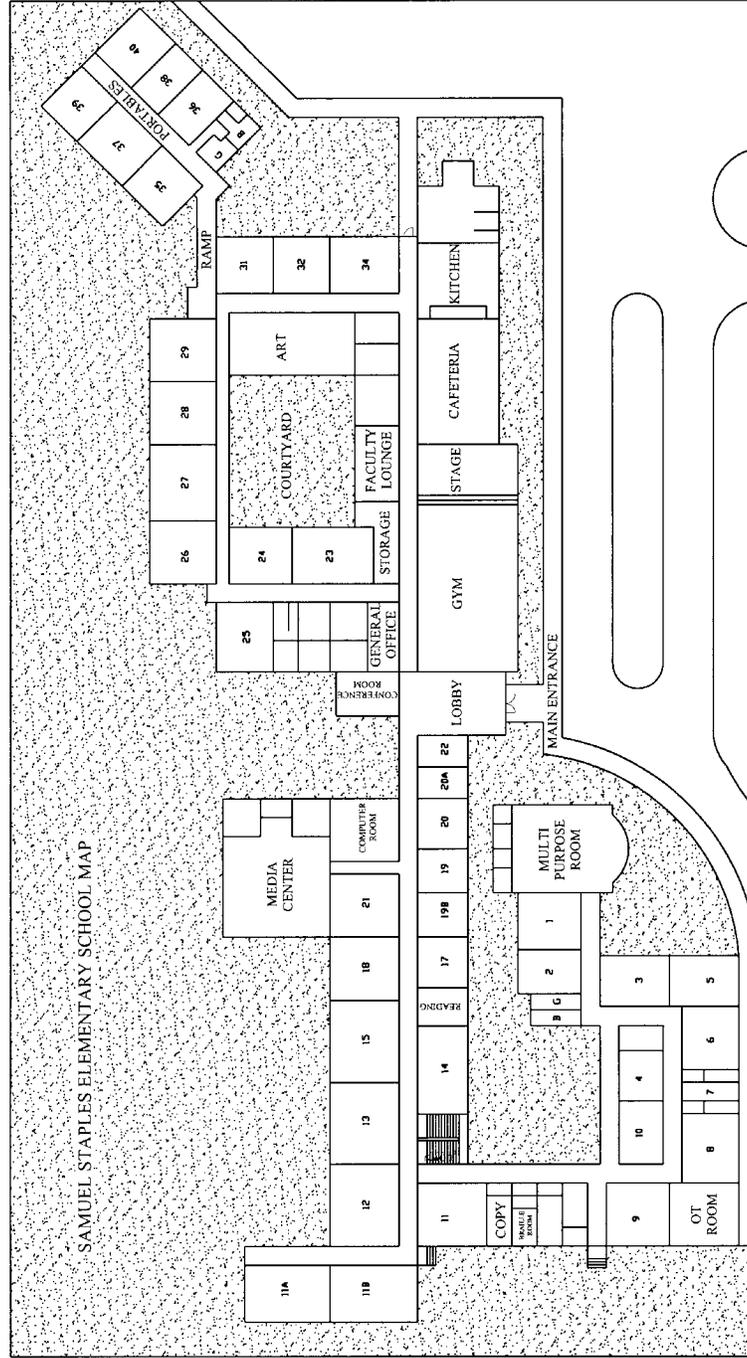
<sup>c</sup>Seven persons worked in both wings and the portable units (see definition on p. 4)

\*\*Statistically significant at  $p < 0.05$ , based on chi-square

**FIGURE 1. DATE BUILDING-RELATED SYMPTOMS STARTED**



**APPENDIX A. FLOOR PLAN OF SAMUEL STAPLES ELEMENTARY SCHOOL**



## **APPENDIX B. QUESTIONNAIRE**

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
CENTERS FOR DISEASE CONTROL AND PREVENTION  
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

Samuel Staples Elementary School  
Easton, CT  
HETA-2004-0138

The National Institute for Occupational Safety and Health (NIOSH) is a part of the United States Public Health Service and an institute within the Centers for Disease Control and Prevention (CDC) that is concerned with workplace health and safety. We have received a Health Hazard Evaluation request to evaluate health concerns that may be related to your workplace environment. The purpose of this evaluation is to identify the prevalence and work-related patterns of symptoms among employees, and to determine if there are areas in the building where symptom prevalence is elevated.

This is a questionnaire about your health history and work history. Although participation is entirely voluntary, NIOSH feels it is important for you to complete the questionnaire in order for the study to be successful. The overall study results (without names or other personal identifying information) will be provided to the requesters and the faculty and staff at Samuel Staples Elementary School; management is required to post a copy of the final report in a place accessible to employees for a period of 30 days. In addition, if you so request, NIOSH will send you a copy of the final report.

All medical and other personal information that you provide NIOSH is considered confidential in accordance with the Privacy Act of 1974 (Public Law 93-579). The information you provide NIOSH will be used for statistical and research purposes and will be summarized so that no individual is identified. All information is stored at NIOSH until destroyed. Management will not see your response.

**“BY COMPLETING THIS QUESTIONNAIRE, YOU INDICATE YOUR  
CONSENT TO PARTICIPATE IN THIS STUDY.”**

**Thank you for your participation.**

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Public reporting burden of this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to CDC/ATSDR Reports Clearance Officer, 1600 Clifton Road NE, MS D-24, Atlanta, Georgia 30333; ATTN: PRA (0920-0260).

1. Date: \_\_ \_\_/\_\_ \_\_/2004
  
2. Name: \_\_\_\_\_  
                    First                    MI                    Last
  
3. Date of Birth: \_\_ \_\_ / \_\_ \_\_ / \_\_ \_\_ \_\_ \_\_  
                    Month    Day    Year
  
4. Gender:       1. \_\_\_ Male  
                    2. \_\_\_ Female
  
5. Ethnicity (Please choose one):  
                    1. \_\_\_ Hispanic or Latino  
                    0. \_\_\_ Not Hispanic or Latino
  
6. Race (Please choose all that apply):  
                    1. \_\_\_ American Indian or Alaska Native  
                    2. \_\_\_ Asian  
                    3. \_\_\_ Black or African American  
                    4. \_\_\_ Native Hawaiian or Other Pacific Islander  
                    5. \_\_\_ White

7.1 During the past 12 months have you had wheezing or whistling in your chest at any time? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

7.2	Have you had wheezing or whistling in your chest one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
7.3	When you were away from the school was the wheezing or whistling:	1.Same ___ 2.Worse ___ 3.Better ___
7.4	In what month and year did you first have wheezing or whistling in your chest?	___ / ___ Mo. Year

8.1 During the past 12 months have you had chest tightness? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

8.2	Have you had chest tightness one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
8.3	When you were away from the school was the chest tightness:	1.Same ___ 2.Worse ___ 3.Better ___
8.4	In what month and year did you first have chest tightness?	___ / ___ Mo. Year

9.1 During the past 12 months have you had shortness of breath? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

9.2	Have you had shortness of breath one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
9.3	When you were away from the school was the shortness of breath:	1.Same ___ 2.Worse ___ 3.Better ___
9.4	In what month and year did you first have shortness of breath?	___ / ___ Mo. Year

10.1 During the past 12 months have you had cough? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

10.2	Have you had cough one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
10.3	When you were away from the school was the cough:	1.Same ___ 2.Worse ___ 3.Better ___
10.4	In what month and year did you first have cough?	___ / ___ Mo. Year

11.1 During the past 12 months have you been awakened by an attack of breathing difficulty? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

11.2	Have you been awakened by an attack of breathing difficulty one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
11.3	When you were away from the school was the awakening by attacks of breathing difficulty:	1.Same ___ 2.Worse ___ 3.Better ___
11.4	In what month and year were you first awakened by an attack of breathing difficulty?	___ / ___ Mo. Year

12.1 During the past 12 months, have you had shortness of breath when hurrying on level ground or walking up a slight hill? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

12.2	Have you had shortness of breath when hurrying on level ground or walking up a slight hill one or more times per week in the past 4 weeks?	1.Yes ___ 0.No ___
12.3	When you were away from the school was this shortness of breath:	1.Same ___ 2.Worse ___ 3.Better ___
12.4	In what month and year did you first have this shortness of breath?	___ / ___ Mo. Year

13.1 During the past 12 months have you had cough with phlegm? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

13.2	Have you had cough with phlegm one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
13.3	When you were away from the school was the cough with phlegm:	1.Same ___ 2.Worse ___ 3.Better ___
13.4	In what month and year did you first have cough with phlegm?	___ / ___ Mo. Year

14.1 During the past 12 months have you had episodes of fever and chills? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

14.2	Have you had episodes of fever and chills one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
14.3	When you were away from the school were these episodes of fever and chills?	1.Same ___ 2.Worse ___ 3.Better ___
14.4	In what month and year did you first have episodes of fever and chills?	___ / ___ Mo. Year

15.1 During the past 12 months have you had episodes of flu-like achiness or achy joints? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

15.2	Have you had episodes of flu-like achiness or achy joints one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
15.3	When you were away from the school was the flu-like achiness or achy joints:	1.Same ___ 2.Worse ___ 3.Better ___
15.4	In what month and year did you first have episodes of flu-like achiness or achy joints?	___ / ___ Mo. Year

16.1 During the past 12 months have you had unusual tiredness, fatigue, or drowsiness? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

16.2	Have you had unusual tiredness, fatigue, or drowsiness one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
16.3	When you were away from the school was the unusual tiredness, fatigue, or drowsiness:	1.Same ___ 2.Worse ___ 3.Better ___
16.4	In what month and year did you first have unusual tiredness, fatigue, or drowsiness?	___ / ___ Mo. Year

17.1 During the past 12 months have you had difficulty remembering things or concentrating? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

17.2	Have you had difficulty remembering things or concentrating one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
17.3	When you were away from the school was the difficulty remembering things or concentrating:	1.Same ___ 2.Worse ___ 3.Better ___
17.4	In what month and year did you first have difficulty remembering things or concentrating?	___ / ___ Mo. Year

18.1 During the past 12 months have you had dizziness or lightheadedness? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

18.2	Have you had dizziness or lightheadedness one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
18.3	When you were away from the school was the dizziness or lightheadedness:	1.Same ___ 2.Worse ___ 3.Better ___
18.4	In what month and year did you first have dizziness or lightheadedness?	___ / ___ Mo. Year

19.1 During the past 12 months have you had headaches? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

19.2	Have you had headaches one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
19.3	When you were away from the school were the headaches:	1.Same ___ 2.Worse ___ 3.Better ___

20.1 During the past 12 months have you had any episodes of stuffy, itchy or runny nose? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

20.2	Have you had a stuffy, itchy or runny nose one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
20.3	When you were away from the school was the stuffy, itchy or runny nose:	1.Same ___ 2.Worse ___ 3.Better ___

21.1 During the past 12 months have you had sneezing? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

21.2	Have you had sneezing one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
21.3	When you were away from the school was the sneezing:	1.Same ___ 2.Worse ___ 3.Better ___

22.1 During the past 12 months have you had dry or itchy skin? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

22.2	Have you had dry or itchy skin one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
22.3	When you were away from the school was the dry or itchy skin:	1.Same ___ 2.Worse ___ 3.Better ___
22.4	In what month and year did you first have dry or itchy skin?	___ / ___ Mo. Year

23.1 During the past 12 months have you had any episodes of watery, itchy eyes? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

23.2	Have you had watery or itchy eyes one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
23.3	When you are away from the school were the watery or itchy eyes:	1.Same ___ 2.Worse ___ 3.Better ___
23.4	In what month and year did you first have watery or itchy eyes?	___ / ___ Mo. Year

24.1 During the past 12 months have you had burning eyes? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

24.2	Have you had burning eyes one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
24.3	When you are away from the school were the burning eyes:	1.Same ___ 2.Worse ___ 3.Better ___
24.4	In what month and year did you first have burning eyes?	___ / ___ Mo. Year

25.1 During the past 12 months have you had a sore or dry throat? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

25.2	Have you had a sore or dry throat one or more times per week in the last 4 weeks?	1.Yes ___ 0.No ___
25.3	When you are away from the school was the sore or dry throat:	1.Same ___ 2.Worse ___ 3.Better ___
25.4	In what month and year did you first have a sore or dry throat?	___ / ___ Mo. Year

26.1 During the past 12 months have you had a cold? 1.Yes \_\_\_ 0.No \_\_\_

IF YES:

26.2	Have you had a cold in the last 4 weeks?	1.Yes ___ 0.No ___
26.3	How many times have you had a cold in the last 12 months?	_____ Times

27.1 During the past 12 months have you had sinusitis or sinus problems? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

27.2	Was it confirmed by a doctor?	1.Yes ___ 0.No ___
27.3	Have you had sinusitis or sinus problems in the last 4 weeks?	1.Yes ___ 0.No ___
27.4	How many episodes of sinusitis or sinus problems have you had in the last 12 months?	_____Times
27.5	When you were away from the school were the sinusitis or sinus problems: 1.Same ___ 2.Worse ___ 3.Better ___	
27.6	In what month and year did you first have sinusitis or sinus problems?	___/___ Mo. Year

28.1 During the past 12 months have you had pneumonia? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

28.2	Was it confirmed by a doctor?	1.Yes ___ 0.No ___
28.3	Have you had pneumonia in the last 4 weeks?	1.Yes ___ 0.No ___
28.4	How many times have you had pneumonia in the last 12 months?	_____Times

29.1 During the past 12 months have you had bronchitis? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

29.2	Was it confirmed by a doctor?	1.Yes ___ 0.No ___
29.3	Have you had bronchitis in the last 4 weeks?	1.Yes ___ 0.No ___
29.4	How many times have you had bronchitis in the last 12 months?	_____Times

30.1 Has a doctor ever told you that you have asthma? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

30.2	Date of asthma diagnosis:	___/___ Mo. Year
30.3	Do you still have asthma?	1.Yes ___ 0.No ___

31.1 Has a doctor ever told you that you have hypersensitivity pneumonitis? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

31.2	Date of hypersensitivity pneumonitis diagnosis:	___/___/___
		Mo. Year

32.1 Have you ever smoked cigarettes regularly? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

32.2	Do you still smoke cigarettes?	1.Yes ___ 0.No ___
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33.1 What was the date you started working at Samuel Staples Elementary School?

\_\_\_/\_\_\_/\_\_\_  
Mo. Year

34.1 Please indicate your current job title:

- 1. \_\_\_ Classroom Teacher
- 2. \_\_\_ Special Subject Teacher
- 3. \_\_\_ Special Education Teacher
- 4. \_\_\_ Office Staff
- 5. \_\_\_ Administration
- 6. \_\_\_ Paraprofessional
- 7. \_\_\_ Custodian
- 8. \_\_\_ Technical Support
- 9. \_\_\_ Cafeteria Worker
- 10. \_\_\_ Senior Center Worker
- 11. \_\_\_ Other (specify \_\_\_\_\_)

35.1 Please list the room numbers where you have spent the majority of your time in the last 4 weeks while at Samuel Staples Elementary School (please list in order starting with where you spent most of your time):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

36.1 Have you had symptoms that you think may be related to the school? 1.Yes \_\_\_ 0.No \_\_\_  
IF YES:

36.2	When did the symptoms begin?	___/___/___
		Mo. Year
36.3	Do you still have the symptoms?	1.Yes ___ 0.No ___
36.4	Please list the rooms where you feel you have building-related symptoms:	_____ _____ _____
36.5	What are the symptoms?	_____ _____

37.

During the **LAST FOUR WEEKS YOU WERE AT WORK**, how often have you experienced each of the following environmental conditions while working in this building?

CONDITIONS	CHECK ONE OF THE FOLLOWING:			
	A. Not in last 4 wks	B. 1-3 days in last 4 wks	C. 1-3 days per week in last 4 wks	D. Every or almost every workday
37.1 Too much air movement				
37.2 Too little air movement				
37.3 Temperature too hot				
37.4 Temperature too cold				
37.5 Air too humid				
37.6 Air too dry				
37.7 Tobacco smoke odors				
37.8 Musty or moldy odor				
37.9 Engine fumes				
37.10 Photocopier emissions				
37.11 Unpleasant chemical odors				
37.12 Other unpleasant odors (e.g., body odor, food odor, perfume)				

38.1 Do you have any comments or concerns that might contribute to our investigation?

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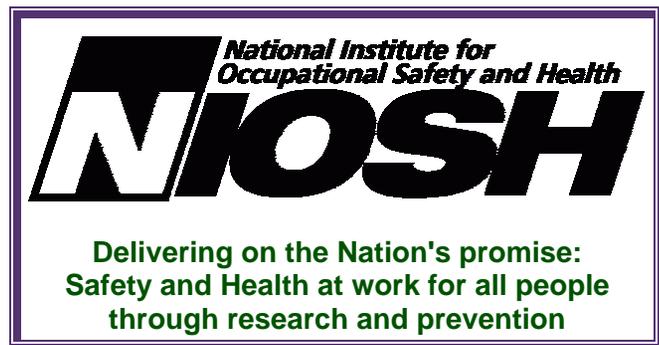
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