

# Arbor Heights Indoor Air Quality Investigation Interim Report

Arbor Heights Elementary PTSA  
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## Indoor Air Quality Investigation Arbor Heights Elementary PTSA

### **Introduction**

Envirotest Research was brought in to investigate and identify sources of poor indoor air quality that may be the cause of the complaints from parents and teachers. Envirotest's experience at several school districts has been that conducting symptom surveys of the teachers provided clues to help identify the location of indoor air quality problems. The analysis of the symptom surveys provides information that reduced investigation time, testing costs, and identified types of hidden mold that are found inside building walls or ceilings.

### Task Description Overview

An initial walk-through of the school revealed moldy odor is in the hallways and several classrooms. There have been reports of asbestos problems and water accumulation under the portables. An investigation of the crawlspace confirmed presence of water and mold in the crawlspace. It was reported that tests by Seattle school district confirmed asbestos and water in the crawlspace.

The portables were installed in the late 1940s or 1950s. There have been reports of roof leaks and hot water heating system leaks in the building and portables over several years.

Symptom surveys were conducted to identify areas of the school that have had water damage and to evaluate symptoms of individuals in those parts of the buildings.

Comparison of the results of the symptom surveys to a database of symptoms and molds from other schools can identify rooms that may have hidden mold inside sheet rock walls. Symptom surveys of about 23 teachers and staff were conducted June 14 and 15. Testing was conducted of dust samples from some rooms likely to have molds found in water damaged building materials. Seven rooms were identified as likely to have hidden mold growing inside the sheet rock walls or ceilings. About 11 other rooms were identified as locations likely to have water damaged building materials where dust samples should be collected but may not be hidden inside walls. Discussions of findings in each room and remediation recommendations are listed.

## Discussion of Results

Symptom surveys of approximately 23 teachers and staff were conducted June 14 and 15, 2005. Evaluation of the results of these surveys provided insights into the history of water problems and mold problems in the building. Some of the water problems have been ongoing for several years. A water problem in the portable wing that includes 9 and 10 occurred in November 1999. The date of the water damage was documented in a November 23, 1999, e-mail to Ed Heller from Lynn Salter. Also staff members from other parts of the building reported coughing, sneezing, and dry retching when they entered the hallway between rooms 9 and 10. The symptoms were so severe that a staff member was unable to conduct work in those rooms and reported that she lost three days of work following exposure while attempting to work in those rooms. I do not have a record of the response to the report of water damage. Reportedly, Labor and Industries (L&I) came out to the school and concluded that there was excessive water in or underneath the portables 9 and 10.

Temperature control in the portables has been an ongoing problem. There are reports of inadequate temperature control as early 1986. The low temperature of the classrooms in November 1999 was a contributing factor to the water problem in that the rooms were not warm enough to dry the water damage. The temperature was reported to be less than 60 degrees during the day.

The ventilation system for the portables is designed to have cross flow ventilation with air entering from the Univent and exiting on the opposite side of the room through a grill in the ceiling or inside the wooden cabinets. In some portables the exhaust grills were blocked with cardboard, by what appeared to be old filter material, or by books stacked in front of the grill. In room 16 the filter had been removed and was not replaced. Light from the roof was visible through the grill.

Several teachers reported that controlling room temperature with the Univent is inadequate. Often they were inadequate to keep the room warm in winter. At other times the heat did not shut off and the rooms were too hot. The only control they found worked was turning off the fan, which also shuts off the fresh air supply from outside. The cause of the overheating / fresh air problems must be resolved.

There may be multiple problems or combination of problems that contribute to the heating / fresh air problems. The exhaust in the wooden cabinets appears to be unregulated allowing for heat lost from a chimney effect. The heat exchanger capacity of a single Univent may be overtaxed in winter or the portables under insulated. Also, airflow through the room may be reduced due to restrictions from a blockage of the

exhaust vent and the wooden cabinets. Several classrooms had books or papers stacked against the grill for the exhaust.

In nearly all of the portable classrooms, the roof drain chase behind the tall closet in the wooden cabinets has evidence of water intrusion. In some classrooms the plywood of the cabinets has water stains on the surface and evidence of surface mold and delamination of the plywood. Teachers copy paper supplies in the cabinets were water damaged but not replaced. The teachers provide their own copy paper for the classrooms.

### Symptom Survey Results.

Teachers reported working with symptoms characteristic of mold or mycotoxin exposure for years. The teachers reported the symptoms diminish or go away during the school breaks.

Effects of the water damage and poor indoor air quality on children were not the objectives of this study. Therefore, children or their parents were not interviewed for symptoms. Several teachers reported children affected by indoor air quality in their classrooms. Blood tests of selected individuals should be conducted for the mold panel 3B by Immunoscience's Laboratory. The testing should be conducted within a week of exposure to be indicative of the conditions in the classroom. The results of the blood tests will indicate whether the children were affected by the conditions in the room.

It is my experience that air testing of classrooms is not a productive use of funds to identify problem areas. Analysis of dust is more likely to provide useful information. PCR is the definitive test for mold in dust but identification is limited to the list of molds in the test.

### Building materials

The main building has primarily concrete or plaster and lathe walls. The ceiling tiles appeared to be cellulose with glue attaching the tiles to the ceiling, which may also grow mold. Although the windows show leaks in the corners, the water stains on the walls appeared to be limited to efflorescence and breakdown of the plaster. Mold growth was not evident. Some of the wood casing or shelves in the library near the windows show evidence of water damage.

The wall design and building materials used in the portables did not appear to foster mold growth unless repeated water intrusion occurred. The sheetrock in the walls appeared to be a plaster type material covered with heavy paper. The sheetrock in the walls rests on a

three-inch wood baseboard which keeps the sheetrock off the floor. The baseboard is covered by cove base. This design keeps the sheetrock above water pooling on the floor. Sheetrock used in remodeling is not of the same type of material and may be more likely to foster mold growth.

Dirt in the crawlspace saturated with water provides conditions favoring mold growth on the surface of the dirt. The surface area is equivalent to the total number of square feet in the classroom. The ventilation or pipe chase draws air from the crawlspace into the pipe chase or into the classroom by a chimney effect. The inlet to the Univent is less than two feet from one of the four the crawlspace vents in the foundation.

Some classrooms were recently thoroughly cleaned. A dust sample was collected from Room 16. Horizontal surfaces including the top of the florescent lights had very little dust. A PCR test of the dust identified only two types of mold in the dust: *Cladosporium cladosporioides* and *Paecilomyces variotii*. *Cladosporium* is one of the predominant molds found in air samples outdoors. *Paecilomyces* is known to be associated with eye problems and infections of tear ducts.

Asbestos analysis of the dust by TEM did not show a trace of asbestos. Richard Staudt reported in his May 27, 2005 e-mail to Scott Roed that extended cleaning in that classroom was conducted December 2004. Our test results confirm the thoroughness of the extended cleaning.

The crawlspace under portables 16 and 17 has extensive water accumulation. See photographs. There is a history of water under the portables over several years. In 1999 L&I concluded that there was water under portables 9 and 10. The source of water under the portables has not been conclusively identified. Some of the possible sources are reported to be: 1) heating water pipe leaks; 2) surface water drainage from the playground; 3) plumbing leaks from the roof drains or pressurized plumbing. Refer to the photographs of water under the portables.

Mold growth is evident on the surfaces of the joists under the portables. A large area of mold is under the door on the west side of room 16. See photographs.

In room No. 17, moisture in the crawlspace or leaks from the roof drain through the pipe chase have rotted the floor. See photographs room 17.

The plywood in the tall closet is delaminated from repeated water leaks in room 15. See photographs of white mold on the surface of the plywood wood in the back and floor of the closet, and the delaminated plywood shelf of the closet.

The rubber backed area rugs under the water coolers in the hallways are another source of bacteria and mold growth. The carpets were saturated with water when I was at the school. There was a noticeably moldy odor in the hallways near the carpets. The carpets have a rubber backing, which contain the water within the area rug.

#### Fungal Test Results of Water Cooler Area Rugs.

The samples were taken after the students were out of class. The hall carpet was dry when the dust sample was collected from the area carpet. The results from Room 15 are in line with what I would have predicted based on symptoms from the symptom survey. The results from the hall carpet indicate very high contamination of mold in the carpet. It is likely there was high bacterial contamination as well, but tests for bacteria were not conducted. There was a noticeable decrease in moldy odor in the downstairs hallways once the area carpets under the water coolers had dried out.

The high fungal concentrations in the hall carpet are understandable given that the carpets only dried out for a few days on weekends and during holidays. The rest of the time the carpets were wet and dirt from student foot traffic provides a food source for the mold growth.

The sample collected in Room 15 was from the carpet a few feet in front of the hall closet and near the teacher's desk. The dust sample was from four square feet of carpet.

Some of the symptoms associated with the various molds are: *Paecilomyces variotii* can infect tear ducts and cause eye irritation. *Penicillium chrysogenum* has been found in other schools where they had high instances of respiratory problems. Symptoms of other molds will be discussed in the final report.

#### Water Damage Observations by Room

##### Room No. 1

There is a small dark stain on the ceiling near the corner of the room. This should be tested to determine if it is mold.

##### Room No. 2

Water stains or mold were not evident. The room above, room 22, had a leak in the heating system last fall.

### Room No. 3

Water stains or mold were not evident.

### Room No. 4.

Mold was not evident. There is evidence of water damage. The plaster is swelling under the windows.

### Room No. 5 and 6 -- Library

The plaster was swelling under the windows and at the corners. Mold growth is not evident in the building materials under the windows. The carpet has been water damaged by a leak in the Univent. The carpet is water stained. There is a noticeable moldy odor in the library. The carpet should be cleaned with a mycotoxin solvent.

### Room No. 7

There are signs of a water leak near the tall closet, and in the ceiling near the center of the room.

### Room No. 8.

Water damage is in portions of the ceiling, and near the tall closet.

### Room No. 9

There is a history of water damage in this room in the hall from November 1999. There are several locations with stained ceiling tiles that have been painted over. It appears there have been several roof leaks because the water damaged ceiling tiles are spaced throughout the ceiling. It was reported there was water in the crawlspace under the classroom in 1999. Although the source of the water was stopped, removal of water damaged building materials was not reported. There is still evidence of water damage in the hall next to room 9.

The sheetrock in the ceiling above the stained ceiling tiles should be checked for mold growth and the water stained materials should be replaced. The ceiling should be replaced with materials that do not contain cellulose.

Room No. 10.

There is visible evidence of water stained ceiling tiles in several locations.

Room No. 11 Staff Room

Recent water intrusion was reported near the tall closet during the last year. There is visual evidence of water staining near the tall closet.

Room No. 12

Water stains or mold were not evident.

Room No. 13

Water stains or mold were not evident.

Room No. 14.

There is a moldy odor or stagnant odor in the room. But there were no visible water stains. There is an access hole in the closet that has not been sealed. There is visible evidence of water damage near the tall closet. Based on symptom survey results, the room should be tested for *Stachybotrys*. This room needs further investigation.

Room No. 15.

There is visible water damage in the tall closet. The shelves of the closet have delaminated. There is mold growth on the sheetrock behind the closet wall. It is likely that the water damage occurred over a long period of time. Additional investigation of the adjacent sheetrock should be conducted. The carpet should be cleaned with a mycotoxin solvent to remove mold mycotoxins.

The narrow rooms between rooms 15 and 16, and psychologist's office.

There is visible evidence of water damaged sheetrock under the windows in these small rooms. The water damage was extensive enough to remove the paint from the wall but the sheetrock was not replaced. There is a strong moldy odor in the psychologist's office. The sheetrock under the windows is swollen from previous water damage.

#### Room No. 16.

The crawlspace has nearly 50 percent of the area under water. The joists have visible mold growth particularly near the door to the outside. There is a strong moldy odor in the access panel above the tall closet. The room was recently cleaned in December 2004. There were no visible dust accumulations in the room. The mold should be removed from the surface of the joists in the crawlspace. At least 1/8 inch of wood should be removed to be sure to remove the mold and hiving. Some boards particularly under the area near the door to the outside may have to be replaced. A structural engineer should be contacted to evaluate the effects on structural changes made by removal of the surface of the wood.

The room should be sealed from air intrusion from the crawlspace. Given the structure of the unit it may not be possible to seal it completely. Alternatively the crawlspace should be placed under negative pressure as compared to the classroom. An exhaust fan in the crawlspace may provide sufficient difference in pressure to prevent airflow from the crawlspace into the classroom. Location of the exhaust should be on another side of the building from the air intake for the Univent.

#### Room No. 17

There is a noticeable moldy odor in the room. There is evidence of water damage in the corner of the room near the tall closet. The floor in front of the tall closet has rotted nearly completely through. See Photographs of the floor. There is obvious water damage to the ceiling near the tall closet. There is water in the crawlspace under room No. 17. See photographs of the crawlspace. Water damaged materials should be replaced. The same precautions for room 16 should be taken in room 17.

#### Room No. 18.

There is a slight moldy odor in the room. There is evidence of multiple water leaks in the ceiling. There are water stains near the ceiling in the hall opposite the tall closet of room No. 18. There are high moisture readings in the hallway wall. See photographs of moisture meter measurements of water stained bricks. Air from the crawlspace should not be allowed into the room. The ceiling of the tall closet crumbled when they worked on it earlier in the year. Samples should be collected from the ceiling near the tall closet.

#### Room No. 19.

It is likely that there are Penicillium/Aspergillus type molds in this room. The source of the mold growth was not determined. Further investigation should be conducted in this room.

Room No. 20.

Water stains or mold were not evident.

Room No. 21.

Water stains or mold were not evident.

Room No. 22.

Water damage to the ceiling tiles was not evident. A leak in the heating system was reported to have occurred last fall. The outside wall appears to be plaster. Mold growth was not evident.

Room No. 23.

Water stains or mold were not evident.

Room No. 24.

There are water stained ceiling tiles near the corner of the room next to the window. The ceiling tiles should be removed in any water damaged portions of the ceiling should be repaired. Cellulose containing materials that have been water damage should be replaced.

Room No. 25.

No visible mold growth or stained ceiling tiles. There is evidence of water damage under or near the windows. The damage appears to be limited to cracked plaster. Mold growth is not visible.

Room No. 26.

There is evidence of previous water damage near the windows on either side. The left side of the window appears to have extensive water damage. The building materials

appear to be plaster. Mold growth is not evident. Source of the water from the windows should be determined and repaired.

#### Upstairs Conference Room.

Stained ceiling tiles were not evident. There was extensive water damage under the heating system on the South wall. The entire length of wall has cracked peeling molding and floor tiles. The wall under the window has been covered with steel plate. If there is water damage under the plate the plate does not allow the water to dry out which will result in mold growth behind the steel plate. The steel plate should be removed and the wall allowed to dry if there is water from leaking windows. The heating system should be repaired and water damaged insulation or wall materials should be replaced.

There is a roof vent in the ceiling. It was reported that odors from the first floor were noticeable in the upstairs conference room. A chimney effect of air rising from the first floor could account for the odors travel from the first floor to the conference room.

The water damaged walls, cove base, and flooring should all be replaced. These are areas of continuing mold growth. The wall should be examined for evidence of water damage under the steel plate. Water damaged materials should be replaced.

If the steel plate is reinstalled there should be a space between the wall and the steel plate to allow for air to dry the wall should a window leak occur.

The conference room has a common wall with the plumbing wall of the girls bathroom. Records should be checked to see if there is a history of leaks in the plumbing wall. There was no evidence of moisture at the time I checked the conference room.

#### General Recommendations

- ! The carpets in the upstairs halls should be cleaned with a mycotoxin solvent. The water coolers should not be on carpet. Samples from the downstairs carpet show evidence of mold growth from continued water spills.
- ! The vacuums used in the school should be replaced with HEPA vacuums. Otherwise the vacuums just recycle and redistribute the mold particles. See photograph of school vacuum.
- ! Water tolerant building materials should be used in the remediation. The cost benefits of using plaster instead of sheet rock are clearly evident in the main

building. There have been repeated water intrusions resulting in swelling under the windows, but mold growth did not occur in the walls. Wallboard containing paper or cellulose should not be used in the reconstruction. Concrete board does not contain cellulose and is a reasonable replacement for gypsum wallboard from a perspective of limiting mold growth.

- ! Roof drain replacements. A different roof drain that allows for movement between the roof and the drain pipe should be used. In room 15 the water damage is from water running down the outside of the drain pipe. Water leaks in the pipe or elbows were not found. Leaks from or near the roof drain appeared to be the primary water problem in the portables. The roof drain pipe is next to the tall closet which is where nearly all of the repeated water damage occurred.
- ! Additional sampling of the ceilings for toxigenic molds such as *Stachybotrys* should be conducted in rooms 7, 9, 10, 13, 18, and possibly 19. The ceiling adjacent to the tall closet in all portables should be checked for water damage.
- ! Carpeted areas in the main building and portables should be cleaned using a mycotoxin solvent.
- ! A different method of providing drinking water to the students should be used that keeps water from the carpet or floor.

Respectfully,

**ENVIROTEST Research Inc.**  
David R. Anderson, Ph.D.  
Toxicologist

## **Tables and Figures**

Arbor Heights Elementary Floor Plan

Room 15 and Water Cooler Carpet Dust Sample Analysis by PCR

Room 15 Dust Sample Analysis by Transmission Electron Microscopy(TEM) Qualitative

Room 16 Dust Sample Analysis by PCR

Room 16 Dust Sample Analysis by Transmission Electron Microscopy(TEM) Qualitative

Tape Sample of Mold on Pipe Insulation in Crawlspace