IAQS

Indoor Environmental Testing, Consulting, & More...

TN Tatem Middle School

Indoor Air Quality Assessment September 2016

Completed by Island Air Quality Services
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1 Report Summary

IAQS was contracted by Mr. Cleun Gaiton, Department of Education Facilities Manager, to carry out an indoor air quality assessment of five (5) rooms at the TN Tatem Middle School located at 60 Middle Road, Warwick.

An outline of the findings are as follows:

- Levels of airborne mould throughout were lower than those observed outdoors, although there are concerns with regards to the dominant levels of *Aspergillus* / *Penicillium* in Classroom 204 and the Art Classroom Supply Rooms. This suggests that a reservoir is present in each of these areas.
- Fungal contamination was found on each of the five (5) surfaces sampled in generally low levels, with evidence of active mould growth on the exhaust vent in the Art Classroom Supply Room East.
    - Of particular note is the presence of the toxigenic moulds *Chaetomium* on the surface tested in the Art Classroom Supply Room West vent, and *Stachybotrys* on the surface tested in the Art Classroom Supply Room East vent.
- Carbon dioxide, relative humidity, temperature and carbon monoxide levels at the time of testing were satisfactory.
- Relative humidities throughout were elevated above standards recommended for inhibition of mould growth.

Detailed discussion and recommendations can be seen in Section 6 of the report.

2 Introduction & Visual Assessment Notes

IAQS attended the TN Tatem Middle School on 28th September, 2016, to carry out a visual assessment and testing. The following notes provide a summary of conditions observed:

- Classroom 204:
  - Ceiling A/C unit is present but no climate control at time of testing
  - Surfaces were generally clean and uncluttered
  - Small section of ceiling tile was missing, exposing open ceiling space at time of testing
  - Water damaged ceiling tile present (Photo 1)
- Classroom 203:
  - Ceiling A/C unit is present, but no climate control at time of testing
    - Dust and / or fungal contamination present A/C vent (Photo 2)
  - Water damaged ceiling tile present (Photo 3)
  - Evidence of previous water damage present on walls (Photo 4)
  - Evidence of possible fungal growth present in cabinetry (Photo 5)
- Classroom 253:
  - Evidence of minor dust build-up present on upper surfaces (Photo 6)
  - Standing air-conditioner / dehumidifier operational at time of testing
  - No immediate evidence of water intrusion
- Art Classroom Supply Room West / East:
  - Neither room is climate controlled, but each has an exhaust fan installed
    - Both exhaust fans showed heavy dust build-up
  - Each room contained large amounts of stored materials with evidence of fungal growth (Photos 7 - 16)
  - The outside of each door showed discolouration consistent with possible fungal growth (Photos 17 & 18)
  - Heavy dust build-up, including insects and insect fragments, was present on surfaces and floors in each room

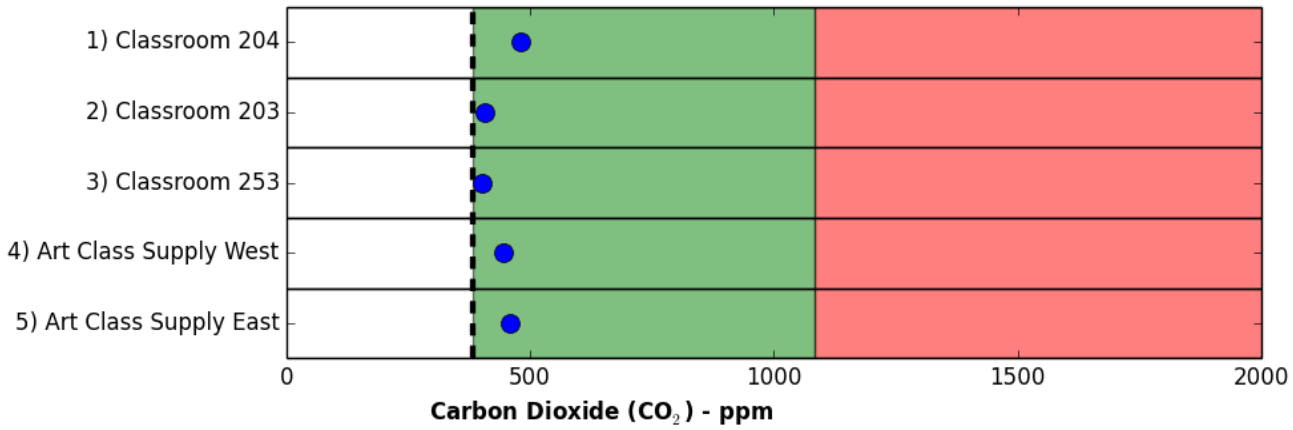
3 General Air Quality Results

3.1 Carbon dioxide

Outdoor carbon dioxide levels at the time of testing were 383 parts per million (ppm). ASHRAE standards indicate that levels of carbon dioxide 700 ppm or greater above outdoor levels suggests insufficient ventilation and introduction of fresh air within a building. On the day of testing this would be 1083 ppm.

At the time of testing levels of carbon dioxide in the test area fell well within recommended standards, comparable with those outdoors.

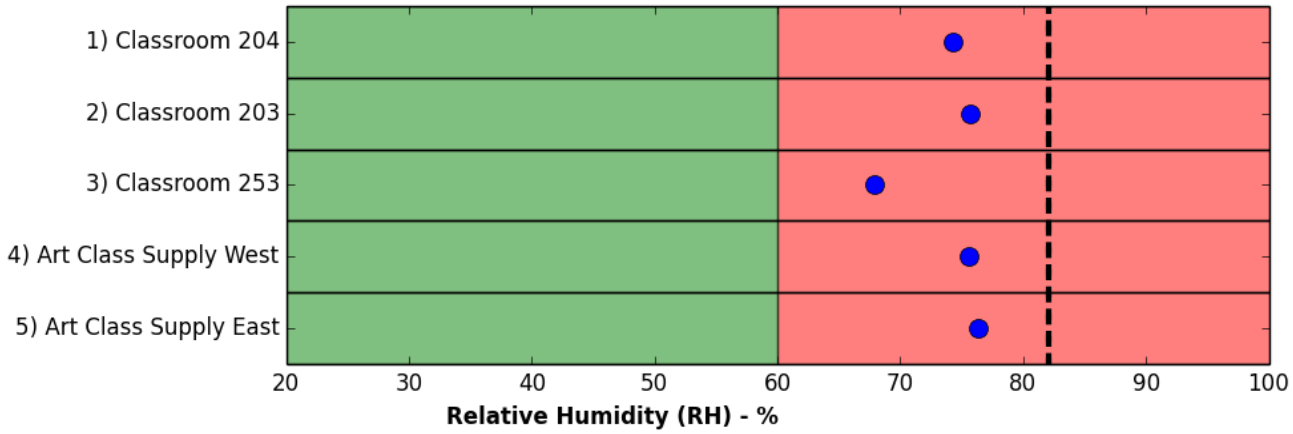
(Note: in each graph the dotted line represents the outdoor control)



3.2 Relative humidity

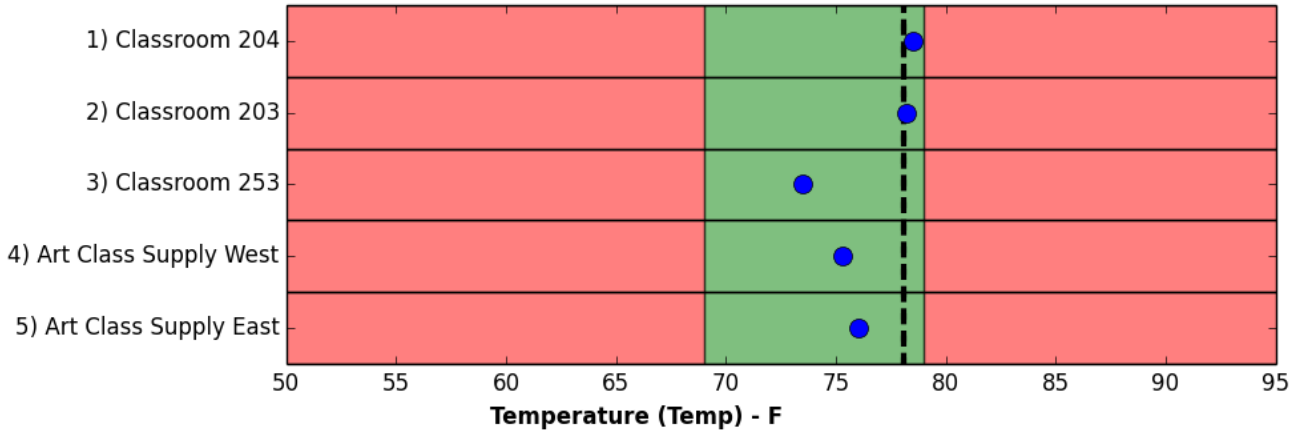
ASHRAE recommends that relative humidity levels within a building served by mechanical systems should be less than 65%. Levels above 70% are particularly conducive to fungal growth, while maintenance of humidity levels between 20% - 60% effectively inhibits growth.

Relative humidity in each test area exceeded recommended levels.



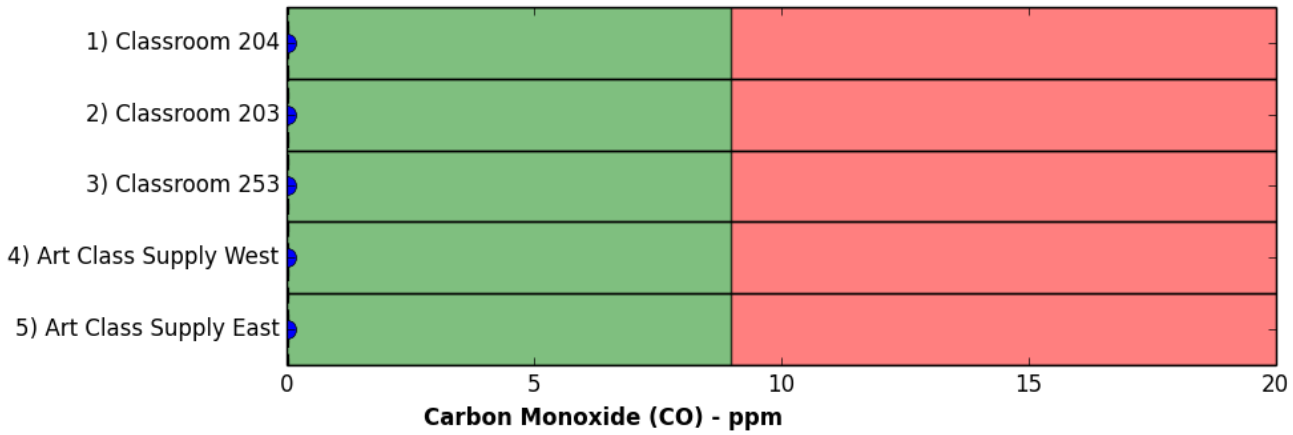
3.3 Temperature

ASHRAE recommends that temperature levels are maintained between 68 – 79°F for the greatest occupant comfort. Temperatures throughout the school test areas fell within recommended comfort parameters.



3.4 Carbon monoxide

ASHRAE standards indicate that levels of carbon monoxide exposure over 8 hours should not exceed 9ppm. No carbon monoxide was measured in the school test areas.



4 Airborne Mould

	Classroom 204	Classroom 203	Classroom 253
Total # of Spores	**1,010 spores/m^3**	**620 spores/m^3**	**1,940 spores/m^3**
Fungal Types Present (%)			
Ascospores	5.0	14.5	20.6
Aspergillus / Penicillium	74.3	6.5	22.7
Basidiospores	19.8	79.0	56.7
Cladosporium	-	-	-
Smuts / Myxomycetes / Periconia	-	-	-
Unidentifiable Spores	-	-	-
Pyricularia	-	-	-
Nigrospora	1.0	-	-

	Art Classroom Supply West	Art Classroom Supply East	Outdoor Control
Total # of Spores	**4,580 spores/m^3**	**6,810 spores/m^3**	**13,090 spores/m^3**
Fungal Types Present (%)			
Ascospores	0.9	1.5	23.7
Aspergillus / Penicillium	93.9	82.4	9.2
Basidiospores	4.4	16.2	65.9
Cladosporium	0.9		0.7
Smuts / Myxomycetes / Periconia	-	-	0.1
Unidentifiable Spores	-	-	0.2
Pyricularia	-	-	0.3
Nigrospora	-	-	-

Levels of airborne mould in the outdoor control were 13,090 spores/m^3 at the time of testing. The dominant moulds in the sample were Basidiospores.

Results for airborne mould levels in each test area were well below those observed outdoors. Despite this, concerns were raised in Classroom 204 and the Art Supply Rooms due to the dominant presence of the moulds *Aspergillus* / *Penicillium*. It should also be noted that levels of airborne mould in the Art Supply Rooms were considerably higher than those observed in other test areas.

5 Surface Mould

Five (5) surface samples were taken within the test areas, as follows:

Classroom 204 A/C Vent:

- Rare levels (1 – 10 spores/cm^2) Basidiospores
- Rare levels (1 – 10 spores/cm^2) Unidentifiable Spores

Classroom 203 A/C Vent:

- Rare levels (1 – 10 spores/cm^2) *Aspergillus* / *Penicillium*
- Rare levels (1 – 10 spores/cm^2) *Cladosporium*
- Rare levels (1 – 10 spores/cm^2) *Curvularia*
- Rare levels (1 – 10 spores/cm^2) *Torula*

Classroom 253 A/C Vent:

- Rare levels (1 – 10 spores/cm^2) Alternaria
- Rare levels (1 – 10 spores/cm^2) Ascospores
- Low levels (11 – 100 spores/cm^2) *Aspergillus* / *Penicillium*
- Rare levels (1 – 10 spores/cm^2) Basidiospores
- Rare levels (1 – 10 spores/cm^2) *Bipolaris* / *Drechslera*
- Low levels (11 – 100 spores/cm^2) *Cladosporium*
- Rare levels (1 – 10 spores/cm^2) *Curvularia*
- Rare levels (1 – 10 spores/cm^2) Smuts / Myxomycetes / Periconia
- Rare levels (1 – 10 spores/cm^2) *Nigrospora*
- Rare levels (1 – 10 spores/cm^2) Pithomyces
- Rare levels (1 – 10 spores/cm^2) *Tetraploa*

Art Classroom Supply Room West Exhaust Vent:

- Rare levels (1 – 10 spores/cm^2) *Chaetomium*
- Rare levels (1 – 10 spores/cm^2) *Cladosporium*
- Rare levels (1 – 10 spores/cm^2) Curvularia
- Rare levels (1 – 10 spores/cm^2) *Pestalotia*

Art Classroom Supply Room West Exhaust East:

- Rare levels (1 – 10 spores/cm^2) Ascospores
- Low levels (11 – 100 spores/cm^2) *Cladosporium* (including the presence of active growth)
- Rare levels (1 – 10 spores/cm^2) *Stachybotrys*
- Moderate levels (101 – 1000 spores/cm^2) *Penicillium* (including the presence of active growth)
- Rare levels (1 – 10 spores/cm^2) Pithomyces

Results of surface testing show that fungal contamination was present on each of the five (5) surfaces tested, in generally low levels. Evidence of active mould growth was present on the Art Classroom Supply Room West exhaust vent.

Of additional note is the presence of the moulds *Chaetomium* and *Stachybotrys* on vents in the Art Supply rooms. While levels were low, and no active mould growth was observed, these moulds are considered to be "toxigenic" and their presence on the exhaust vent surfaces suggests that they have been circulating in the air.

6 Discussion and Recommendations

Results of fungal testing carried at the TN Tatem Middle School on 28th September, 2016, indicate concerns regarding airborne moulds present in the Art Classroom Supply Rooms and, to a lesser degree, Classroom 204.

While levels of airborne mould in each of the test areas were lower than those outdoors at the time of testing, the Art Supply Rooms showed levels considerably higher than those in other rooms tested, suggesting a source of mould and / or insufficient ventilation. Additionally, the moulds *Aspergillus* / *Penicillium* were dominant in the Art Supply Rooms and Classroom 204. While these are very commonly observed outdoors, their dominant presence indoors suggests that a reservoir is present in the test area (typically water damage to building and / or cellulose materials).

Surface mould was present on each of the five (5) surfaces tested, including evidence of active growth on the exhaust vent in the Art Supply Room East. This active growth indicates that favourable conditions are present for mould growth (i.e. adequate nutrition and moisture).

Of particular note is the presence of the toxigenic moulds *Stachybotrys* and *Chaetomium* in the Art Supply Rooms. Their presence suggests that a source is, or has been present and is circulating through the air in the room. These moulds are observed as a result of repeated moisture damage to cellulose materials including paper and cardboard, as is stored in the rooms.

Relative humidities exceeded levels recommended standards for inhibition of mould growth in each of the test areas. Maintaining relative humidity levels below 60% (necessary to inhibit mould growth) in Bermuda can be very difficult without central air-conditioning. In cases where air-conditioning is not present or being utilized, adequate ventilation and air movement through opening of windows and doors, and utilization of fans, can aid in inhibiting settling and subsequent growth of mould spores.

Carbon dioxide, temperature, and carbon monoxide levels at the time of testing were satisfactory throughout.

6.1 Recommendations:

The following should take place in order to improve and maintain satisfactory air quality within the TN Tatem Middle School test areas:

- The Art Supply Rooms should be emptied and all surfaces cleaned. Any materials being stored showing evidence of possible fungal growth should be discarded and replaced as necessary.
    - Due to the levels and types of moulds observed in the air and on surfaces in the Art Supply Rooms, consideration should be given to contracting Government approved mould remediation contractors to carry out this work. This will ensure that efforts are made to prevent cross-contamination to adjacent areas, in addition to the use of proper PPE for personal protection of workers and school occupants.
- Methods of ventilation should be installed in the Art Supply Rooms to ensure air movement and climate control. This will aid in inhibiting mould growth on materials being stored.
- Plastic containers should be used to store materials in the Art Supply Rooms as these are easily wipeable and not porous. Ideally, materials should be stored in a way that allows air movement.
- An assessment of the ceiling space above Classroom 204 should be carried out to ascertain whether water damage has taken place leading to the growth of mould on surfaces.
- If any areas of bubbling paint on walls inside become apparent, they should be addressed as follows:
    - Vacuum affected areas with a HEPA vacuum to remove any loose dust or paint
    - Scrape walls to remove remaining bubbling paint
    - Wipe walls down with a detergent solution and run dehumidifier to allow drying and to draw any moisture from within the wall.
    - Wall can be painted once wet wiping treatment has dried.

- All water damaged ceiling tiles, and those immediately adjacent, should be removed and replaced.
- The cabinetry in Classroom 203 should be wiped down to remove surface contaminants.

Once this work has been carried out, the following should continue to maintain satisfactory air quality:

- Regular checks of the building envelope should take place to ensure any cracks are addressed as soon as they are noticed.
- Windows should be checked to ensure that they are water-tight. Any leaks should be repaired and materials which have been water damaged as a result of water intrusion through the windows should be removed and replaced.
- Ventilation should continue to be carried out daily. During the cooler and less humid months, windows should be left open when occupants are home to allow for a good exchange of fresh air. During the warmer humid summer months, windows should be opened for at least an hour each morning and another hour each afternoon or evening. Air conditioning units can otherwise be used for climate control.
- Servicing of the A/C's should take place on a regular basis. This should include addressing any areas of condensation leading to leaks and resulting staining on walls, or water damaged ceiling tiles.
- Cleaning products should be used as specified on the packaging, and diluted as necessary. Chemical odours (VOC's) can be harmful and strong concentrations should be avoided.
- Regular cleaning of the office should continue. This includes HEPA vacuuming followed by damp-wiping of all wipeable surfaces, including:
    - Work surfaces including desks
    - Storage surfaces including shelving, cabinetry and other fixtures in the classrooms
    - A/C vents (top and bottom surfaces)

Appendix I: General IAQ Results in TN Tatem Middle School

General IAQ Results collected during 28th September, 2016 Sampling

	Temperature (°F)	Relative Humidity (%)	Carbon Monoxide (ppm)	Carbon Dioxide (ppm)
Classroom 204	78.5	74.3	0.0	480
Classroom 203	78.2	75.7	0.0	408
Classroom 253	73.5	67.9	0.0	401
Art Class Supply West	75.3	75.6	0.0	445
Art Class Supply East	76.0	76.3	0.0	459
Outdoor Control	78.1	82.1	0.0	383

Appendix II: Methodologies and Equipment used: TN Tatem Middle School

Airborne mould sampling
Spore trap sampling is carried out so that a broad sample of airborne moulds may be collected for analysis. This method of sampling captures both viable ("alive") and non-viable ("dead") spores, thus allowing for an accurate view of the moulds in the air at the time of assessment.

Sampling for airborne mould was carried out using a spore trap sampler and Zefon Air-O-Cell cassettes. Samples were run for 5 minutes at 15 l/min.

Surface mould sampling
Sampling of dust and suspected mould contamination from surfaces is collected to confirm contamination and ascertain whether active growth is present. It is also an indicator of the types of mould that may have been in the air previously, though not necessarily at the immediate time of testing.

Sampling was carried out using a piece of clear tape which is placed on a glass slide for analysis once the sample has been collected. A 1 cm^2 sample was collected.

General Air Quality Testing
Carbon dioxide, carbon monoxide, relative humidity and temperature measurements (collectively referred to as "General Air Quality") were sampled using the TSI IAQ-CALC 7545 meter.

Carbon dioxide is not measured as a toxicity concern, but to give a measurement of whether ventilation within the building is adequate. Levels in office buildings which are mechanically climate controlled and house several employees are generally observed to be approximately 600ppm, while levels in residences are expected to be lower.

Carbon monoxide is a colourless and odourless toxic gas, and is of greatest concern in residences, where combustion sources (stoves, fireplaces and barbeques) are most commonly found. Carbon monoxide is also of particular concern in industrial workplaces and garages.

Relative humidity levels are particularly important when sampling for moulds within the building. If relative humidity levels are sustained above 70% for great periods of time, this can effectively promote mould growth.

Temperature measurements are collected to ascertain whether comfort levels are being maintained within a work place. Additionally, in circumstances in which temperature is low and relative humidity is high, concern for condensation is raised which may lead to fungal growth.

Appendix III: Photographs taken during visual assessment and testing

Photo 1: Water damaged ceiling tile present in Classroom 204

Photo 2: Evidence of dust / fungal accumulation on surface inside A/C unit in Classroom 203

Photo 3: Water damaged ceiling tile present in Classroom 203

Photo 4: Evidence of previous water bubble on wall in Classroom 203

Photo 5: Evidence of possible fungal growth in Classroom 203 cupboard

Photo 6: Dust build-up on surface of projector in Classroom 253

Photo 7: Supplies stored in Art Classroom Supply Room West (A)

Photo 8: Supplies stored in Art Classroom Supply Room West (B)

Photo 9: Supplies stored in Art Classroom Supply Room West (C)

Photo 10: Supplies stored in Art Classroom Supply Room West (D)

Photo 11: Supplies stored in Art Classroom Supply Room West (E)

Photo 12: Supplies stored in Art Classroom Supply Room East (A)

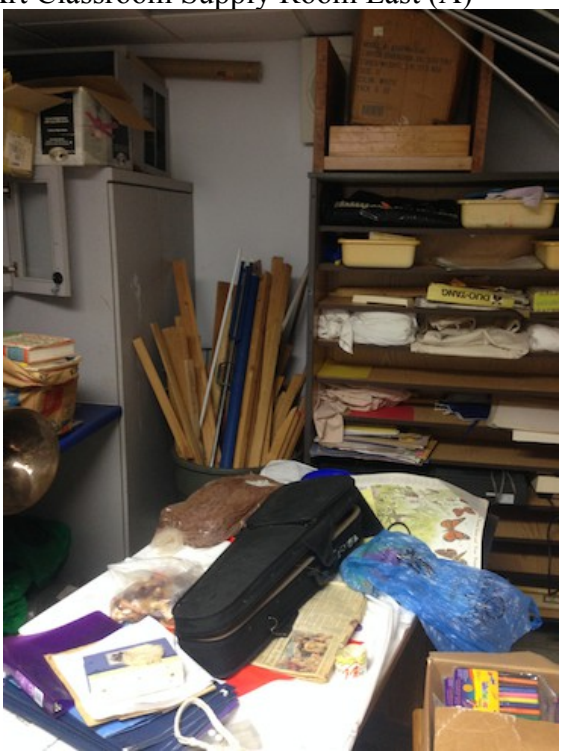


Photo 13: Supplies stored in Art Classroom Supply Room East (B)

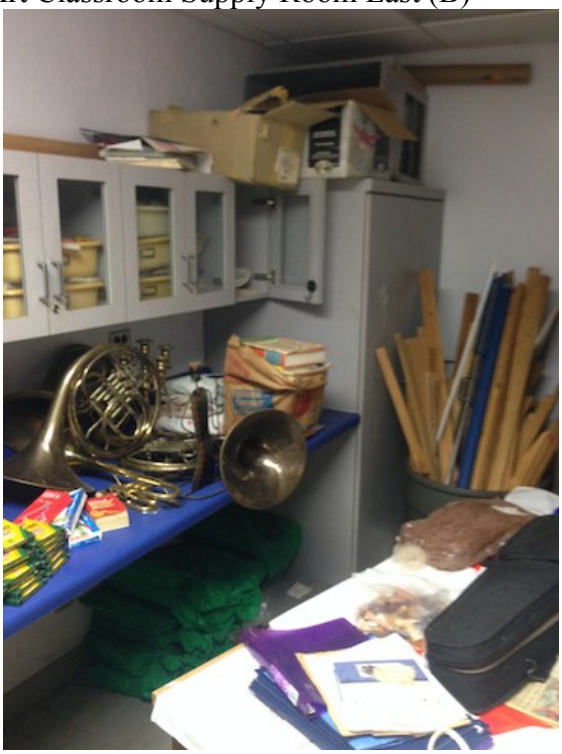


Photo 14: Supplies stored in Art Classroom Supply Room East (C)

Photo 15: Supplies stored in Art Classroom Supply Room East (D)

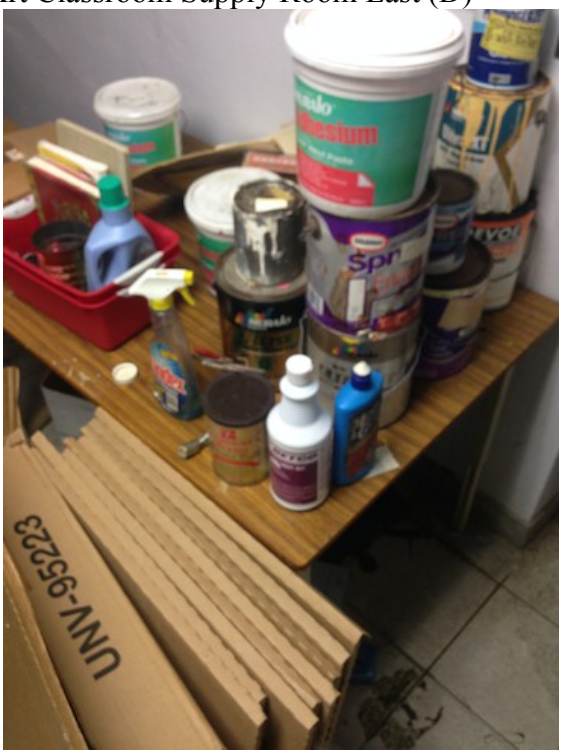


Photo 16: Supplies stored in Art Classroom Supply Room East (E)

Photo 17: Evidence of dust build-up / possible fungal growth on Supply Room West door

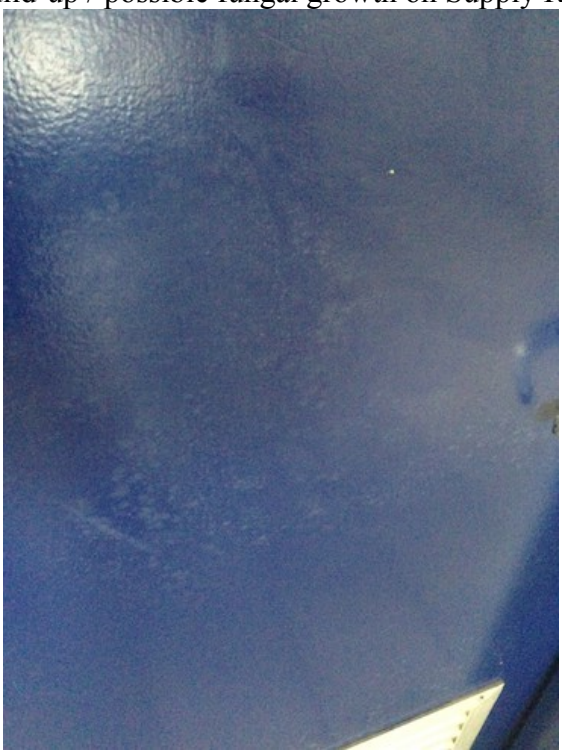


Photo 18: Evidence of dust build-up / possible fungal growth on Supply Room East door