Mold and Fungi Awareness

(Fungus 101)

Antelope Valley College

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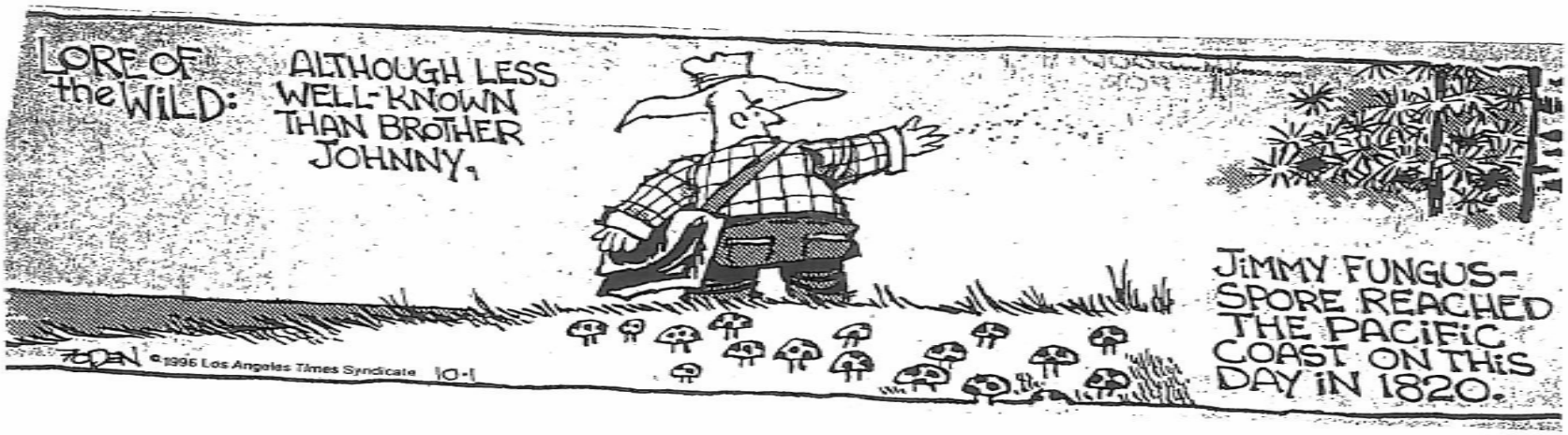
February 26 and 27, 2014


LORE OF the WILD:
ALTHOUGH LESS WELL-KNOWN THAN BROTHER JOHNNY,
JIMMY FUNGUS-SPORE REACHED THE PACIFIC COAST ON THIS DAY IN 1820.
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Mold and Fungi Awareness

Fungus
- Mushrooms
- Yeasts
- Rusts
- Molds
- Smut

Characterized by the absence of chlorophyll

What is the study of microbiology

Bacteria
Fungi
Virus

Other normal indoor air allergens

Dander
Pollen
Animal hair
Insect parts
Insect feces

- Dust mites
- Arachnids

What is a Bacteria?

Single celled prokaryote (no nucleus) living organisms
Many diseases are caused by bacteria, primarily gram-negative
Environmental bacteria include

- Legionella - Cooling Towers
- Escherichia coli (E coli) - Sewage Back-ups
- Staphylococcus in hospitals

What is a virus?

Non-living (outside of a host) prokaryotic genetic packages, that use a living organism to reproduce

Examples

- Chicken Pox
- Common colds
- Influenza
- AIDS

What is a fungus?

Kingdom of living organisms

Fungi (Mycota)

Mushrooms

Yeasts (single celled)

Rusts (plant pathogens)

Molds (multicellular)

Smut (plant pathogen)

Characterized by the absence of chlorophyll

Dimorphic reproduction

Sexual and asexual

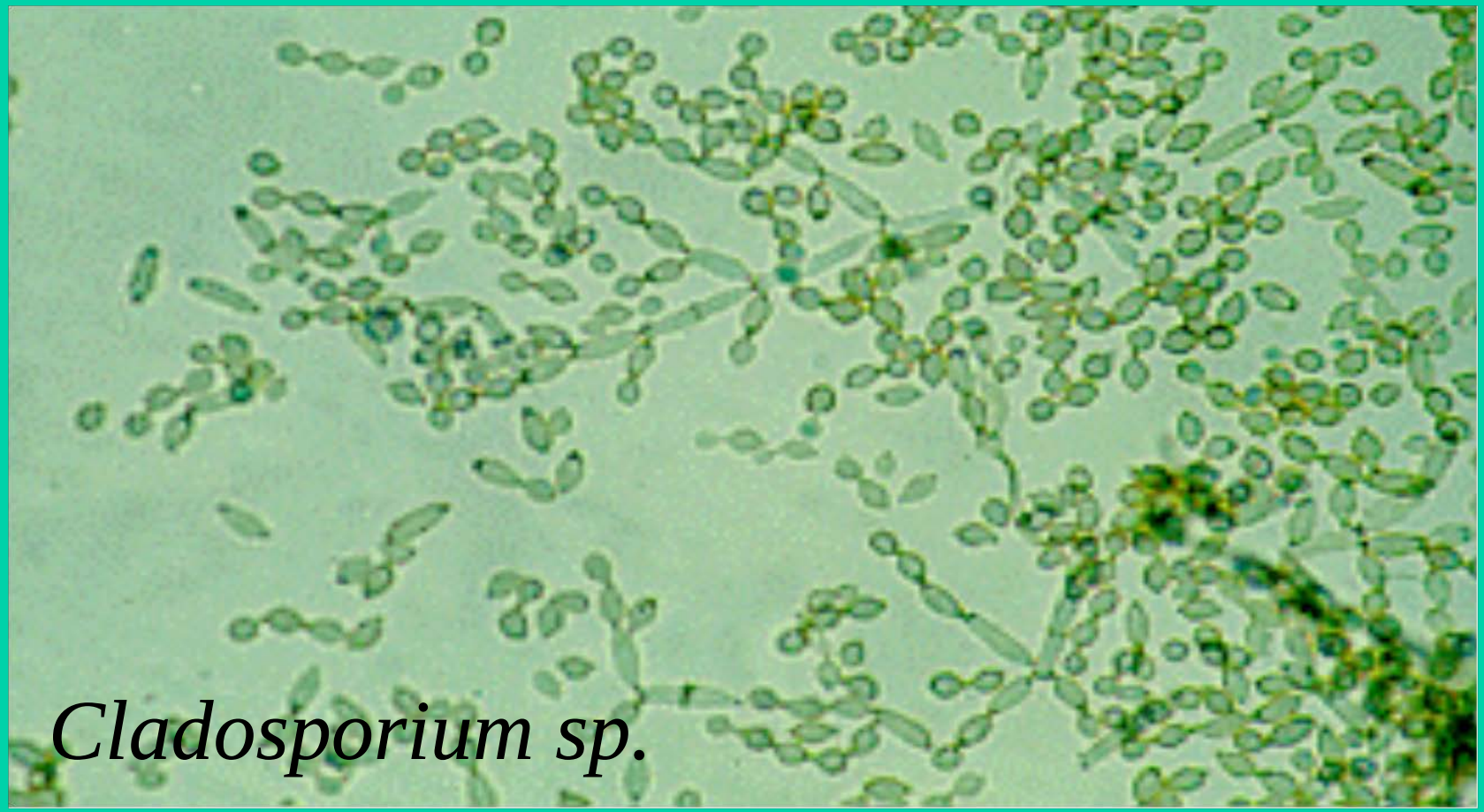
What is a fungal spore?

Spores are seeds
Culturable spores
Non-culturable spores
Spores are ubiquitous
Other structures

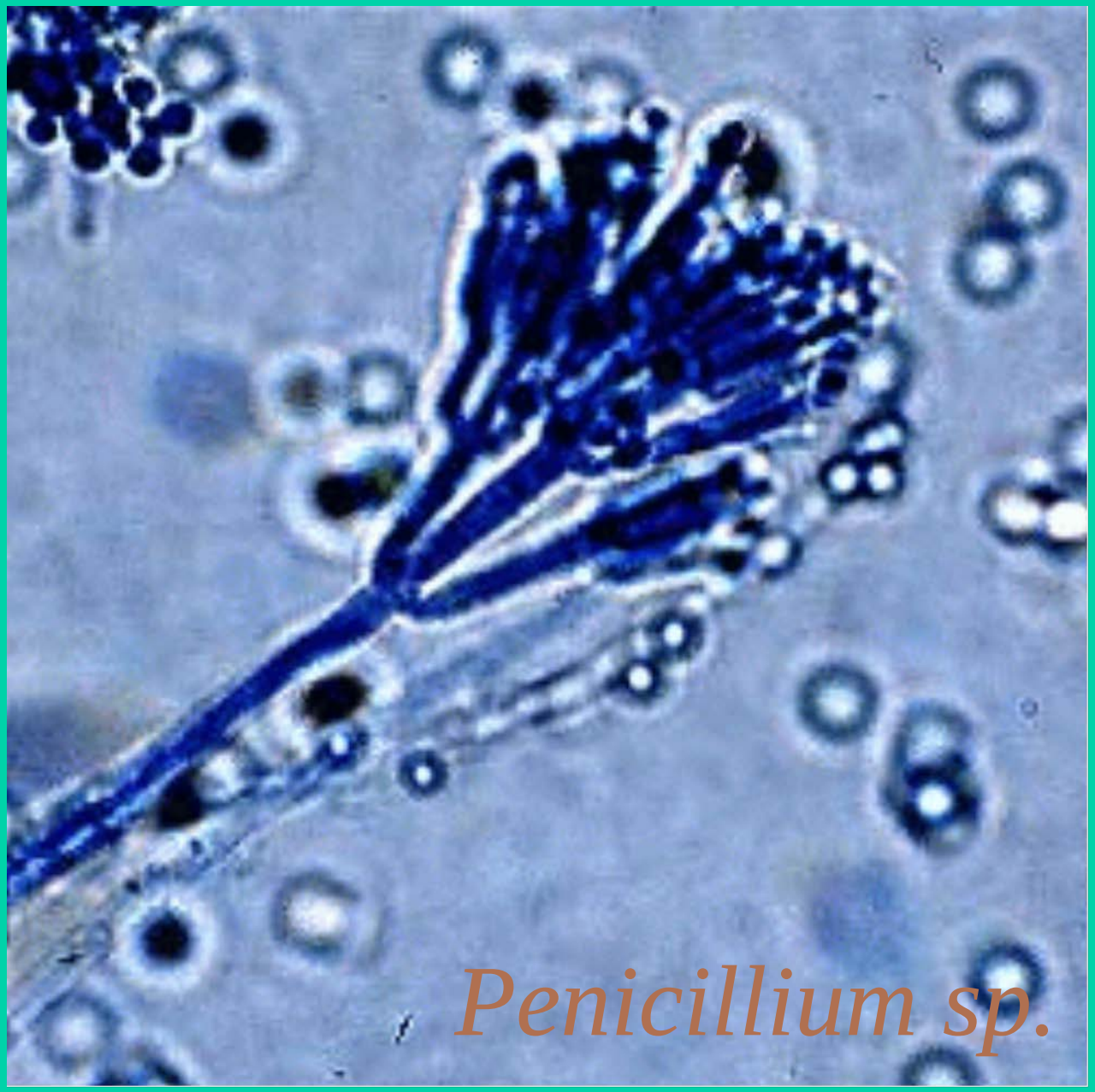
- Hyphae
- Mycelium
- Conidia

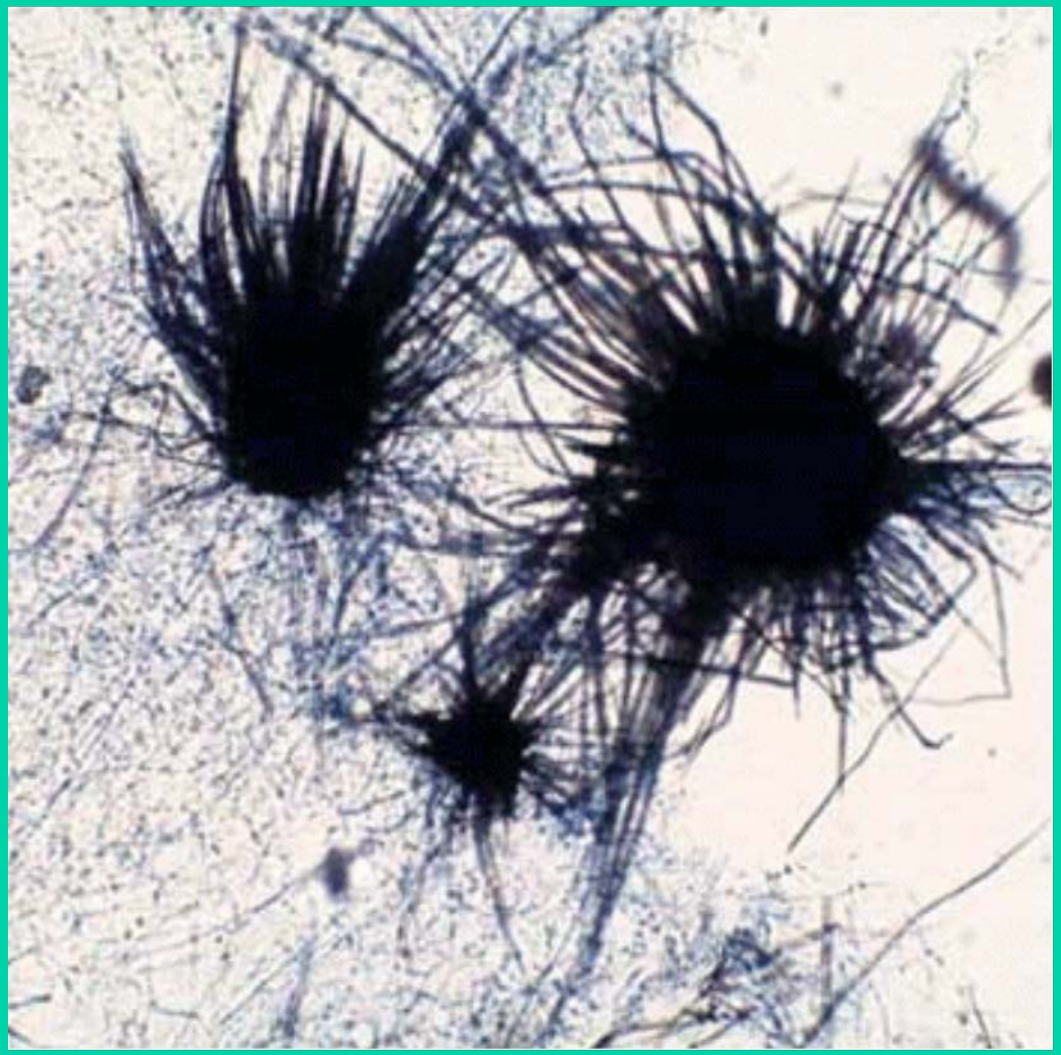
Aspergillus fumigatus

Bipolaris sp.



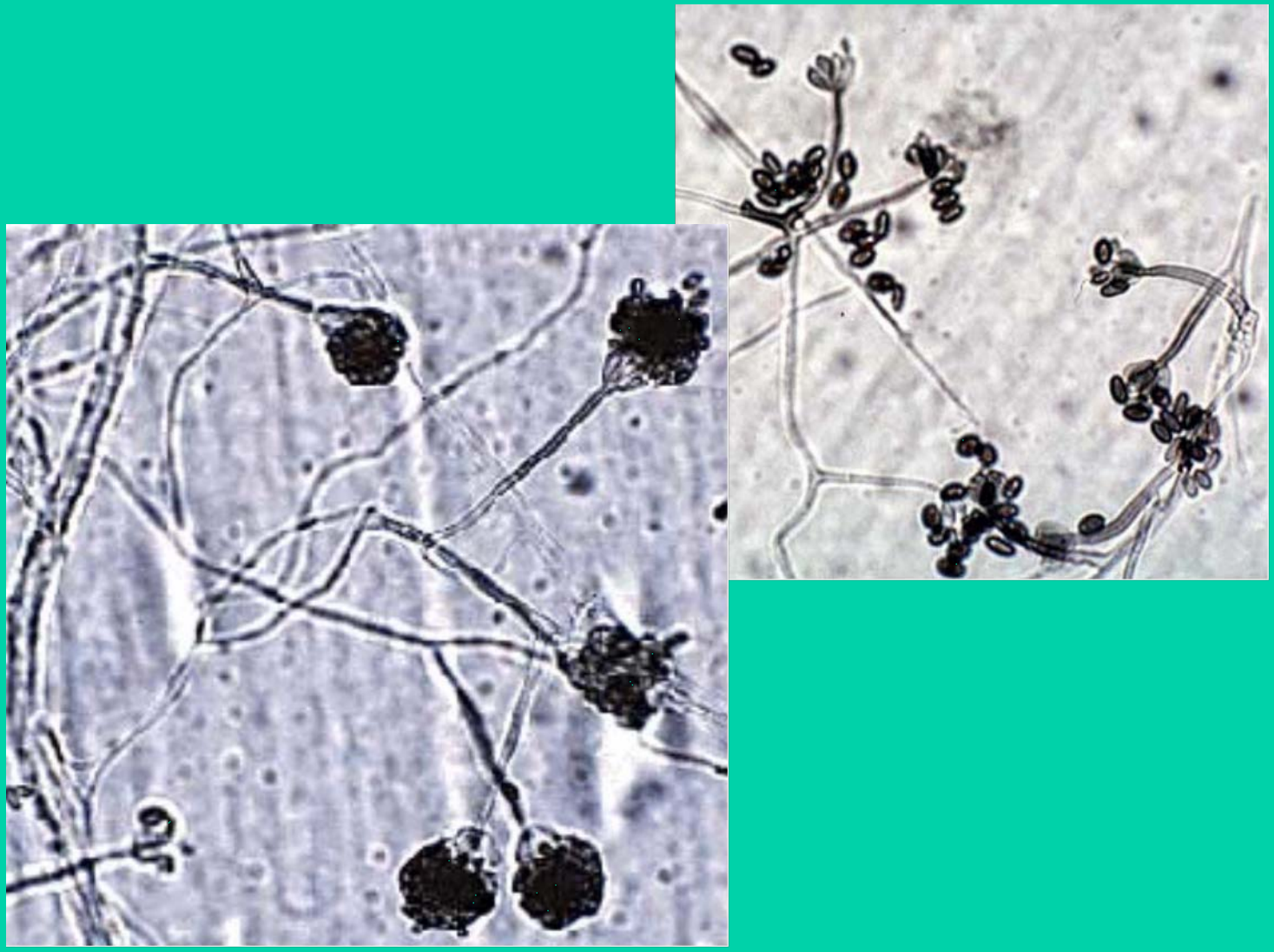
Cladosporium sp.


Penicillium sp.



Chaetomium sp.

Stachybotrys sp. (Stachybotrys chartarum)



Environmental and Economic Importance

Decay of dead materials - Primarily Cellulose (i.e. trees)
Recycling of basic nutrients
Production of various chemicals and foods including:
- alcohols;
- cheese;
- bread;
- antibiotics (e.g. Penicillin);
- mushrooms;
- etc.

What does fungus need to grow

Food
- Dead Organic Material

Water
- Leaks
- Drips
- Relative humidity

Temperature
- Comfortable to humans

Factors to consider during a Clean water intrusion event

Speed at which fungal growth can start

- 8 to 72 hours

Remove water as quickly as possible

Begin drying process

Lift carpeting and install fans and de-humidifiers and dispose of the carpet pad

If walls become wet

- Remove baseboard/coving
- Install wall air movement/airheating equipment

Evaluate moisture Levels

- Use a moisture meter
- Psychrometer
- Thermometer

All porous materials must be dried out or cleaned

Depending upon the size of the water intrusion event, some or all of the above items will be utilized.

Factors to consider after a Black Water Event

All of the previous plus

- Dispose of fabric materials
- Carpeting
- Carpet padding
- Removal of all lower wall sections
- Clean exposed wall cavities
- Disinfect

Depending upon the size of the spill, some or all of the Items will be performed.

Factors to consider

Evidence of water leaks

Brownish (water) staining on ceiling drywall below roof leaks
Water stains on the underside of a wood roof
Water stains adjacent to or below windows
Corner joint stains at leaking windows
Water stains below sinks
Mineral deposits or corrosion on plumbing lines or water heaters
Stained carpet tack strip below windows, next to sliding glass doors, or showers
Buckled wood flooring
Stained linoleum adjacent to toilets or plumbing
Over watered plants
Observable, usually dark, fungal growth on exposed surfaces

Other Factors to Consider

- Elevated levels of relative humidity, above 60 to 70 % (I.e. eastern seaboard, gulf coast)
- Over-watering of vegetation either on exterior walls or interior plants
- Condensation and growth inside of buildings, through the building paper or on glass (hot showers, constantly boiling water, etc.)
- Subterranean Growth of Plants
- Moisture in the Crawlspace
- Algal cell growth on stucco

Health risks associated with Fungi

Exposure via air, contact, or ingestion

Allergic reactions
Irritation
Toxicosis
Pathogens (i.e. cause disease)

Fungi as pathogens

Primarily opportunistic diseases
(other than athletes foot or yeast infections)

Weakened immune system (i.e. AIDS, TB, or transplant patients)
Very young or very old (immune system building or declining)
Examples include thrush (caused by *Candidus albicans*) and aspergillosis (cased by *Aspergillus fumigatus*)
Skin related diseases
Fungus ball (former TB patients)

Toxicosis caused by Fungi

No direct evidence that links low level exposure with toxic health risks

Only casual linkage of mold presence and health effects (i.e. I have health effects and my house has mold) without confirmation of route of exposure

Extremely high airborne levels (occupational agricultural exposures) have been linked to toxicosis

Ingestion, eating or drinking contaminated food supplies has been documented to cause toxicosis

Cleveland Baby case

Irritation caused by Fungi

Primarily odor associated (fungal flatulence)
Volatile organic compounds (VOCs) created when fungi are actively growing
The odors are the normal unpleasant mildew type odors
No known direct effects from microbial VOCs, requires more investigation

Allergic reaction mechanics

Percentage of population that is allergic (approximately 10-20%)

T-helper and mast cells

- Immunoglobulin cells
- IgG
- IgE

Primary and secondary immune system reactions

Severity of reactions depends upon individual susceptibility. These are listed in order of most to least prominent.

- Normal allergic response (runny nose, sneezing, etc.)
- Asthmatic reactions
- Hypersensitivity pneumonitis/anaphylactic shock reactions (almost never happens, extremely rare)

Cleveland Baby Case

CDC investigation

Pulmonary Hemorrhage/Hemosiderosis Among Infants (bleeding lung disease)

10 original cases (1993-1994) with 11 other cases later identified (1995-1996) of infants in a small geographical suburb area of Cleveland

1 infant death resulted from the disease in the original 10 and 2 from the second 11, and possibly another 6 who were originally diagnosed with SIDS

Investigations originally lead to identifying the causative agent to be toxins created by the fungi *Stachybotrys chartarum*

Follow-up review of the data by an internal and external committees have determined that the case has not been proven (published in March 2000).

Reasons for abatement of fungi

Potential allergenic effects to humans
Damage to building materials
Non-lumberyard fungal growth unacceptable inside of occupied buildings
Economic loss due to stigma
Current law (SB 732) requires that buyers be informed of the presence of fungal growth in a residence prior to transfer

Source of leak is primary importance

Ways to identify water leaks and potential locations of fungal growth

- Stains on drywall
- Stains on carpeting
- Water drip lines on wood
- Corrosion or mineral deposits (efflorescence) around plumbing or windows
- Cracks in stucco

Leaking Windows, Sliders, and Showers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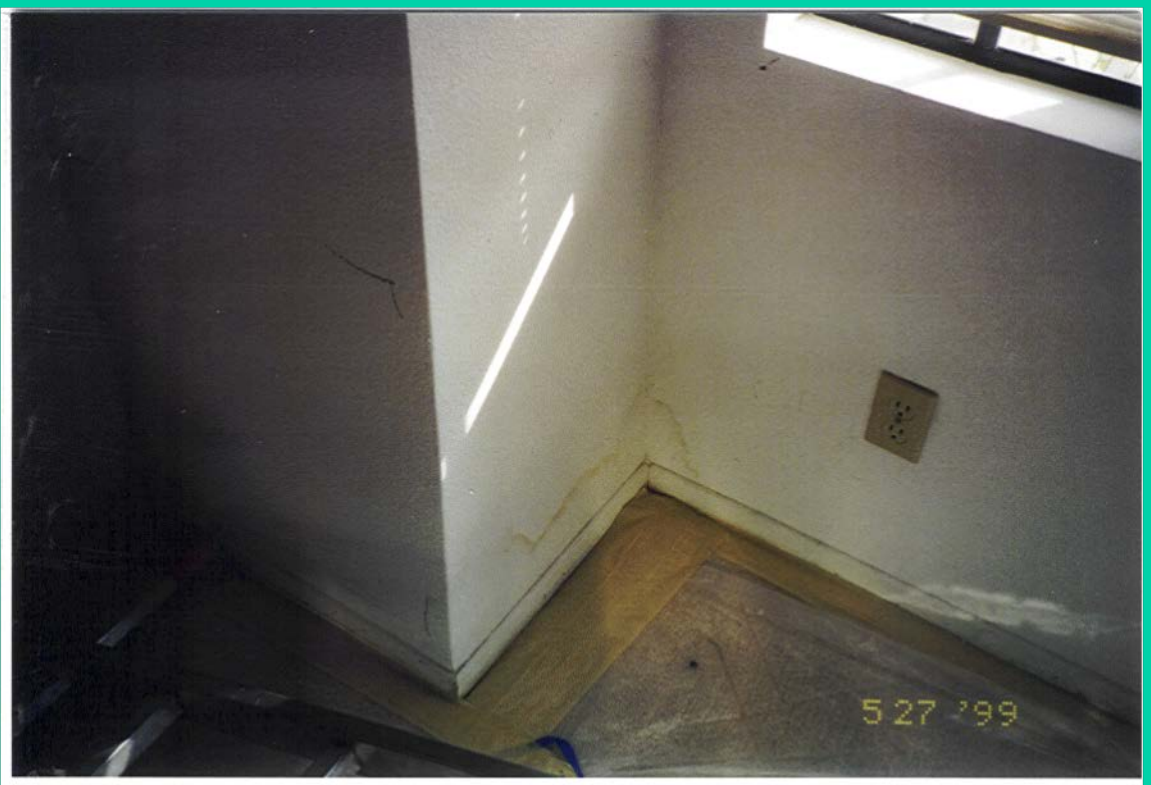
2 6 '02

This is normal non-stained carpet tack strip

Master bedroom sliding glass door and carpet tack strip closed side (begin of roll #6)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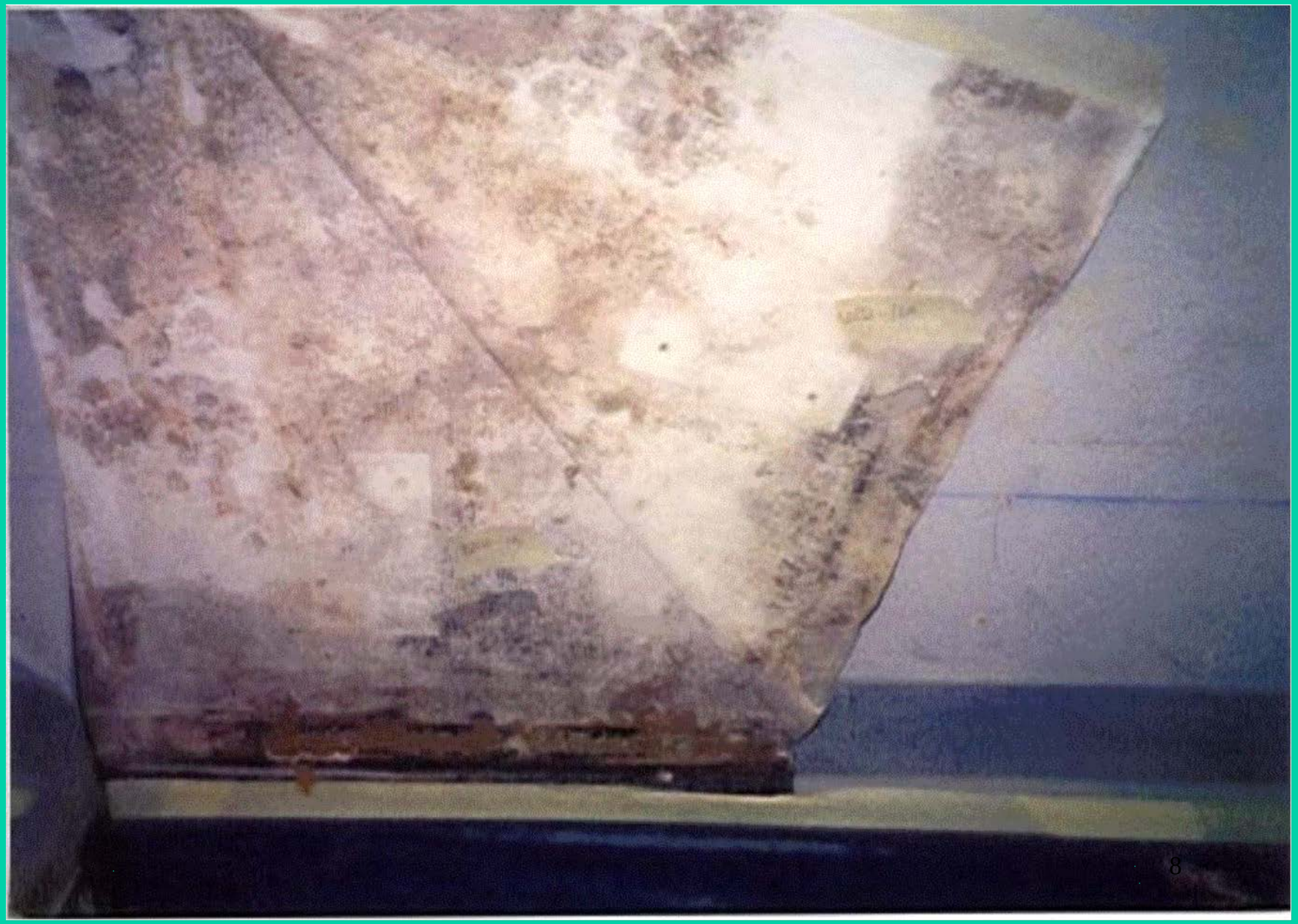
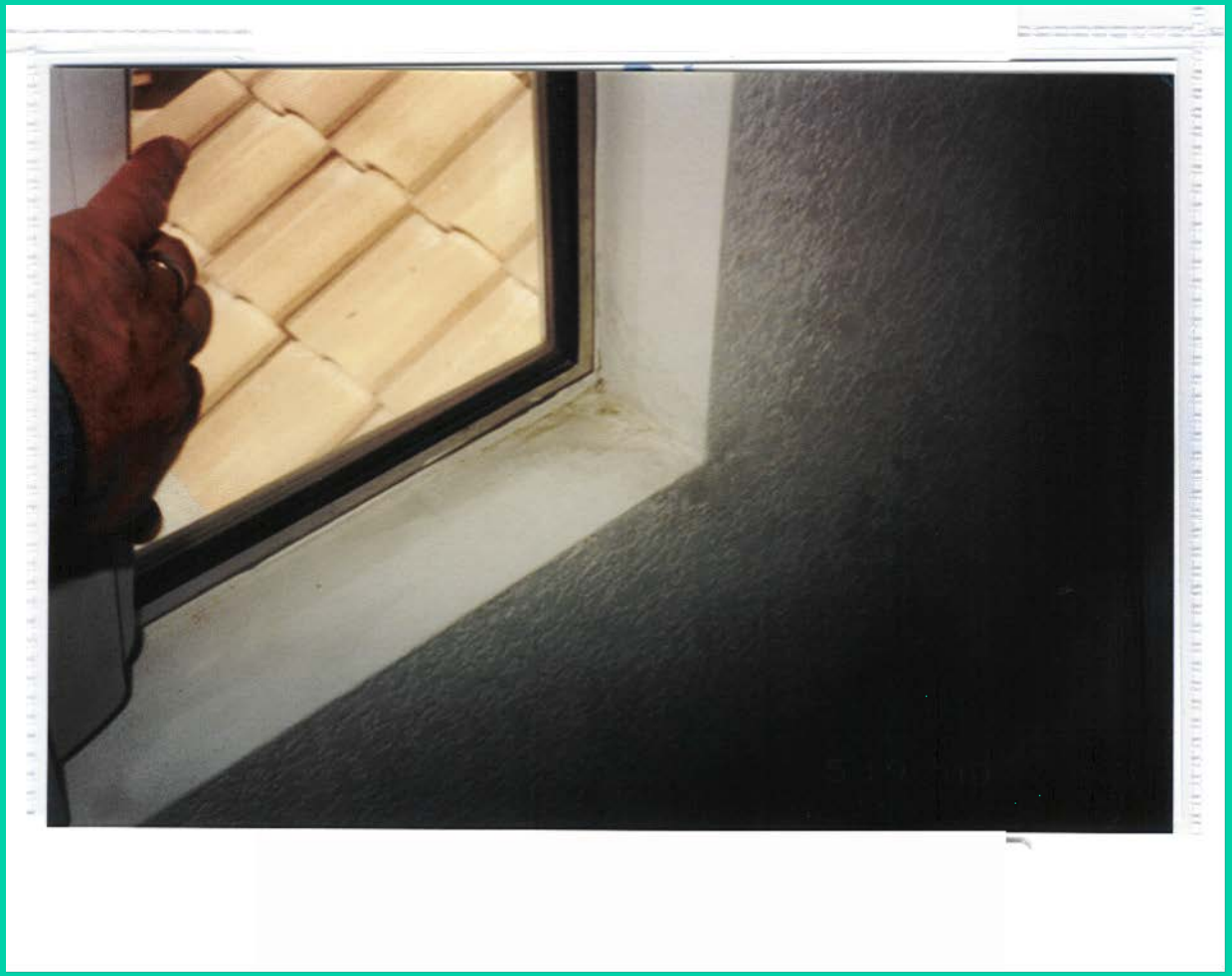
stain



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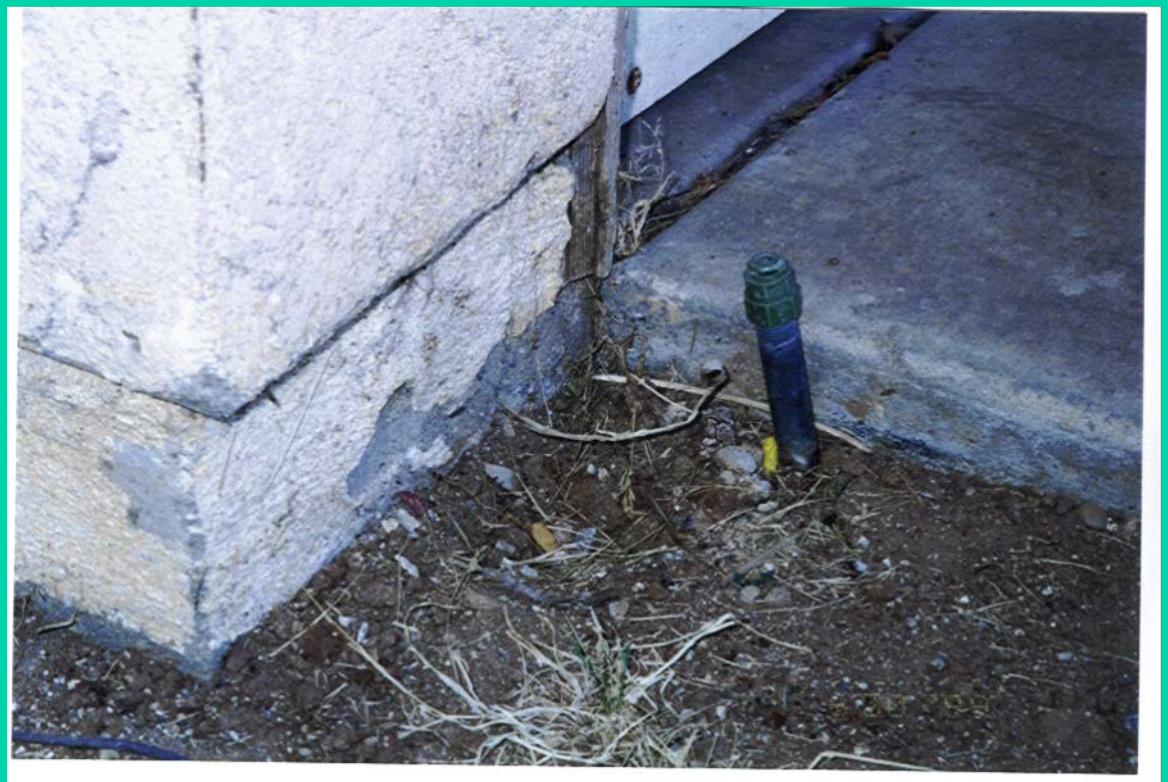
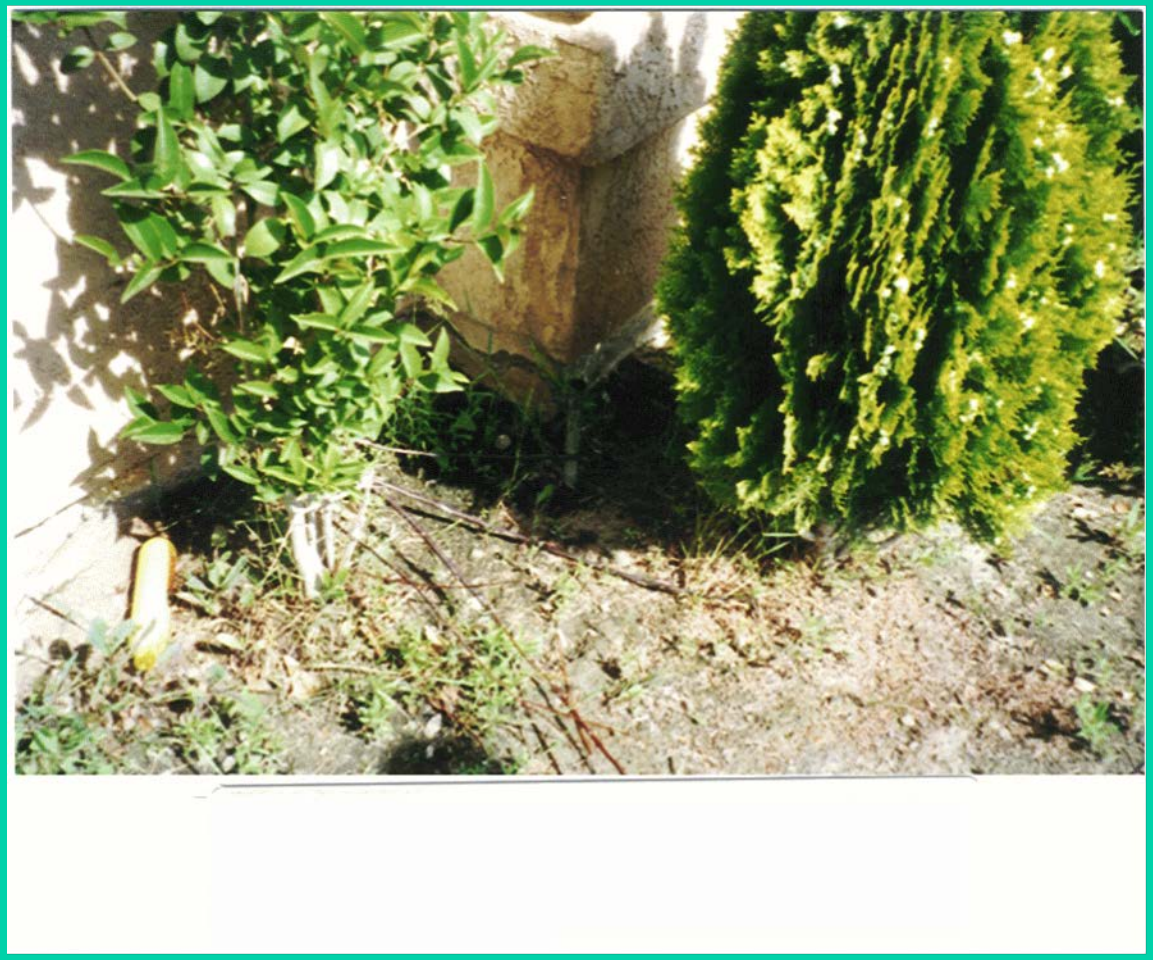
Upstairs window with approximately 100 nails into stucco

Backyard family room sliding glass door track with hole in track



Front of residence with sprinkler near wall, spraying towards wall

Front yard sprinklers and their proximity to the residence



Conduit and hole in wall outside of the family room side of residence

Balcony railing connection (end of roll #2)

Balcony connection to residence with cracked stucco

Front yard sprinklers and their proximity to the residence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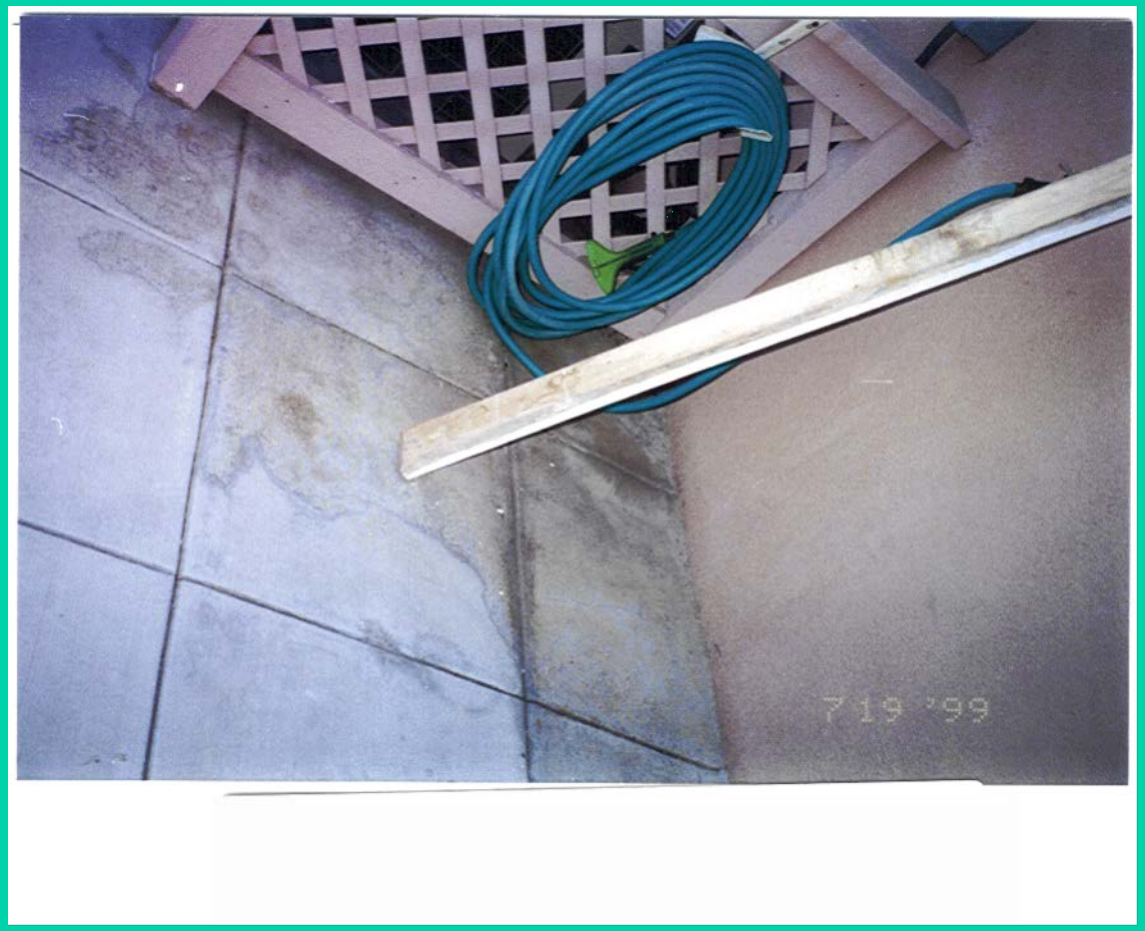
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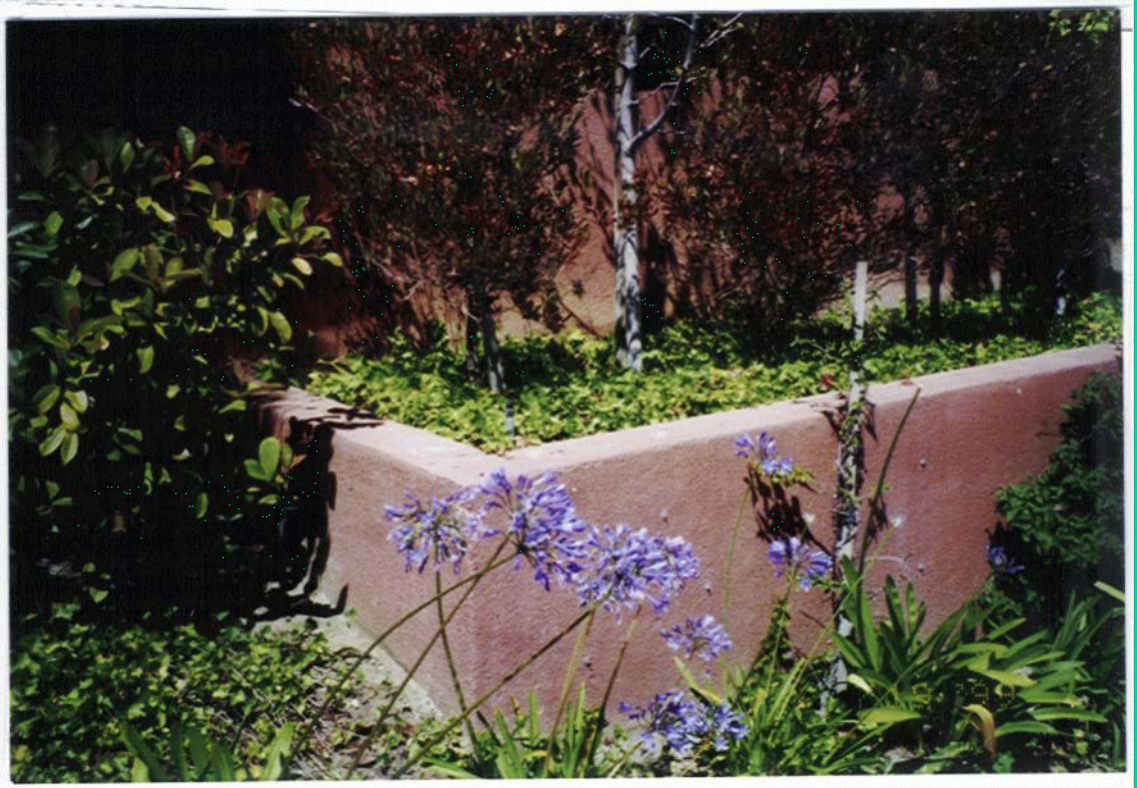
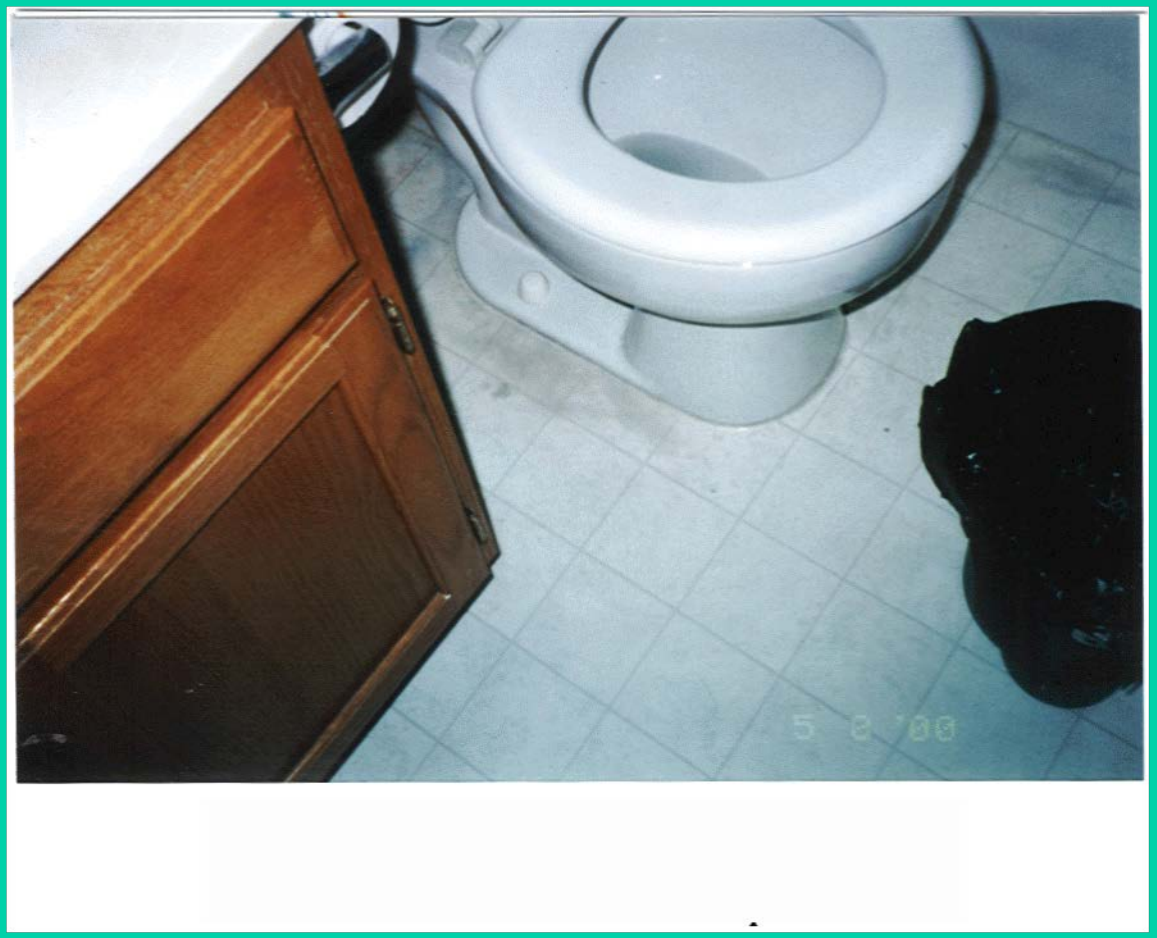


Master bathroom with staining on linoleum

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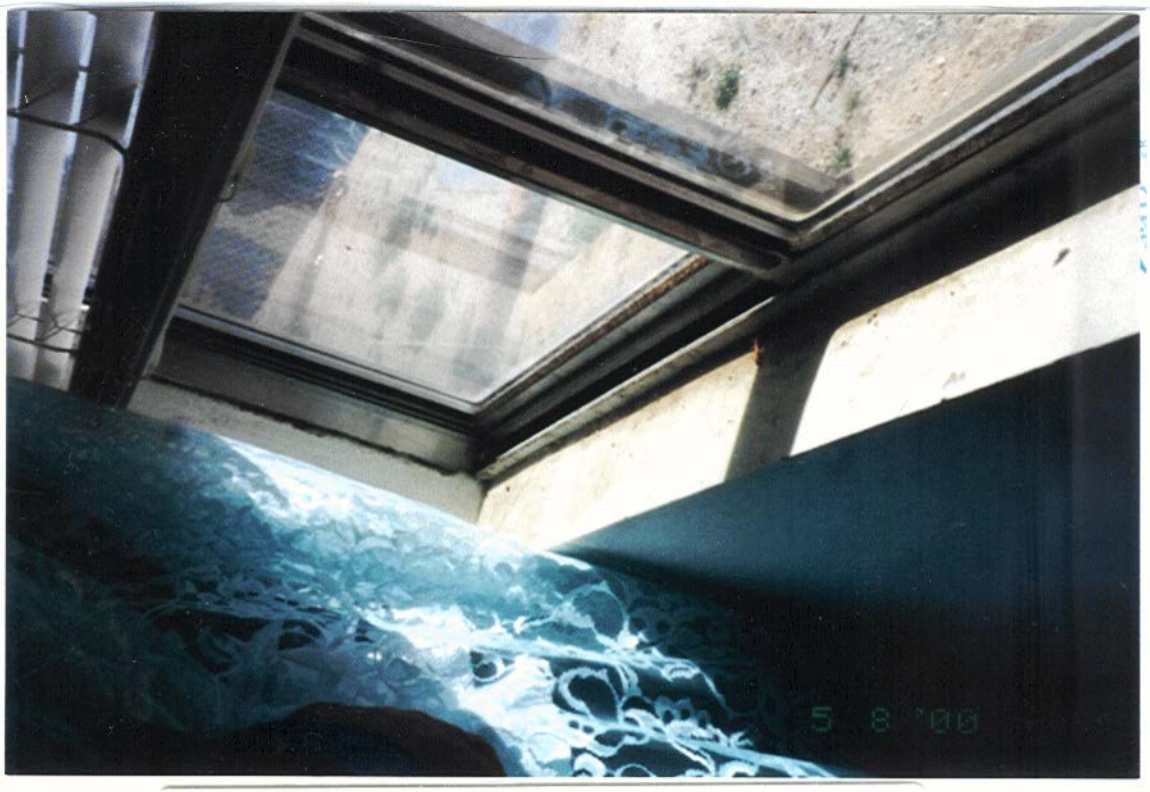
Master bathroom sink with staining

Living room aquarium filtering equipment and water pump

Dining room plant on wheels (carpet dry around pot)

Garage wall water stains on exterior side (opposite front door)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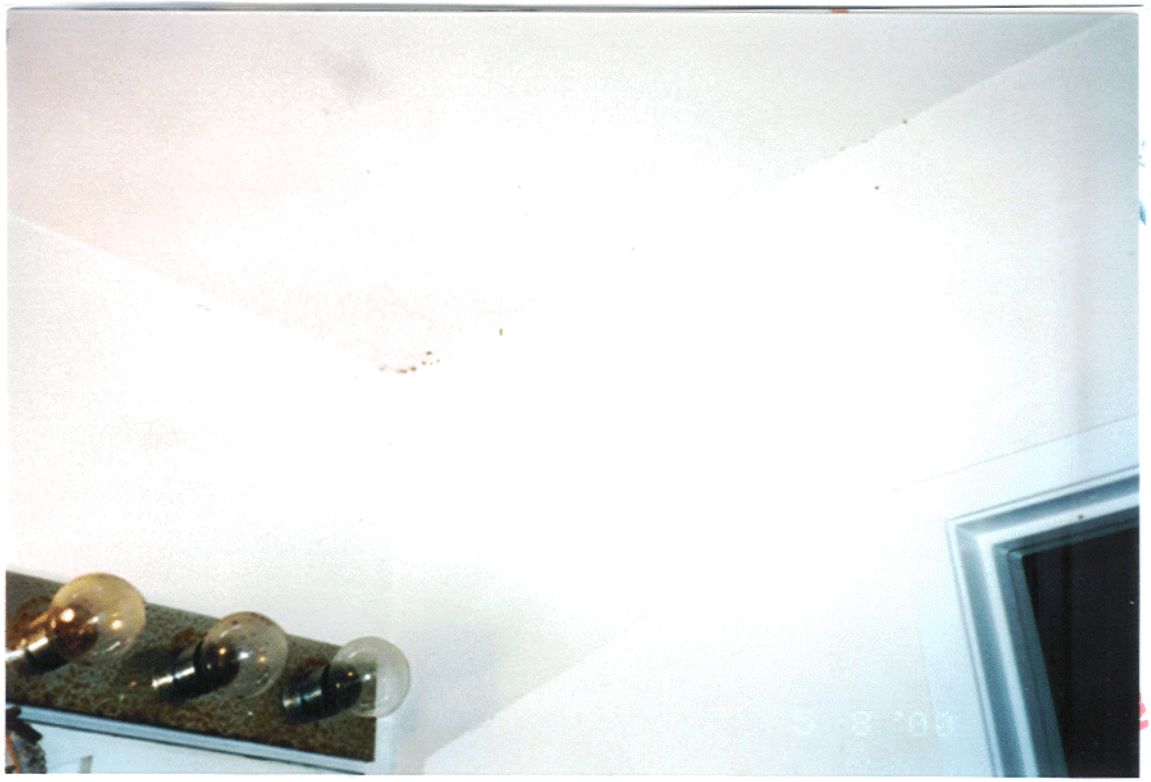


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12/30/2002

Fungal remediation

Containment (asbestos type depending upon the size of the remediation)
Negative air pressure
HEPA vacuums
Minimal usage of water
Vestibule or decon unit (depending on amount of fungi present)
Trained and experienced contractor and workers
Double bag waste debris as either normal construction waste or household waste (materials not hazardous waste)
Removal of colonized building materials plus an additional 12 to 24 inches of non-colonized and non-water stained material

Personal Protective Equipment

Respiratory protection
Skin, eye, and body protection (again, depending upon the size of the remediation, excluding routine cleaning)

Remediation Standards

Current governmental standards are non-existent

Governmental guidelines include

- Mold Remediation in Schools and Commercial Buildings (EPA)
- Guidelines on Assessment and Remediation of Fungi in Indoor Environments (Health Department of the City of New York)
- ACGIH Bioaerosols Handbook
- Institute of Inspection, Cleaning, and Restoration Certification (IICRC) S520

IAQ Sampling (Fungi)

- Total spores – provides the total spore load (alive and dead) in an environment (results to genus, in most cases).
- Culturable spores – provides data on spores that are alive and cause disease (results to genus, in most cases).
  - Using two general purpose agar media.

IAQ Sampling (Fungi)

- Grab type sampling for both totals and culturable fungal spores (3 to 5 minutes)
- Total spore method cannot differentiate between spore types that look the same (i.e. Hyaline spores are all small, clear round spores, Penicillium, Aspergullis, Mucor, Rhizpous, etc.).

IAQ Sampling (Fungi)

- Culturable method used to referee results of spores that all look the same.
- Provides analysis to species (in most cases).
- Takes longer and many times requires subculturing.

IAQ Sampling Direct Reading (Cont'd)

- Carbon dioxide – a general measurement of the HVAC systems ability to dilute odors and chemicals exhaled by humans.
- Carbon monoxide – a general measurement of the potential chemicals introduced into a space by the HVAC system (i.e. car exhaust).

IAQ Sampling Direct Reading (Cont'd)

- Temperature and Relative Humidity – the HVAC systems ability to provide a comfortable environment.
- Particulate counts – the HVAC systems ability to filter outdoor particles.

IAQ Standards

- Few Exist – There are various standards for industrial applications (PELs, TLVs, etc.).
- Those that exist are based on extremely low exposure levels and are for chemicals.
- There are no fungal standards (industrial of IAQ) and there never will be.

Interpretation of Results

- Indoor/Outdoor comparison.
- 10 Percent of OEL (i.e. PEL/TLV).
- Based on both distribution (i.e. ranking, most prominent) and amount (total versus culturable).
- At low levels, the distribution and amount are more volatile and less important.

Direct Reading Results

Sample Collection Site	Loc A Outside-Btwn SSV & BE		Loc B Outside-S. of SSV		Loc C Outside-NE of BE		Loc 1 SSV, Office 192		Loc 2 SSV, Office 188		Loc 3 SSV, Hallway Outside Office 117		Normal Range (ASHRAE)	PEL	STEL
Time	1015	1711	1110	1737	1125	1723	1034	1450	1152	1504	1205	1517			
Carbon Dioxide (ppm)	387	435	442	449	418	543	70.3	1058	1368	1013	1012	867	<Bkg + 700ppm	5000	30000
Carbon Monoxide (ppm)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 5ppm	25	200 C
Temperature, (°F)	49.5	59.7	66.3	54.3	63.4	53.8	70.5	75.8	77.2	77.2	73.9	75.2	68-79 °F		
Relative Humidity (%)	62.4	41.8	29.1	55.7	35.7	57.8	40.0	33.4	34.7	31.5	31.9	30.9	30-70%		

Abbreviation: ppm = parts per million by volume; °F=Degrees Fahrenheit; %=Percent; ND = none detected (approximately <1 ppm)

Sample Collection Site	Loc 4 SSV, Office 101		Loc 5 SSV, SW corner Hallway		Loc 6 SSV, Classroom 236 AM/Hallway outside Classroom 236 PM *		Loc 7 SSV, Hallway outside office 221		Loc 8 SSV, Classroom 204		Loc 9 BE, Office 211		Normal Range (ASHRAE)	PEL	STEL
Time	1219	1530	1232	1542	1245	1655	1301	1556	1316	1609	1334	1627			
Carbon Dioxide (ppm)	1276	1211	834	899	755	880	957	872	1010	654	854	901	<Bkg + 700ppm	5000	30000
Carbon Monoxide (ppm)	ND	ND	ND	N D	ND	ND	ND	ND	ND	ND	ND	ND	< 5ppm	25	200 C
Temperature, (°F)	73.9	73.6	72.1	73.8	72.3	77.5	72.5	75.2	74.7	74.5	74.1	74.5	68-79 °F		
Relative Humidity (%)	31.9	35.7	30.0	30.7	31.7	29.8	34.3	31.6	74.8	31.3	33.6	35.6	30-70%		

Abbreviation: ppm = parts per million by volume; °F=Degrees Fahrenheit; %=Percent; * = Class in session during second round of air sampling; ND = none detected (approximately <1 ppm).

Sample Collection Site	Loc 10 BE, NE Hallway outside office 209		Background Outside, E. Of SSV, (Full shift averages)	Normal Range (ASHRAE)	PEL	STEL
Time	1349	1637	1033-1942			
Carbon Dioxide (ppm)	709	887	388	<Bkg + 700ppm	5000	30000
Carbon Monoxide (ppm)	ND	ND	-0.2	< 5ppm	25	200 C
Temperature, (°F)	73.6	74.5	62.8	68-79 °F		
Relative Humidity (%)	33.6	30.2	40.8	30-70%		

Abbreviation: ppm = parts per million by volume; °F=Degrees Fahrenheit; %=Percent; ND = none detected (approximately <1 ppm)

Total Spore Air Sampling Spreadsheet

Analysis of Culturable and Total Spore Air Samples Collected for Antelope Valley College, on November 25, 2013

140095E.A

Sample #	Location	E Total CFUs/M3 or	C Total CFUs/M3 or	Alternaria sp.	Ascospores	Aspergillus/ Penicillium	Basidiospores	Beltrania	Bipolaris sp.	Chaetomium	Cladosporium	Curvularia	Epicoccum	Fusarium	Ganoderma	Myxomycetes	Nigrospora	Oidium	Rust	Trichocladium	Ulocladium sp.
	Total Spore ID Number/Letter	S/M3	S/M3																		
	OUTDOOR SAMPLES																				
a-19778457-1	Location A, Outside between SSV and BE Buildings	3310	3310	0	100	890	1400	0	0	0	800	0	0	0	0	80	40	0	0	0	0
a-18954749-2		860	860	0	10	200	300		10	0	300	0	0	0	0	0	0	0	0	0	0
b-19778427-1	Location B, Outside of the south side of the SSV Building	1740	1740	40	40	300	630	0	0	0	300	10	40	0	0	300	0	0	0	0	0
b-18954556-2		740	740	0	40	80	200	0	0	0	300	0	40	0	0	80	0	0	0	0	0
c-19778549-1	Location C, Outside of the northeast side of the BE Building	1600	1600	0	80	680	300	0	0	0	420	0	0	0	0	80	0	40	0	0	0
c-19778626-2		980	980	0	0	300	300	0	0	0	300	0	0	0	0	40	0	0	0	0	0
	INDOOR SAMPLES																				
#1-19778434-1	Location 1, SSV, Office 192	340	340	10	0	200	40	0	0	0	0	40	0	0	0	40	0	0	0	0	0
#1-19778794-2		200	200	40	0	40	0	0	0	0	40	0	0	0	0	40	0	0	0	0	0
#2-19779272-1	Location 2, SSV, Office 188	330	330	0	0	200	0	0	0	0	40	0	0	0	0	80	0	0	0	0	0
#2-19779242-2		230	230	0	0	100	40	0	0	0	0	0	0	0	0	40	0	0	10	0	0
#3-19778554-1	Location 3, SSV, Hallway outside of Office 117	200	200	0	0	40	40	0	0	0	40	0	0	0	0	40	0	0	0	0	0
#3-19778458-2		200	200	40	0	100	0	0	0	10	0	0	0	0	0	40	0	0	10	0	0
#4-19778766-1	Location 4, SSV, Office 101	350	350	40	10	200	0	0	0	0	40	0	0	0	0	40	0	0	0	0	10
#4-19778595-2		300	300	0	10	200	10	0	0	0	0	0	0	0	0	80	0	0	0	0	0
#5-19778691-1	Location 5, SSV, Southwest corner hallway	160	160	0	0	80	40	0	0	0	0	40	0	0	0	0	0	0	0	0	0
#5-19778563-2		90	90	10	0	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6-19778598-1	Location 6, SSV, Classroom 236 (AM) and Hallway outside of the classroom (PM)	260	260	0	0	200	0	0	0	0	40	0	0	0	0	10	0	0	0	0	0
#6-19778557-2		490	490	0	0	200	0	0	0	0	80	10	10	0	0	100	0	0	10	40	0
#7-19779253-1	Location 7, SSV, Hallway outside office 221	140	140	0	0	100	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0
#7-18954553-2		190	190	0	0	100	0	0	0	0	40	0	0	0	0	10	0	0	0	0	0
#8-18954560-1	Location 8, SSV, Hallway outside of classroom 204	380	380	40	0	80	80	0	0	0	40	0	10	0	0	40	0	0	10	0	0
#8-19778702-2		250	250	40	0	40	40	0	0	0	40	0	0	0	0	40	0	0	0	0	10
#9-19778591-1	Location 9, BE, Office 211	160	160	0	0	80	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0
#9-19779204-2		90	90	0	0	40	0	0	0	0	0	0	0	0	0	40	0	0	10	0	0
+10-18954567-1	Location 10, BE, Northeast Hallway, outside of Office 209	290	290	10	0	100	40	0	0	0	80	10	0	0	0	10	0	0	0	0	0
+10-19777405-2		50	50	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0
19778452-Blank	Field Blanks	No trace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OUTDOOR STATISTICS																				
Minimum		740	740	0	0	80	200	0	0	0	300	0	0	0	0	0	0	0	0	0	0
Maximum		3310	3310	40	100	890	1400	0	10	0	800	10	40	0	0	300	40	40	0	0	0
Average		1538.33	1538.33	6.67	45.00	488.33	521.67	0.00	1.67	0.00	483.33	1.67	13.33	0.00	0.00	96.67	6.67	6.67	0.00	0.00	0.00
	INDOOR STATISTICS																				
Minimum		50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum		490	490	40	10	200	80	0	0	10	80	40	10	0	0	100	0	0	10	40	10
Average		235	235	11.5	1	107	18.5	0	0	0.5	28	5	1	0	0	34.5	0	0	2.5	2	1
RATIOS (INDOOR/OUTDOOR)																					
Minimum		7%	7%	ERR	ERR	0%	0%	ERR	ERR	ERR	0%	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Maximum		15%	15%	100%	10%	25%	6%	ERR	0%	ERR	10%	400%	25%	ERR	ERR	33%	0%	0%	ERR	ERR	ERR
Average		15%	15%	173%	2%	36%	4%	ERR	0%	ERR	7%	300%	8%	ERR	ERR	36%	0%	0%	ERR	ERR	ERR

FUNGAL AIR SAMPLING RESULTS - SUMMARY		
	CULTURABLE	TOTALS
OUTDOOR STATISTICS		
Minimum	120	740
Maximum	576	3310
Average	224	1538.33
INDOOR STATISTICS		
Minimum	0	50
Maximum	96	490
Average	44.7	235
RATIOS (INDOOR/OUTDOOR)		
Minimum	0%	7%
Maximum	17%	15%
Average	20%	15%

Location A, Outside between SSV and BE;
Location B, Outside south of SSV;
Location C, Outside northeast of BE;
Location 1, SSV office 192;
Location 2, SSV office 188;
Location 3, outside SSV office 117;
Location 4, SSV office 101;
Location 5, southwest corner hallway SSV floor 1;
Location 6, SSV classroom 236
Location 7, hallway outside SSV office 221;
Location 8, hallway outside SSV room 204;
Location 9, BE office 211; and
Location 10, hallway outside BE

Total Dust Results

Sample Collection Site	Loc A Outside-Btwn SSV & BE		Loc B Outside-S. of SSV		Loc C Outside-NE of BE		Loc 1 SSV, Office 192		Loc 2 SSV, Office 188		Loc 3 SSV, Hallway Outside Office 117		PEL
Instrument	TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		
Time	1020	1710	1103	1737	1125	1724	1034	1451	1152	1504	1205	1518	
Average (mg/m^3)	0.456	0.470	0.502	0.454	0.481	0.458	0.453	0.456	0.556	0.476	0.472	0.476	10.000
Minimum (mg/m^3)	0.402	0.456	0.501	0.448	0.475	0.451	0.427	0.439	0.498	0.445	0.451	0.451	
Maximum (mg/m^3)	0.611	0.501	0.504	0.464	0.493	0.468	0.548	0.506	0.658	0.521	0.506	0.513	

Abbreviation: ppm – parts per million by volume; °F–Degrees Fahrenheit; %–Percent

Sample Collection Site	Loc 4 SSV, Office 101		Loc 5 SSV, SW corner Hallway		Loc 6 SSV, Hallway outside Classroom 236		Loc 7 SSV, Hallway outside office 221		Loc 8 SSV, Classroom 204 AM/Hallway outside Classroom 204 PM*		Loc 9 BE, Office 211		Loc 10 BE, NE Hallway outside office 209		PEL
Instrument	TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		TSI DusTrak		
Time	1225	1530	1232	1542	1237	1655	1303	1556	1317	1609	1335	1628	1349	1637	
Average (mg/m^3)	0.679	0.576	0.456	0.454	0.465	0.584	0.496	0.488	0.515	0.476	0.499	0.512	0.504	0.490	10.000
Minimum (mg/m^3)	0.576	0.574	0.446	0.443	0.440	0.501	0.445	0.463	0.481	0.449	0.452	0.451	0.470	0.444	
Maximum (mg/m^3)	0.975	0.773	0.520	0.972	0.520	0.731	0.696	0.525	0.559	0.532	0.690	0.593	0.546	0.586	

Abbreviation: ppm – parts per million by volume; °F–Degrees Fahrenheit; %–Percent; * – Class in session during second round of air sampling.

Results

- The total and culturable spore air sampling indicate that the indoor results were below, and that the spore distributions were similar to, the outside sample results. Therefore, there was no indication of an elevated fungal spore load at all indoor sampled locations as compared to the outdoor sampled locations.

- IAQ-Calc meter readings for carbon dioxide, carbon monoxide, temperature, and relative humidity were also within normally accepted ranges.

Results

- DusTrak readings for fine particulates at all indoor locations were either below or marginally close to levels exhibited outside.

Results – BE Ceiling Plenum

- HSA recommends that the areas surrounding all supply and return vents should be re-cleaned and periodic rodent surveillance should be performed.
- HSA observed water intrusion over SSV office 192 where the sloped roof and original building “egg-crate” decking meet. HSA recommends that this be addressed and all breaches in the roof be inspected and sealed.
  - Subsequent to HSA’s site visit, it was reported that an AVC crew inspected this area of the building and traced by the water stain to what appeared to be its origin, and re-sealed that area.

Results – SSV Roof

- HSA observed significant pooling of rain water on the roof areas. HSA recommends inspection of the roof for potential breaches in the roof protective membrane and check the drains and gutters for excess debris build-up.


DRABBLE by Kelvin Fagan
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