AAPS Ventilation Study Results
Elementary and K-8 Schools

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ANN ARBOR PUBLIC SCHOOLS
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AAPS Ventilation Study Overview

In accordance with AAPS' commitment to health and safety for students and staff, we are preparing our classrooms and buildings across the district for a COVID-informed return to in-person learning. To that end, and concurrent with robust building preparation work in accordance with CDC guidelines and other resources, the AAPS has completed a number of steps to improve indoor air quality, including:

Building Controls Programming, Filter Replacements and HVAC Systems Commissioning

- Programmed a new sequence of operations for the HVAC controls system (Enhanced Indoor Air Quality Mode (EIAQ)) to provide increased ventilation, intake or outside air, and filtration above our typical operating mode, and well beyond code minimum.
- Replaced all filters and increased their density as much as the equipment will allow
- Commissioned all HVAC units (approximately 1,000) including opening the unit, cleaning all components, and verifying the proper operation of items like dampers and actuators.

Room by Room Ventilation Rate Study and Mitigation Actions

- The district has commissioned Fishbeck, a professional engineering firm, to conduct a detailed room-by-room ventilation study for all AAPS buildings. The deliverables of this study include floor plans indicating air changes per hour (ACH) levels by room as well as a summary in the form of an Excel chart. Air changes per hour (ACH) is a measure of how many times the air in a room is replaced, by either outside air or recirculated filtered air, within one hour.
- The Harvard School of Public Health sets ACH levels of five (5) and above to have excellent ventilation.
- Those spaces that fall below 5 ACH will be provided portable air cleaners and/or fans to provide additional air changes to raise the ACH above 5.

COVID-19 + SCHOOLS: WHAT TO KNOW

VENTILATION GUIDE

5 STEP GUIDE TO CHECKING VENTILATION RATES IN CLASSROOMS

DOWNLOAD THE GUIDE

COVID-19 REPORT

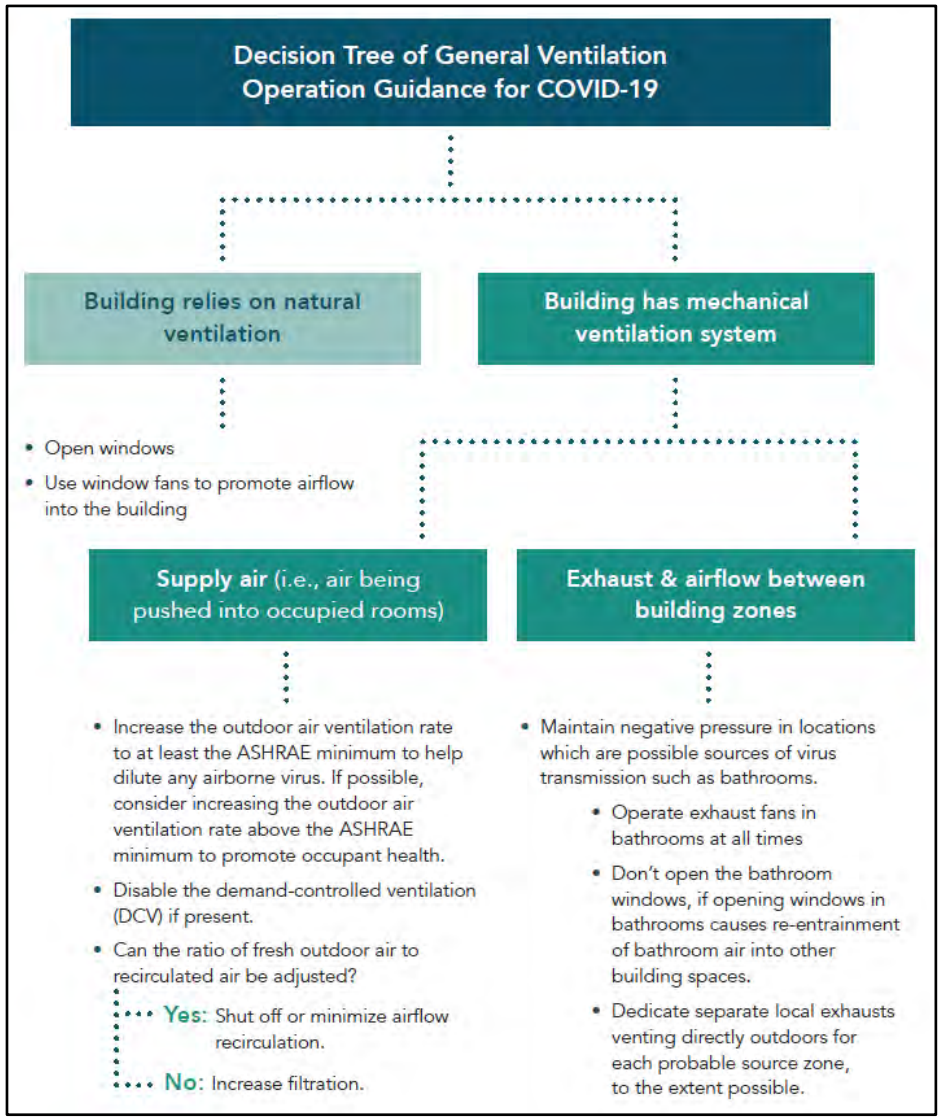
RISK REDUCTION STRATEGIES FOR REOPENING SCHOOLS

READ THE REPORT

COVID-19 TOOLS

CALCULATORS FOR THE CLASSROOM

SEE ALL TOOLS



HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

HEALTHY BUILDINGS FOR HEALTH | forhealth.org

TARGET IS AT LEAST 5 TOTAL AIR CHANGES PER HOUR (ACH)	
	Ideal (6 ACH)
	Excellent (5-6 ACH)
	Good (4-5 ACH)
	Bare Minimum (3-4 ACH)
	Low (<3 ACH)

- Harvard School of Public Health

Air Changes per Hour (ACH) and Probability of Disease Transmission

Increasing Air Changes per Hour (ACH) reduces the probability of virus transmission

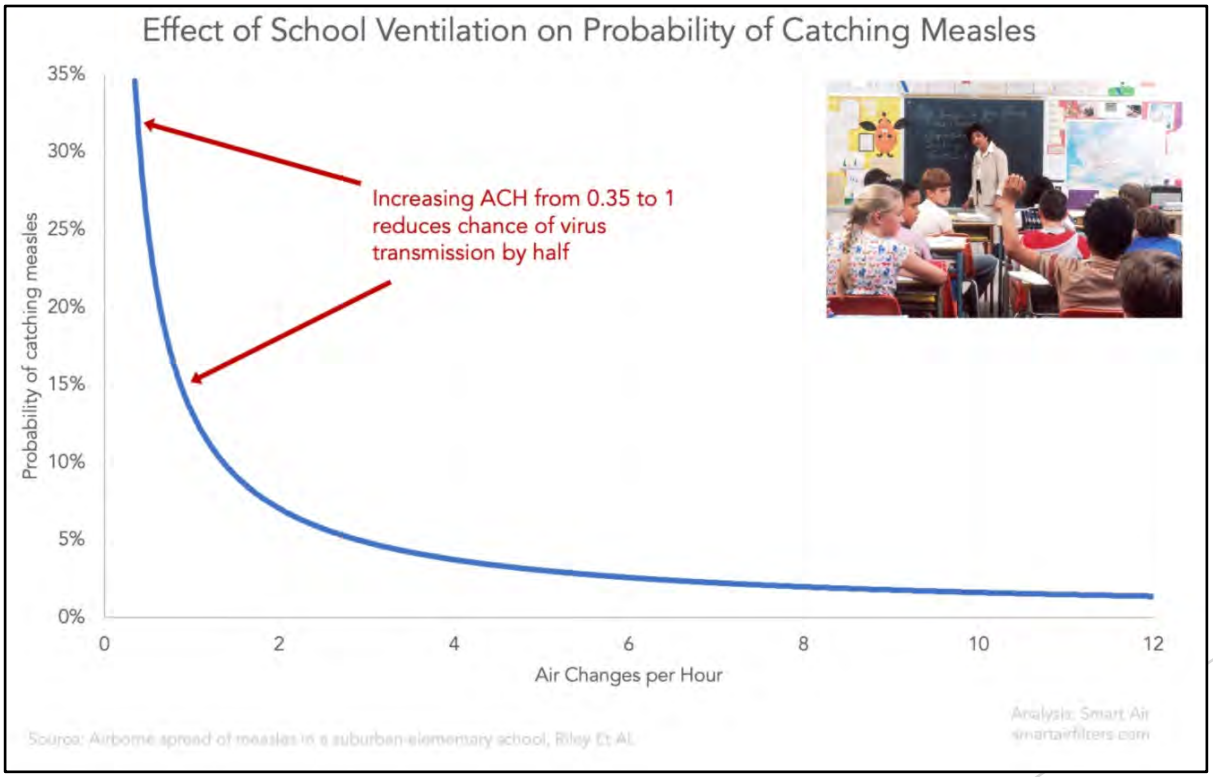


Chart is based on the Wells-Riley model developed as part of a study of a measles outbreak in NY public school in the 1970s

Calculating Air Changes per Hour (ACH)

Air Changes per Hour (ACH) is a measure of how often the air in a room is replaced by either outside air or recirculated filtered air.

SAMPLE CALCULATION

Room Size is **30'wide x 30'long x 10'high = 9,000 cubic feet** of air

Ventilation system provides 1000 cubic feet per minute (CFM) of fresh and/or filtered air.

1000 CFM x 60 minutes = 60,000 cubic feet per hour

$$\frac{\textbf{60,000 cubic feet per hour}}{\textbf{9,000 cubic feet}} = \textbf{6.6 Air Changes per Hour (ACH)}$$

Air Changes per Hour (ACH)

- Code minimum ventilation rates are approximately 2.8 – 3.5 ACH for schools
- **Recommended rates for creating better air quality is 5+ ACH**
- When operating in the Enhanced Indoor Air Quality Mode **AAPS building mechanical systems are generally able to provide between 5 and 11 ACH** depending on the room and/or school mechanical systems.
- In some schools a small number of spaces, typically **big box spaces such as gyms and multi-purpose rooms** have been calculated to be below 5. This is due in part to the high ceilings and large volume of air needing to be changed each hour.
- Portable Air Cleaners can provide **additional ACH** and will be provided in rooms with ACH below 5.
- In the few cases where the number of air cleaners is excessive, additional ACH will be provided by opening doors and/or windows and introducing fans

Mitigation Strategies: Portable Air Cleaners and High Volume Fans

- Portable air cleaners will be provided in rooms where existing mechanical equipment is not able to provide sufficient ventilation. The device works by pulling air into the device, cleaning it with HEPA filter and returning the cleaned air to the room.
- In those few cases where portable air cleaners are not sufficient, high volume fans will be placed in exterior doors of gyms and/or multi-purpose rooms
- **All mitigation strategies will be implemented prior to a return to hybrid instruction and all AAPS spaces will have excellent indoor air quality of 5 ACH or higher**

Ventilation Study Results

- **96% of the AAPS Elementary square footage is >5 ACH and in the "Excellent" category**
- 2% is between 4 and 5 ACH and in the "Good" category
- 2% is below 4 ACH

The vast majority of the areas in need of additional ACH are gyms and multi-purpose rooms.

All elementary school classrooms are above 5 ACH without any corrective action

Individual school results will be available for review on the AAPS website

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	Ideal (6 ACH)
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	Low (<3 ACH)

- Harvard School of Public Health

Ventilation Study Results

Typical School Report – 100% Excellent

Pittsfield Elementary School

Supply Air Changes per Hour (ACH)

fishbeck

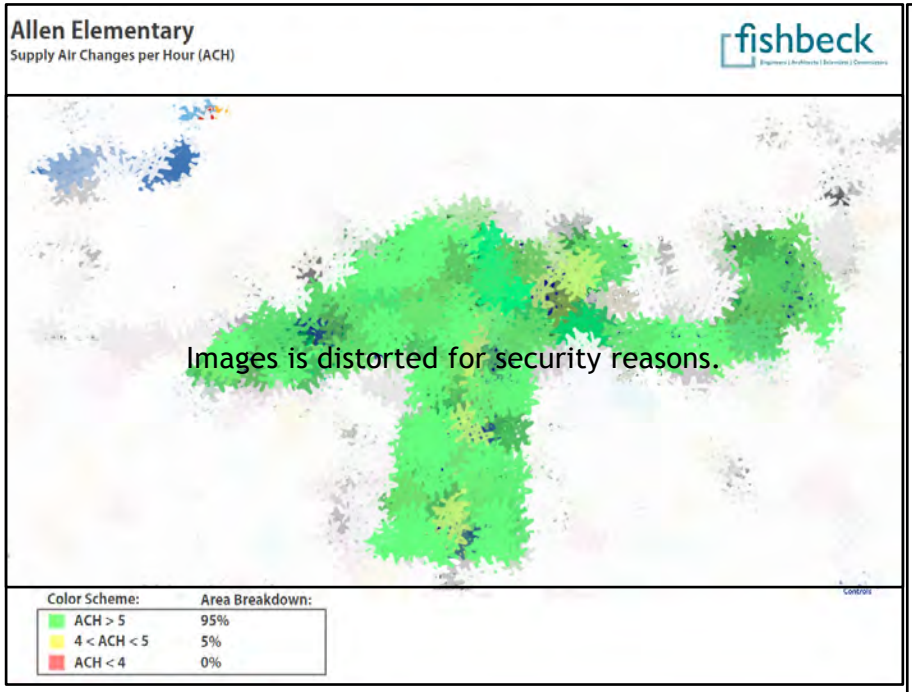
Color Scheme:	Area Breakdown:
ACH > 5	100%
4 < ACH < 5	0%
ACH < 4	0%

PITTSFIELD ELEMENTARY

Equipment	Space	Area (ft2)	Ceiling Height (ft)	Supply Air Flow (cfm)	Supply Air Changes per Hour (ACH)
AHU-HV1	Gym	2,753	22	5600	*5.5*
AHU-HV2	Multi-Purpose	3,547	14	10500	*12.7*
RTU-1	Overall System	1,681	9	2100	*8.8*
RTU-1	B106 - Principal (typical)	248	9	300	*8.5*
RTU-1	B112 - General Office (typical)	388	9	500	*9.1*
MZ-1-RTU	Media Center	2,943	9	2850	*6.8*
UV-C-105	Classroom A105	868	9	1000	*8.1*
Univent	Classroom A104	947	9	1000	*7.5*

Ventilation Study Results

Typical School Report – Issues Fixed with Portable Air Cleaners



ALLEN ELEMENTARY

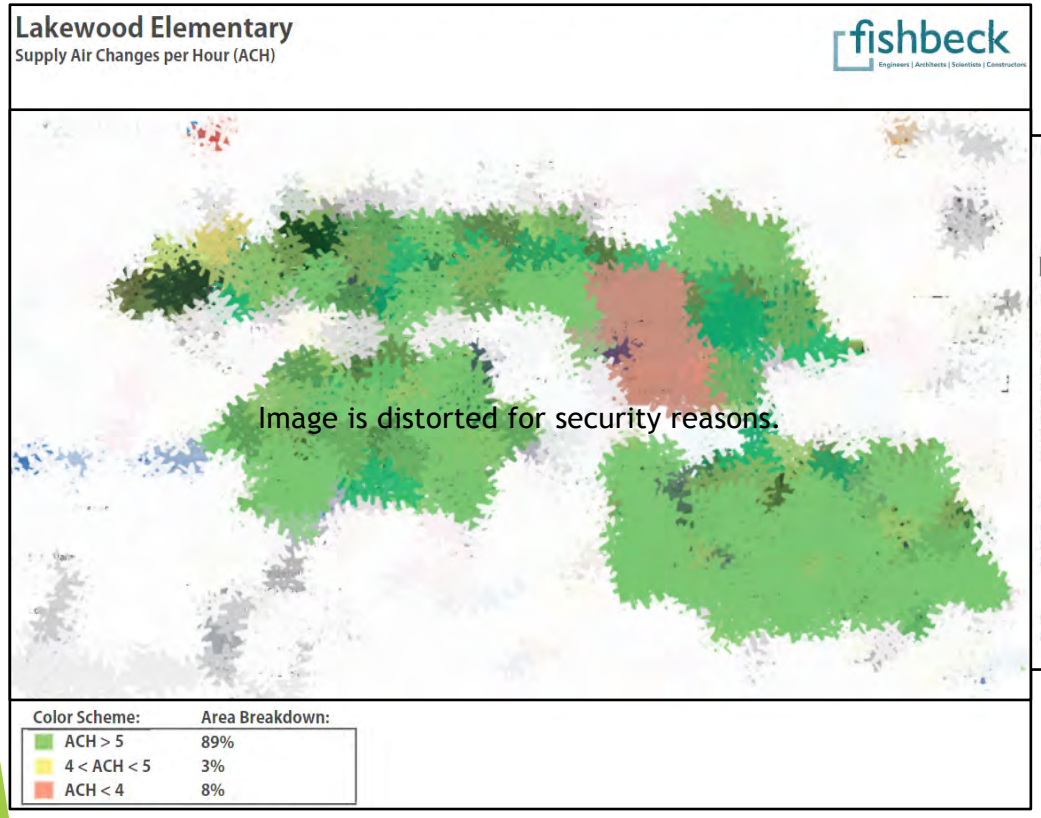
Equipment	Space	Area (ft2)	Ceiling Height (ft)	Supply Air Flow (cfm)	Supply Air Changes per Hour (ACH)	Supply Air Changes per Hour (ACH) with Corrective Actions
HV-1	Multi-purpose	3,800	16	8000	7.9	7.9
RTU-2	Corridor A	1,335	8	800	4.5	6.0
RTU-5	Computer Room	850	8	1200	10.6	10.6
RTU-6	Media Center	2,200	20	3000	4.2	5.0
RTU-7	Overall System	1,070	8	1200	8.4	8.4
	B106 (typical)	580	8	650	8.4	8.4
	B107 (typical)	95	8	200	15.8	15.8
	B108 (typical)	140	8	250	13.4	13.4
RTU-8	Gymnasium	2,040	18	4000	6.5	6.5
UV-01	Work Room	475	8	1000	15.8	15.8
UV-02	Staff Lounge	630	8	1000	11.9	11.9
UV-A-14	Classroom A14	1,025	8	1250	9.1	9.1
UV-A-21	Classroom A21	1,050	8	1250	8.9	8.9
UV-C-5	Classroom 5	860	8	1000	8.7	8.7
UV-C-6	Classroom 6	860	8	1000	8.7	8.7
UV-C-11	Classroom C11	860	8	1000	8.7	8.7
UV-C-12	Classroom C12	850	8	1000	8.8	8.8
UV-K-1	Kitchen 1	1,055	9	1250	8.4	8.4
UV-K-3	Kitchen 3	1,170	9	1250	7.5	7.5
UV-K-4A/4B	Kitchen 4	1,175	9	2000	12	12

Corrective Action(s)

RTU-2	Corridor A	1,335	8	800	4.5	
Add (1) 265 CFM Trio Portable Air Cleaners		1,335	8	1065	6.0	
RTU-6	Media Center	2,200	20	3000	4.2	
Add (2) 300 CFM Goodyear Portable Air Cleaners		2,200	20	3600	5.0	

Ventilation Study Results

Typical School Report – Issues Fixed with Portable Air Cleaners, Open Doors/Windows and Fans



LAKEWOOD ELEMENTARY

Equipment	Space	Area (ft^2)	Ceiling Height (ft)	Supply Air Flow (cfm)	Supply Air Changes per Hour (ACH)	Supply Air Changes per Hour (ACH) with Corrective Actions
RTU-1	Overall System	1,588	9	1800	7.6	7.6
RTU-2	Overall System	4,283	14	5480	5.4	5.4
	Multipurpose Room (specifically)	3,195	16	2720	3.2	8.1
Univents	Classrooms D1 - D6, Centrum D7 (Typ.)	924	9	1000	7.2	7.2
Univents	Classroom C103,106,109,110W (Typ.)	879	9	1000	7.6	7.6
Univents	C109 Media Center (Typ.)	2,099	9	2500	7.9	7.9
Univents	Classrooms A1 - A6 (Typ.)	928	9	1000	7.2	7.2
Univents	Centrum A100 (Typ.)	1,123	9	1000	5.9	5.9
UV-C-107	Classroom C107,C108 (Typ.)	879	9	1250	9.5	9.5
Univents	B102 Classroom (Typ.)	1,212	9	1250	6.9	6.9
UV-C-1	Gym (1/2 of gym)	1,114	22	1700	4.2	5.5
Corrective Action(s)						
RTU-2	Multipurpose Room (specifically)	3,195	16	2720	3.2	
Add (4) 300 CFM Goodyear Portable Air Cleaners		3,195	16	3920	4.6	
Add (1) 24" 3,000 CFM Industrial Fan In Exterior Doors		3,195	16	6920	8.1	
UV-C-1	Gym (1/2 of gym)	1,114	22	1700	4.2	
Add (2) 265 CFM Trio Portable Air Cleaners		1,114	22	2230	5.5	


#THANKYOU