The What, Why, and How of the High-MERV Box Fan Air Cleaner

Allison A. Bailes III, PhD

Westford Symposium on Building Science, 1 August 2022

1

2

- Founder, president, & chief troublemaker of Energy Vanguard
- Author of the Energy Vanguard Blog & an upcoming book

3

MARQUIS
Who's Who®

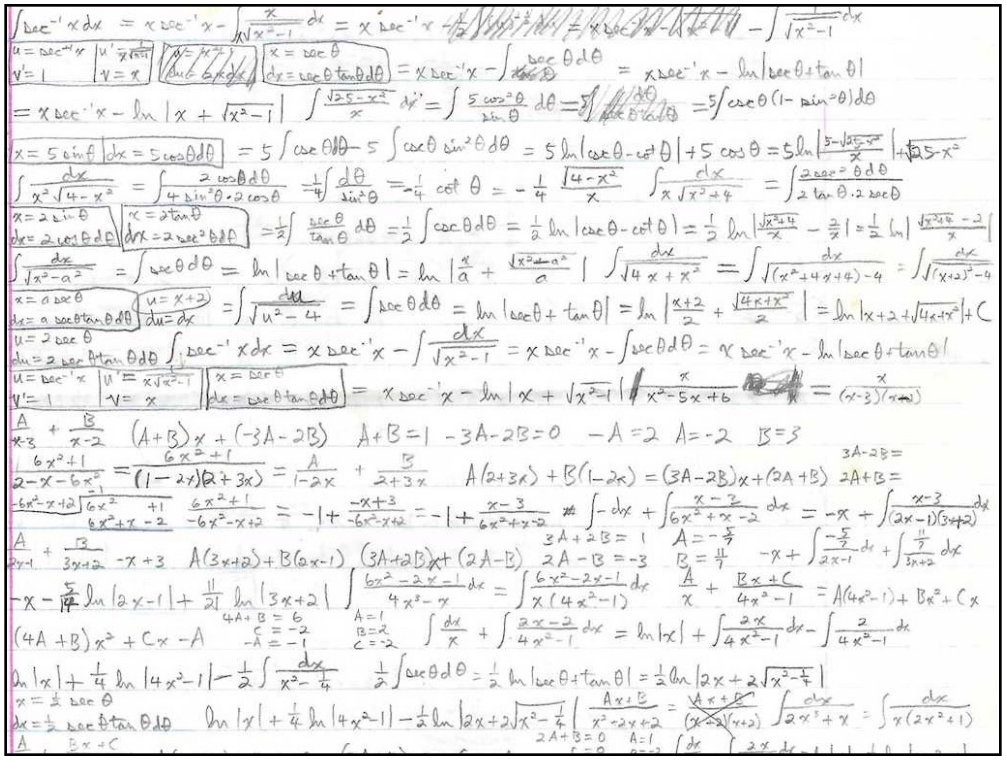
Who's Who of American Women

121 Chanlon Road • New Providence, NJ 07974 U.S.A. • 1-800-521-8110 ext. 7007 • Fax: 1-908-771-8645 • E-mail: women@renp.com

Dear Allison A. Bailes:

Congratulations! Based on the reference value of your outstanding achievements, you have been selected for inclusion in the forthcoming Millennium Edition of **Who's Who of American Women.** This unique compilation will chronicle the most accomplished women from across the United States and Canada who are leading us into a new era.

4



5

The What

6


20 x 20 x
MERV
13
WARNING

7


John Semmelhack @JohnSemmelhack · Sep 15
The MERV-13 box fan filter. A DIY project even a small child can manage (with a little help).
facebook.com/comparettocomf...
Show this thread

8

9

10

Corsi-Rosenthal Box

11

Corsi–Rosenthal Box

From Wikipedia, the free encyclopedia

The **Corsi–Rosenthal Box**, also called a **Corsi–Rosenthal Cube** or a **Comparetto Cube**, is a design for a do-it-yourself air purifier that can be built comparatively inexpensively. It was designed during the COVID-19 pandemic with the goal of reducing the levels of airborne viral particles in indoor settings.

Contents [hide]

1 Background and history
2 Design
3 Efficacy
4 References

An example of a homemade Corsi–Rosenthal Box air filtration unit

Background and history [edit]

Since COVID-19 was declared a pandemic by the World Health Organization on 11 March 2020,[1] evidence, including increasing amounts of peer-reviewed research, has been accumulating that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus causing COVID-19, is airborne.[2][3][4] Superspreading events are generally associated with indoor gatherings.[5][6] In response to the emerging evidence and recommendations of infectious disease researchers,[7][8] engineers have begun to consider how improved ventilation may reduce indoor viral loads.[9]

12

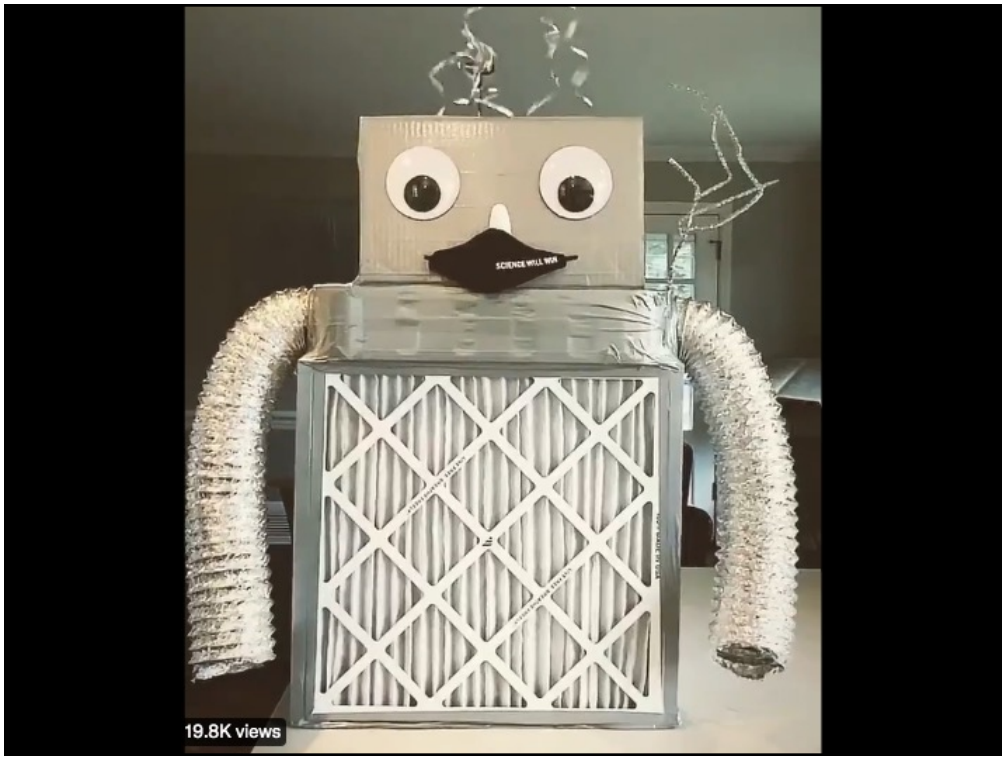
13

14


PRODUCT / PRODUIT
ADULT
ADULTE
PEDIATRIC
PÉDIATRIQUE
ASTM LEVEL / ASTM NIVEAU
LEVEL 1
NIVEAU 1
LEVEL 2
NIVEAU 2
LEVEL 3
NIVEAU 3
COLOUR / COULEUR
BLUE
BLEU
BLACK
NOIR
QUANTITY / QUANTITÉ
40 BOXES
40 BOITES
48 BOXES
48 BOITES
WEIGHT / POIDS
19.25 / 20.95 LB / 8.75KG - 9.5KG
BL99872519 EXP/1223
MANUFACTURER / FABRICANT:
CANADA MASQ CORPORATION
WWW.CANADAMASQ.COM

15

16


SCIENCE WILL WIN
19.8K views

17


SUBSCRIBE
SLJ School Library Journal
News & Features
Reviews+
School Libraries
Censorship
Public Libraries
Corsi-Rosenthal Boxes Help Clear the Air at Schools Across the Country
by Kara Yorio
Feb 04, 2022 | Filed in News & Features
0
High school environmental sciences teacher Carol Matheny didn't want to start a new lesson the day before winter break, so she decided to give her students some reading time.
"Our librarians are phenomenal, and I told them I would really like to do a reading day," says Matheny, who teaches ninth to 12th graders at Parkview High School in Sterling, VA. She couldn't believe the number of books that arrived after her request.

18

19

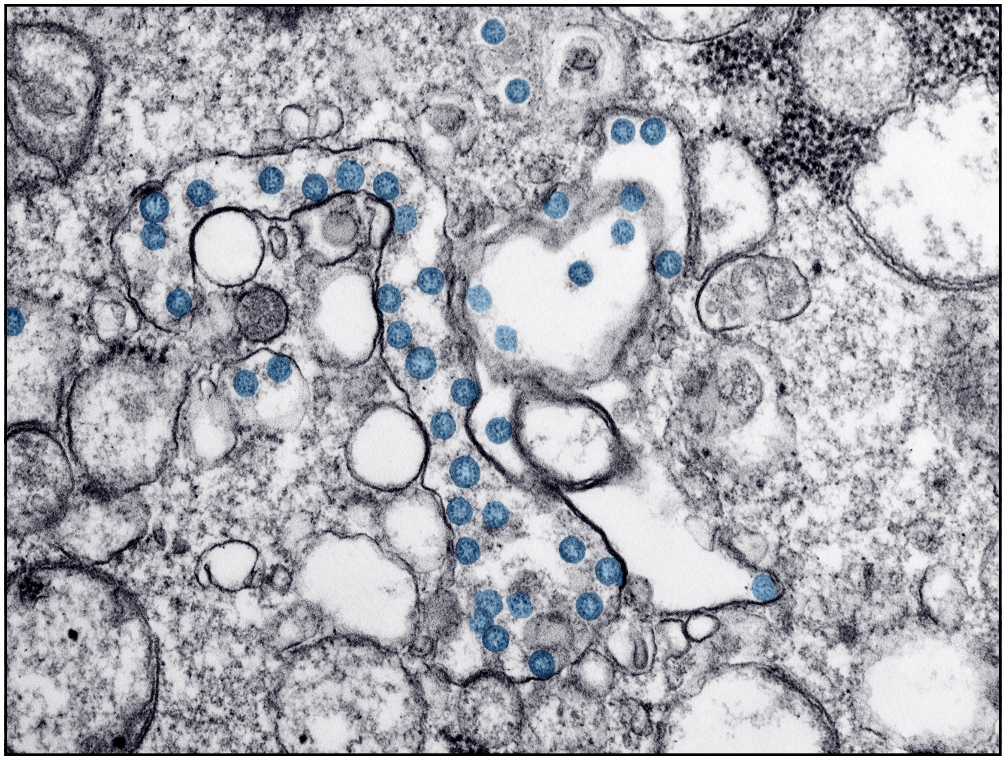
20


THE INTERNATIONAL
Women's
LEADERSHIP ASSOCIATION
April 14, 2015
Dear Allison,
On behalf of The International Women's Leadership Association, it is my distinct pleasure to notify you that, in consideration of your contribution to family career, and community, you have been selected as a woman of outstanding leadership.

21

The Why

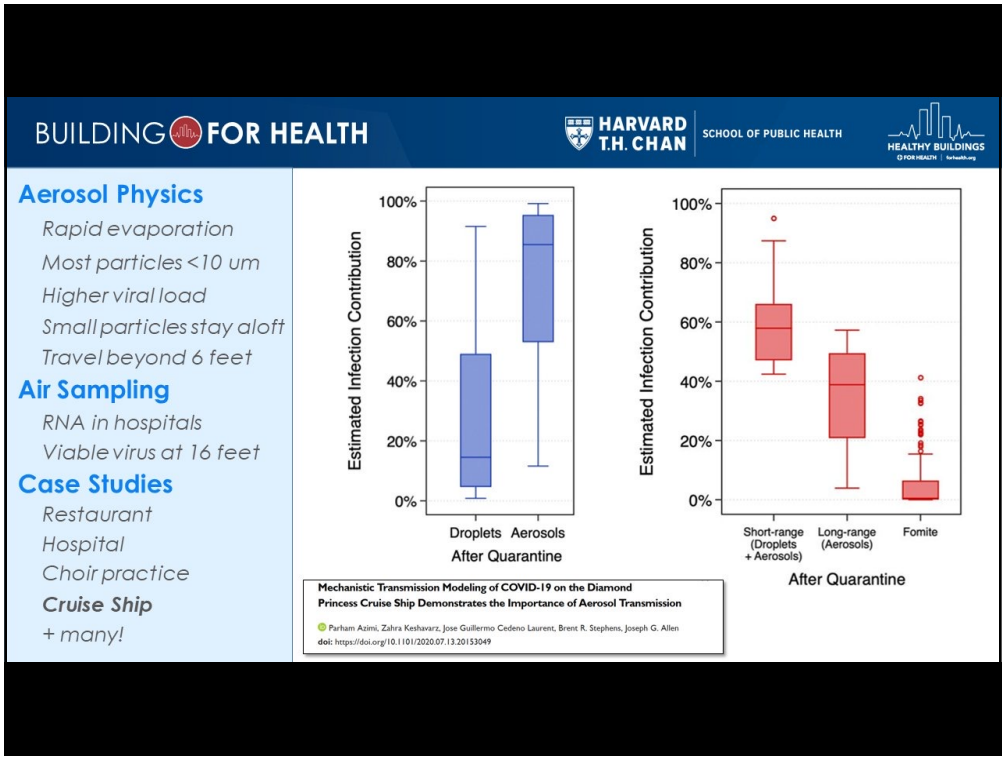
22



23

COVID is airborne!

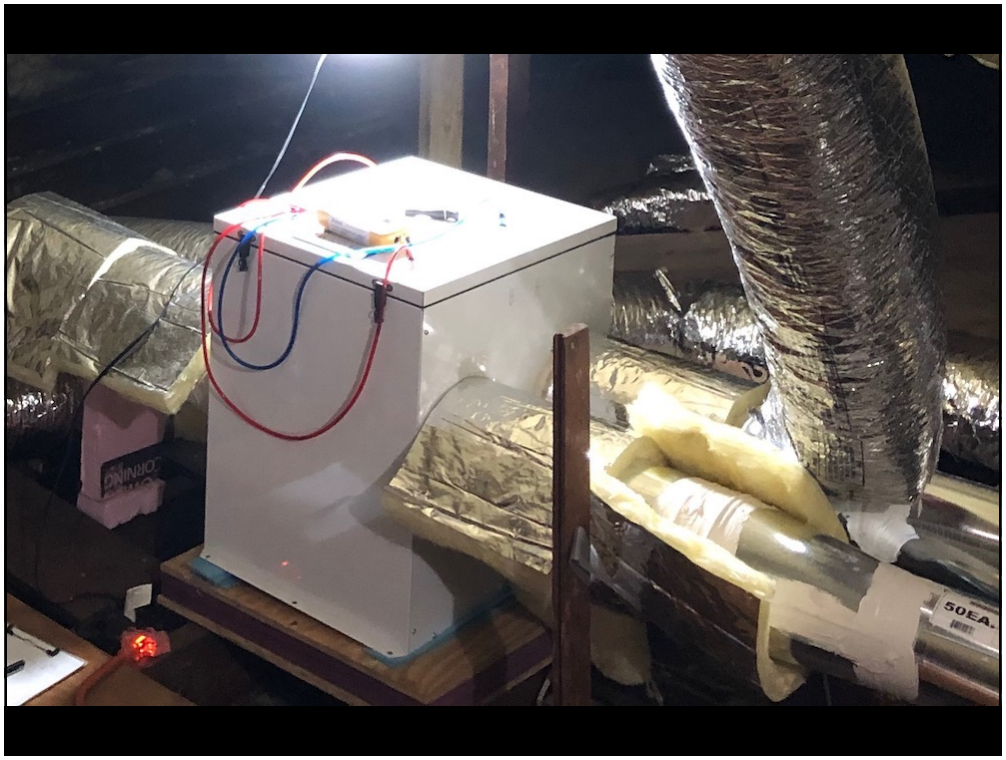
24


BUILDING FOR HEALTH
HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH
HEALTHY BUILDINGS
Aerosol Physics
Rapid evaporation
Most particles <10 um
Higher viral load
Small particles stay aloft
Travel beyond 6 feet
Air Sampling
RNA in hospitals
Viable virus at 16 feet
Case Studies
Restaurant
Hospital
Choir practice
Cruise Ship
+ many!
Estimated Infection Contribution
100%
80%
60%
40%
20%
0%
Droplets
Aerosols
After Quarantine
Short-range (Droplets + Aerosols)
Long-range (Aerosols)
Fomite
After Quarantine
Mechanistic Transmission Modeling of COVID-19 on the Diamond Princess Cruise Ship Demonstrates the Importance of Aerosol Transmission
Parham Azimi, Zahra Keshavarz, Jose Guillermo Cedeno Laurent, Brent R. Stephens, Joseph G. Allen
doi: https://doi.org/10.1101/2020.07.13.20153049

25


80.2°F 26%
2835
CO_2 ppm
aranet4

26



27


Running
PM2.5 (ug/m³)
2.2
PM10 (ug/m³)
3.4
Number of particles (per/L)
333
Good
Tamtop
AQI
HCHO
PM2.5
66.4°F 73%
827
aranet4

28

29

30

Indoor Air Pollutants

- Particulate matter
- Secondhand smoke from cigarettes (SHS)
- Nitrogen dioxide (NO2)
- Carbon monoxide (CO)
- Ozone (O3)
- Volatile organic compounds (VOCs)
- Mold
- Allergens
- Bioeffluents (including CO2)
- Radon
- Viruses

31

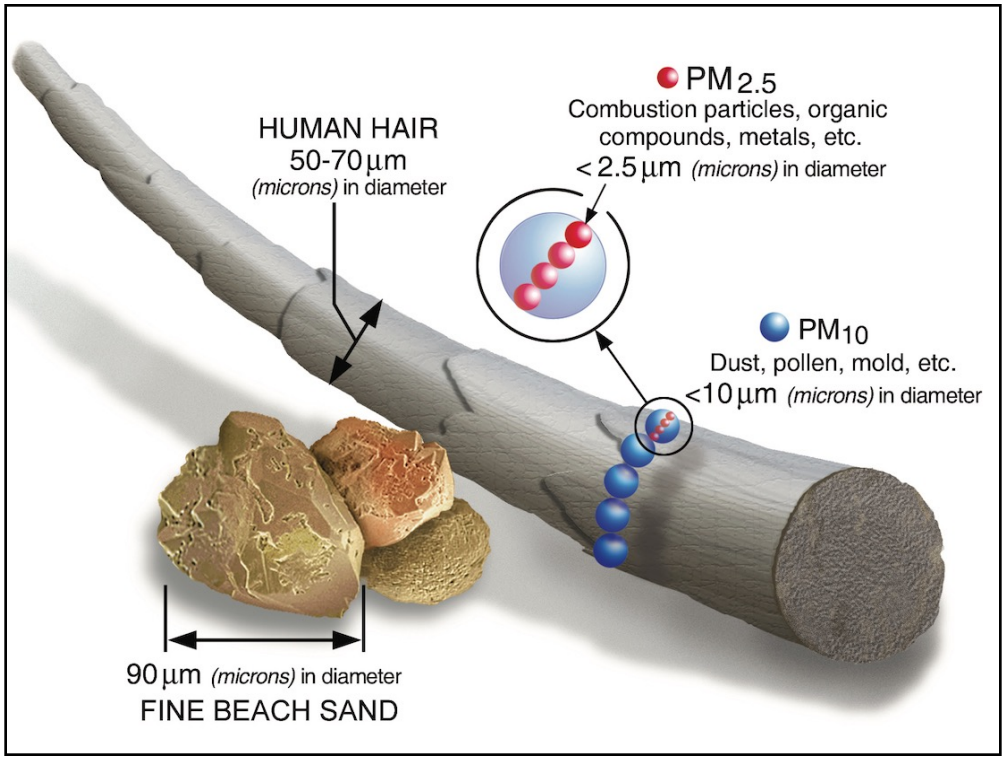
Indoor Air Pollutants That Can Be Filtered Out

- Particulate matter
- Secondhand smoke from cigarettes (SHS)

- Mold
- Allergens
- Bioeffluents (including CO2)

- Viruses

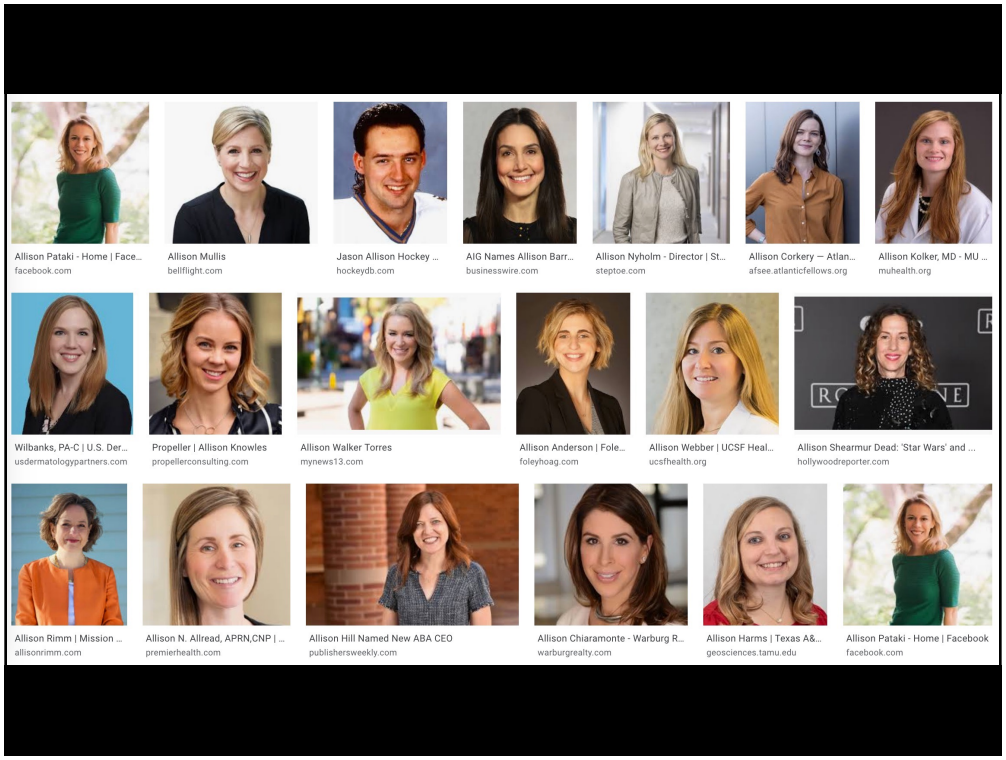
32



33

MERV	0.3-1.0 µm	1.0-3.0 µm	3.0-10.0 µm
16	≥ 95%	≥ 95%	≥ 95%
15	≥ 85%	≥ 90%	≥ 95%
14	≥ 75%	≥ 90%	≥ 95%
13	≥ 50%	≥ 85%	≥ 90%
12	≥ 35%	≥ 80%	≥ 90%
11	≥ 20%	≥ 65%	≥ 85%
10		≥ 50%	≥ 80%
9		≥ 35%	≥ 75%
8		≥ 20%	≥ 70%
7			≥ 50%
6			≥ 35%
5			≥ 20%
4			< 20%
3			< 20%
2			< 20%
1			< 20%

34


Allison Pataki - Home | Face...
facebook.com
Allison Mullis
bellflight.com
Jason Allison Hockey ...
hockeydb.com
AIG Names Allison Barr...
businesswire.com
Allison Nyholm - Director | St...
steptoe.com
Allison Corkery — Atlan...
afsee.atlanticfellows.org
Allison Kolker, MD - MU ...
muhealth.org
Wilbanks, PA-C | U.S. Der...
usdermatologypartners.com
Propeller | Allison Knowles
propellerconsulting.com
Allison Walker Torres
mynews13.com
Allison Anderson | Fole...
foleyhoag.com
Allison Webber | UCSF Heal...
ucsfhealth.org
Allison Shearmur Dead: 'Star Wars' and ...
hollywoodreporter.com
Allison Rimm | Mission ...
allisonrimm.com
Allison N. Allread, APRN,CNP | ...
premierhealth.com
Allison Hill Named New ABA CEO
publishersweekly.com
Allison Chiaramonte - Warburg R...
warburgrealty.com
Allison Harms | Texas A&...
geosciences.tamu.edu
Allison Pataki - Home | Facebook
facebook.com

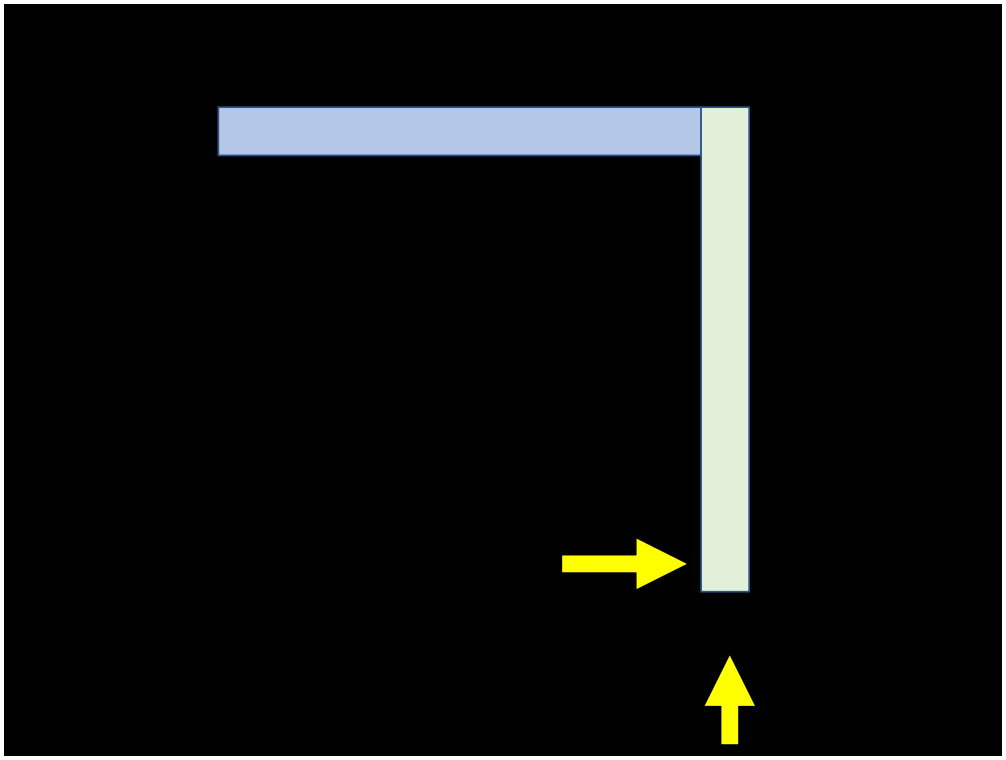
35

The How

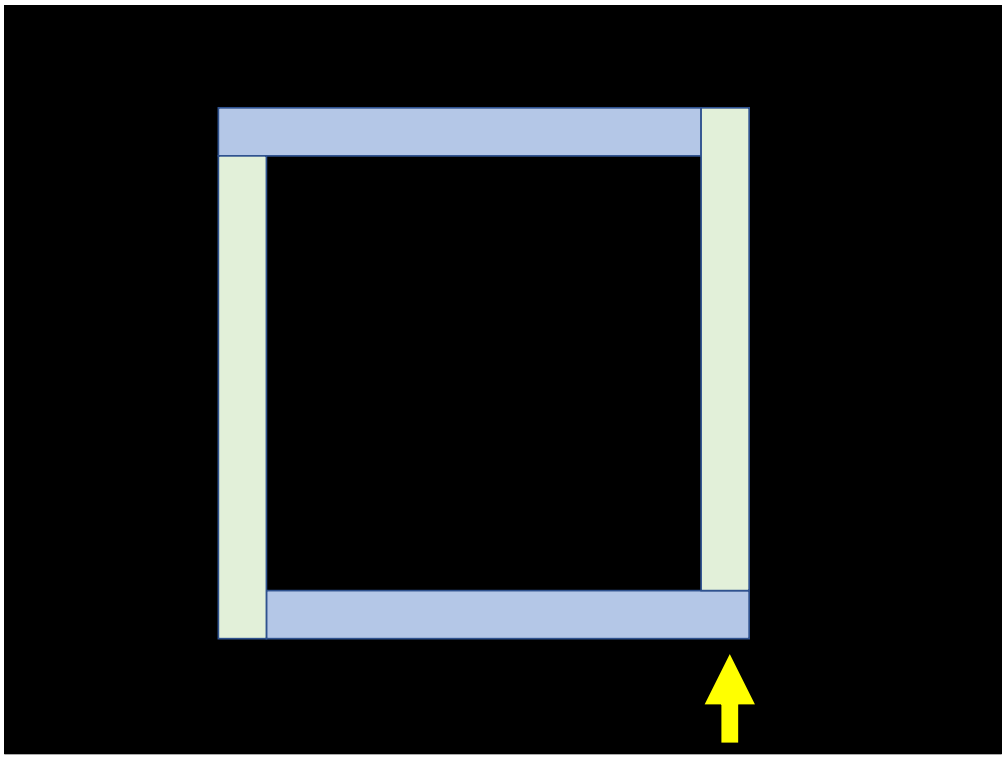
36

37

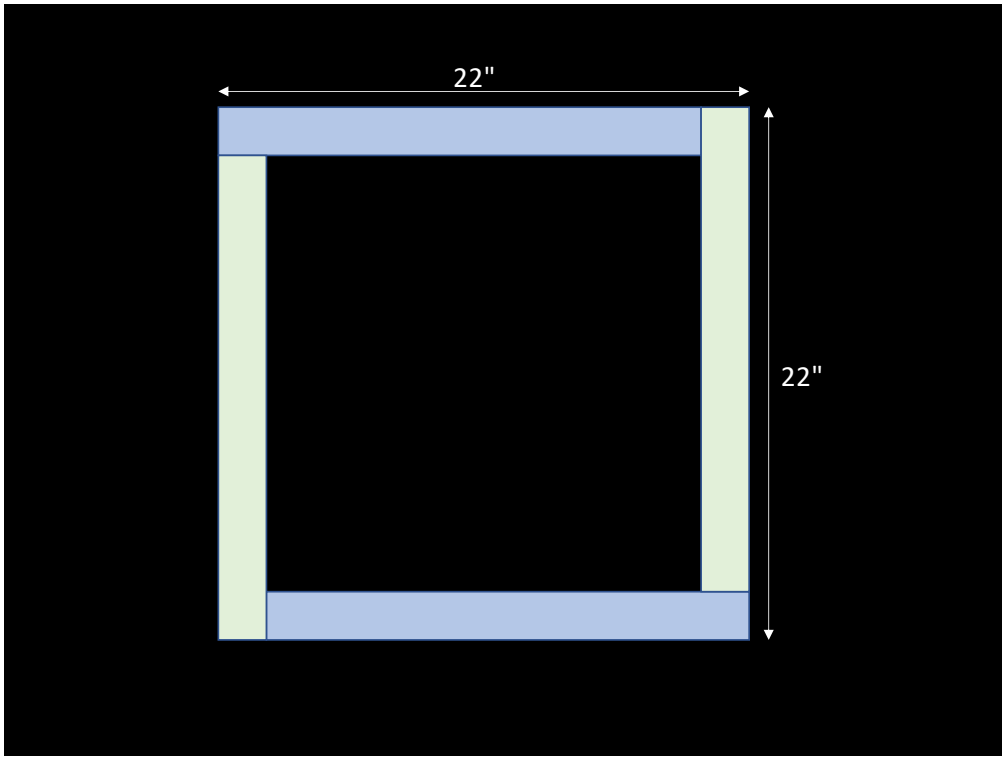
38



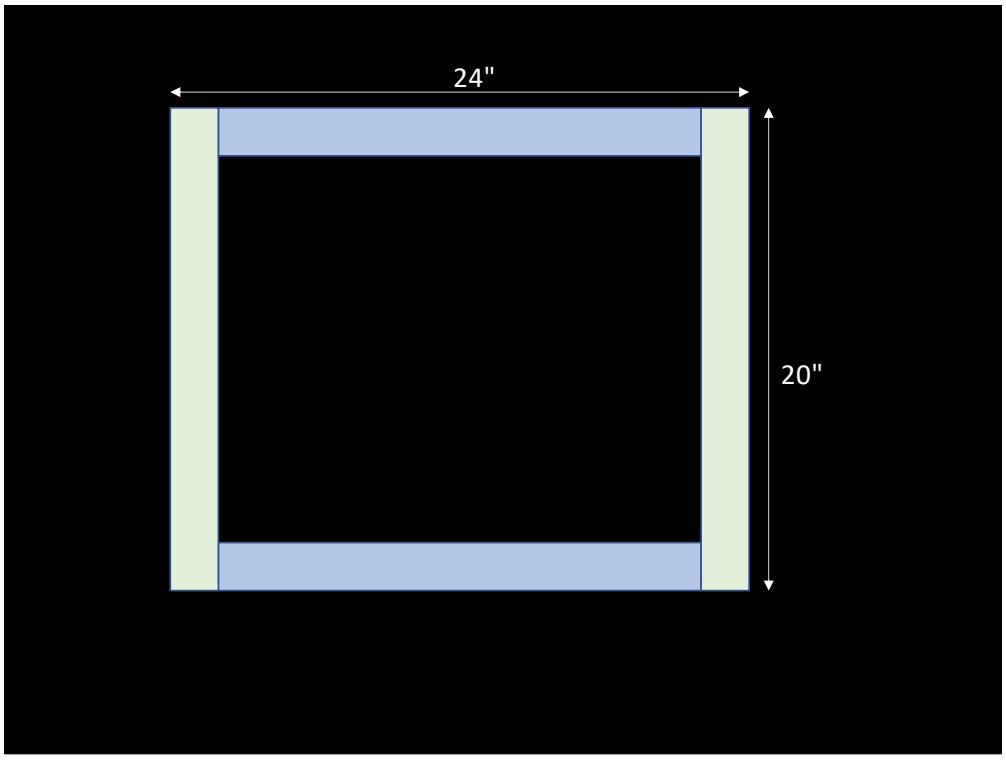
39



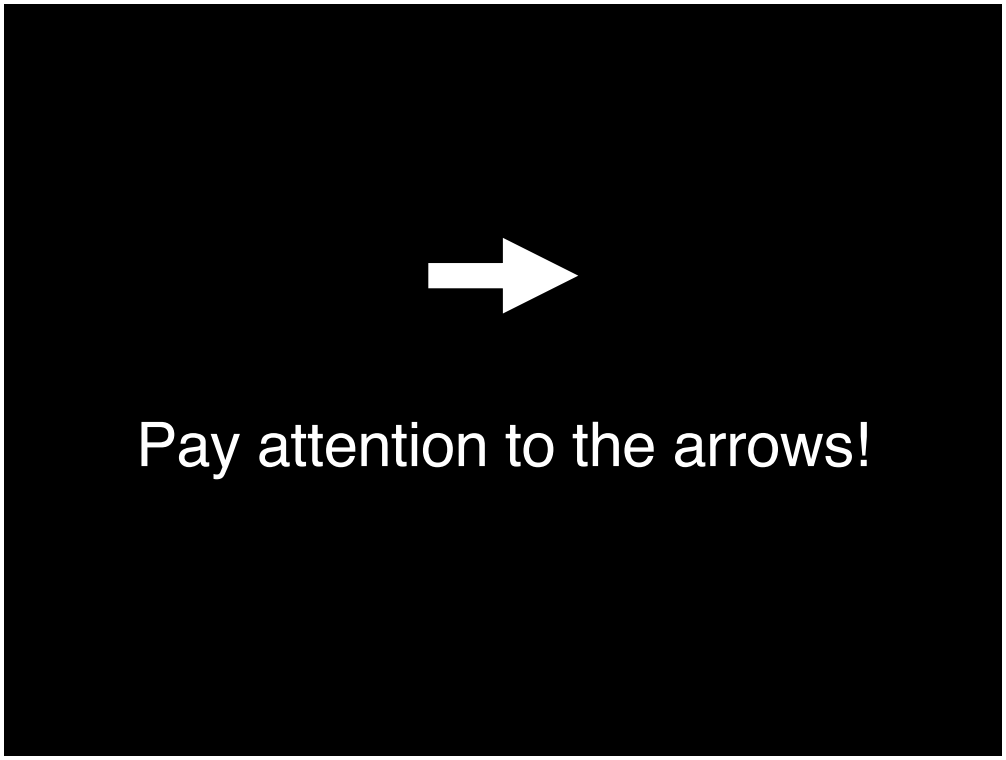
40



41



42



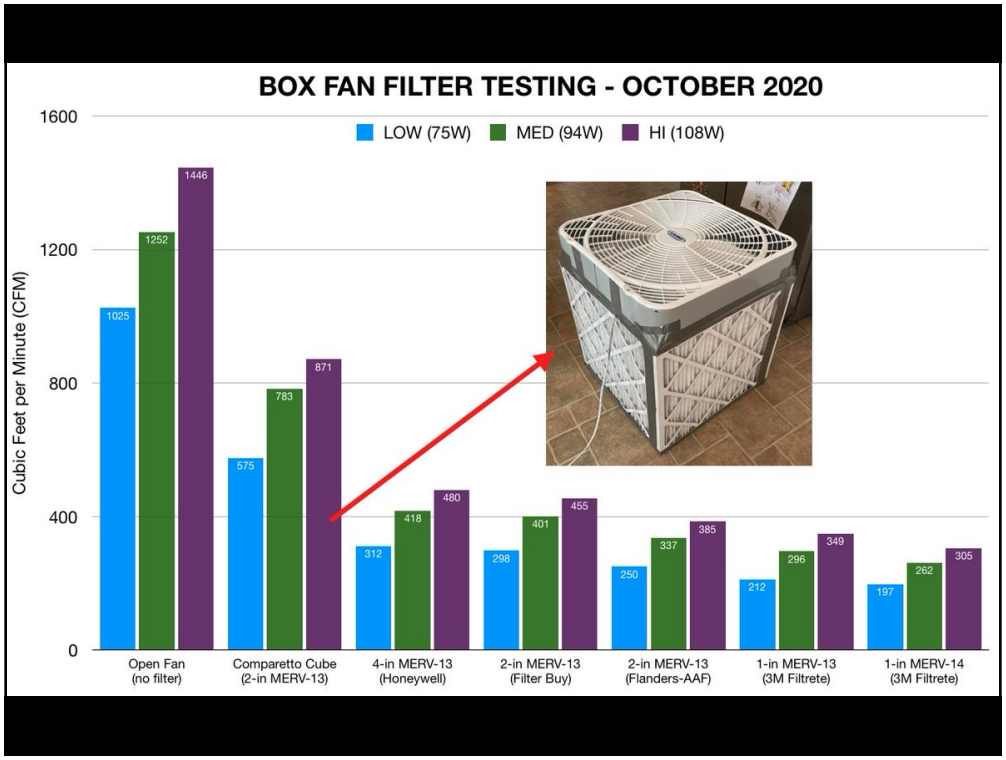
43

44

Air Changes per Hour

45

46



47

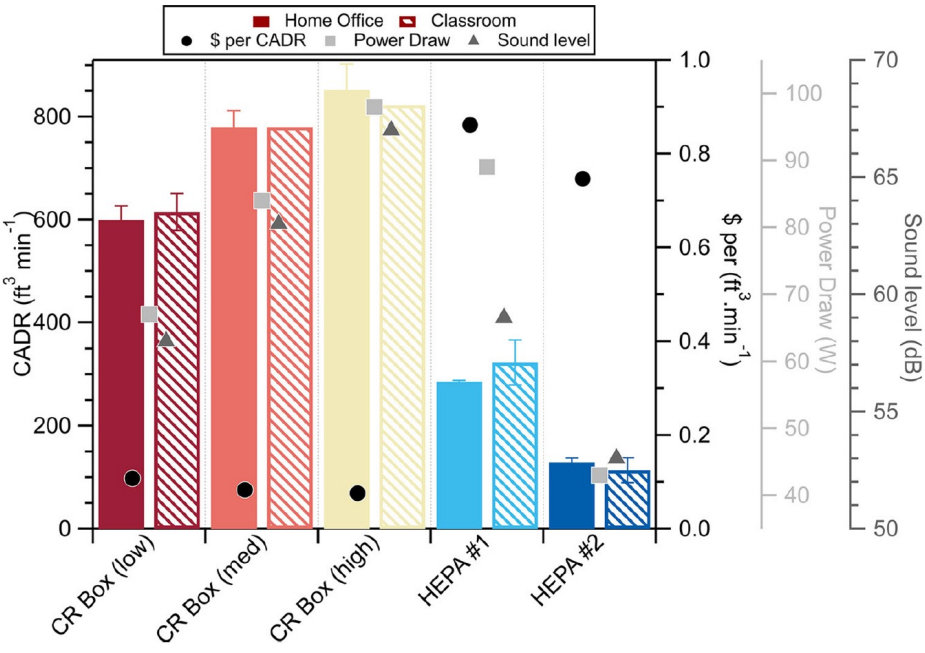
Clean Air Delivery Rate

48

CADR =

Flow rate (cfm)
x
filter efficiency

49



50

Will it catch on fire?

51

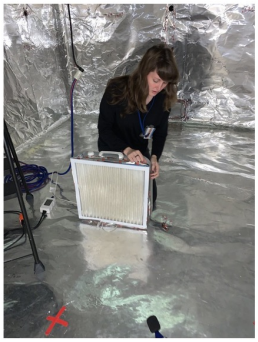
Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors

On this page:

- Study Overview
- UL Safety Report Findings
- Frequently Asked Questions
- DIY Air Cleaner to Reduce Wildfire Smoke Indoors Infographic
- Related Resources, Presentations, and References

Study Overview

Everyone deserves access to clean indoor air during wildfire smoke events. But commercial air cleaners can be difficult to obtain when there are smoky conditions from wildfires because of limited availability or high cost. Many health and air quality agencies and nonprofits are providing instructions and parts for making Do-It-Yourself (DIY) air cleaners as a solution to reducing smoke indoors. DIY air cleaners are made by attaching an air filter to a box fan with tape, brackets or a bungee cord. With their use, concerns have been raised about the potential for the box fans to overheat when operated with a filter attached, which could pose a fire or burn risk.



EPA researcher, Heidi Vreeland, testing a DIY air cleaner.

At this time, there is minimal information on how effective DIY air cleaners are at removing smoke particles. Limited data published in the scientific literature, preliminary testing results from EPA and several anecdotal reports from state, local, and tribal agencies suggest these DIY air cleaners may help reduce exposure to the particles in smoke.

EPA is conducting research to evaluate DIY air cleaners to answer questions from EPA partners and the public about their effectiveness and safety. The research is part of a multi-faceted study called the Wildfire Advancing Science Partnerships for Indoor Reductions of Smoke Exposures (ASPIRE) Study. The objectives of the Wildfire - ASPIRE Study are to compare indoor and outdoor fine particulate matter ($PM_{2.5}$) concentrations, a main component of wildfire smoke, and to develop strategies for reducing indoor pollutant concentrations in public buildings during wildland fire smoke events.

52

"Preliminary results show that throughout the testing, temperatures of all fan components remained safely below recognized temperature safety standards. None of the scenarios tested posed any observable fire hazards."

53

"Preliminary results show that throughout the testing, temperatures of all fan components remained safely below recognized temperature safety standards. None of the scenarios tested posed any observable fire hazards."

54

NO

55

Isn't the virus too small?

56

57

NO

58

Does it work?

59

AEROSOL SCIENCE AND TECHNOLOGY
2022, VOL. 56, NO. 6, 564–572
https://doi.org/10.1080/02786826.2022.2054674

TECHNICAL NOTE

Characterizing the performance of a do-it-yourself (DIY) box fan air filter

Rachael Dal Porto[a], Monet N. Kunz[a], Theresa Pistochini[a,b], Richard L. Corsi[a,c], and Christopher D. Cappa[a]

[a]Department of Civil and Environmental Engineering, University of California Davis, Davis, California, USA; [b]Western Cooling Efficiency Center, University of California, Davis, Davis, California, USA; [c]College of Engineering, University of California Davis, Davis, California, USA

ABSTRACT

Air filtration serves to reduce concentrations of particles in indoor environments. Most standalone, also referred to as portable or in-room, air filtration systems use HEPA filters, and cost generally scales with the clean air delivery rate. A "do-it-yourself" lower-cost alternative, known as the Corsi-Rosenthal Box, that uses MERV-13 filters coupled with a box fan has been recently proposed, but lacks systematic performance characterization. We have characterized the performance of a five-panel Corsi-Rosenthal air cleaner using both research-grade instrumentation (an aerodynamic particle sizer, APS) and a low-cost particle sensor. Measurements of size-resolved and overall decay rates of aerosol particles larger than 0.5 microns emitted into rooms of varying size with and without the air cleaner allowed for determination of the apparent clean air delivery rate—both as a function of size and integrated across particle sizes for a number-weighted median particle diameter of 1.2 ± 0.12 microns. The measurements made in the different rooms produced similar results, demonstrating the robustness of the method used. The size-integrated effective clean air delivery rate increases with fan speed, from about 600 to 850 $ft^3\ min^{-1}$ (1019 to 1444 $m^3\ h^{-1}$) as determined with the APS. The low-cost sensor yields similar clean air delivery rates as the APS, demonstrating a method by which others who lack access to research-grade instruments can determine the effectiveness of Corsi-Rosenthal Boxes that use components that differ from those used here. Overall, our results demonstrate that our Corsi-Rosenthal air cleaner efficiently reduces suspended particle concentrations in indoor environments.

ARTICLE HISTORY
Received 9 January 2022
Accepted 14 March 2022

EDITOR
Jing Wang

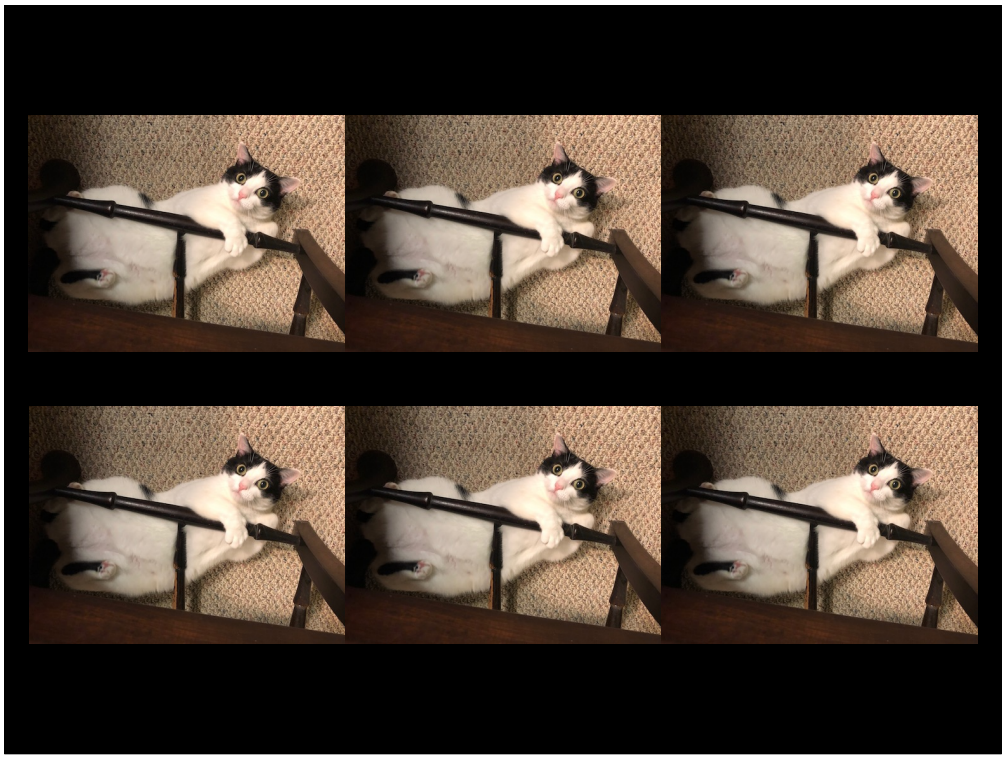
60

61

YES

62

63



64

Thanks to:

John Semmelhack
Lew Harriman
Joe Medosch
Bill Bahnfleth

65

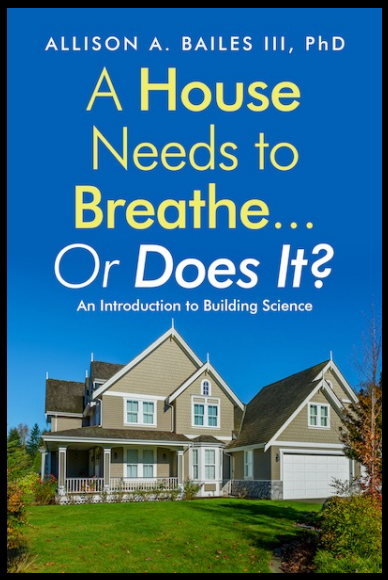
Allison A. Bailes III

evinfo@energyvanguard.com

@EnergyVanguard on Twitter

linkedin.com/in/allisonabailes

66



Coming out this fall!

Sign up for book updates!

energyvanguard.com/book