

## **Podcast script: Healthy Buildings, Healthy People, Healthy Planet**

**[Theme music]**

**Ashley Ahearn (Narrator):** You're listening to Environmental Health Chat – a show from the National Institute of Environmental Health Sciences that explores the connections between our health and our world.

I'm Ashley Ahearn.

**[Music fades out]**

**AA:** The average American spends 90 percent of their time indoors. 90 percent!

That tells us two things:

One: We need to get out more.

And two: Our buildings are an important area of study when it comes to environmental exposures that can affect our health – and perhaps even, our cognitive ability.

Public health researchers want to better understand the health implications of factors like indoor air quality, moisture, temperature, pests, and noise. Buildings also use a lot of energy, contributing to the release of greenhouse gasses that drive climate change.

Joe Allen is one of the leaders in the field connecting the dots between building science and public health. He's an associate professor at the Harvard T.H. Chan School of Public Health.

He is not the first, however, to point out that the buildings where we spend so much time can make us sick.

**Joe Allen:** Traditionally, the idea of sick building syndrome started in the 1980s. And it's a loose collection of symptoms related to time spent in underperforming buildings.

**AA:** Symptoms like malaise, headache, eye irritation, upper respiratory symptoms.

But in Allen's experience, spending time in sick buildings can lead to much more serious health outcomes.

**JA:** I mean, I've done work in buildings where there were brain cancer clusters. I've done work in buildings where the allegation was, it was literally killing children. I've done infectious disease outbreaks in hospitals where people had died. But the problem is that these sick buildings are everywhere.

**AA:** Ok, so what is in buildings that can make us sick?

Allen breaks it down into three main categories:

**JA:** You have outdoors, you have indoors, and then you're most adjacent immediate neighbors. And all of those things influence the health of your indoor space.

**AA:** So when he says “outdoors,” he’s talking about air that circulates into your home from the outdoors. And that can include wildfire smoke or pollution from traffic or industrial facilities nearby.

“Indoors” meaning the volatile organic chemicals and other substances in building materials, carpets, cleaning products, air fresheners, and furnishings that can be toxic.

And then when he says “immediate neighbors,” he means adjoining apartments or garages that can be sources of airborne pollutants that can get into the places we live.

Allen says that if there is one silver lining to the COVID-19 pandemic is that the virus – and the way it’s transmitted – has shined a light on the importance of *ventilation* in buildings as a way to protect our health.

**JA:** There's very little, if any, spread happening outdoors. This is a virus that is spread entirely indoors, in under-ventilated spaces. So for example, there have been outbreaks in restaurants, on a school bus, in office buildings, in schools – the underlying factor is that it's indoors in under-ventilated places.

**AA:** Allen says better ventilation and filtration systems are key to our ability to continue to gather with others indoors.

Business owners, Allen says, have been particularly interested in his work since the pandemic hit.

**JA:** If I'm a CEO, buildings are not some afterthought, they're critical to the function of my company. It's existential, my company would go out of business if I don't have a healthy indoor environment. I want to know about the air quality – what do I need to do to make sure my people are safe and my company can operate?

**AA:** Allen says the learning and adaptation to improve building health has been swift in the corporate world. The main focus has been on improving filtration and ventilation – which is huge, Allen says.

But the pandemic has opened the door to a suite of other possibilities when it comes to improving indoor environments.

**JA:** So now we can talk about water quality and lighting and biophilic design and acoustics and safety and security, and all these things that we know influence our health in a building, while we have everyone's attention that air quality matters. We have their attention because of COVID. But now we can have the more broad conversation about what else matters.

**AA:** Another thing on Allen's radar – the ways in which buildings contribute to the climate crisis:

**JA:** So 80% of global energy is fossil fuel combustion. Buildings consume 40% of that global energy. In addition, we have embodied carbon challenges. Think about all the materials and products we use in our buildings, so they're major contributors to the climate crisis. And this is

what's driving a lot of the electrify everything movement, a lot of the new building standards like New York City's local law 97, Boston's new standard for buildings, Seattle just passed a similar standard. So buildings are getting the attention they need in terms of their contribution to climate.

**AA:** So, they're part of the climate problem, but Allen says, they can also be part of the solution.

Buildings can be designed to be more energy efficient – and to switch from using fossil fuels in their appliances and heating and cooling systems to using electricity. That would reduce demand on the strained electrical grid. And Allen adds...

**JA:** Buildings also have the power to protect us from climate disasters like wildfires and the air pollution that accompanies them, or the threats from heat waves, or even the threats from hurricanes and tornadoes and the ensuing damage that follows after the storms pass through. So buildings really are at the center of many of our international problems, but that also means they're part of the solution set.

**AA:** So, buildings play a role in our climate future. They play a role in how we adapt to the pandemic.

And, Allen's research suggests, they may also play a role in our cognitive ability.

Allen and his colleagues have been trying to understand how indoor air quality can affect decision-making function and cognitive ability through a series of studies, funded in part by NIEHS, known as the Cog FX studies. They started small, back in 2015, with 24 volunteers.

**JA:** The first one was done in a lab with collaborators in New York, in a highly controlled setting, where we showed that higher ventilation rates were associated with better cognitive function performance.

**AA:** The results were dramatic. When volunteers worked in well-ventilated conditions, with lower levels of CO<sub>2</sub> and VOCs, they scored 61 percent higher on cognitive tests than when they worked in typical building conditions.

In the second Cog FX study, Allen and his colleagues expanded to buildings across the U.S. and found the same results. Then, they broadened their study even further.

**JA:** Now the third Cog FX study we just completed we call our Global Cog FX study. We brought this methodology to six different countries over 300 office workers in 42 buildings. And we followed people for an entire year.

**AA:** Workers who participated in the study had an air quality monitor on their desk as well as an app on their phone.

**JA:** And when people are at their desk at work, we ping them and have them take these short surveys. And what do we find?

**AA:** Similar results – lower CO<sub>2</sub> and VOC concentrations in the air meant better test results. But Allen said that by gathering all that data over the course of a whole year, they could look at a variety of different CO<sub>2</sub> concentration levels.

**JA:** And so it wasn't just testing one level versus another level, we had a continuum. And we found that the relationship between ventilation and cognitive function was linear, even at levels that were previously deemed acceptable.

**AA:** Meaning that the better the ventilation – and the lower CO2 levels dropped – the better and better people scored.

**JA:** Right, no threshold. And the implication is really important for people in buildings – that even good buildings have room to improve, right? It's not once you hit a certain level, we're okay. But we kept seeing this effect. And we see this linear, no threshold effect.

**AA:** But get this – they didn't just see effects around CO2 levels. They were also able to look at real-time particulate levels – or PM 2.5 – in the air that surrounded study participants desks and they found real-time drops in cognitive function correlated with higher particulate levels.

**JA:** That's really interesting. Because if you think about most of the studies of particles, PM 2.5, it's usually done with outdoor air monitors and large epidemiological cohort studies or datasets of people. This is looking at what happens with particle concentrations indoors measured in real time against real time cognitive function performance, and we see an impact.

**AA:** So, how do we keep our buildings from making us dumber? When millions of students across the country go to school every day, what can be done to not only keep them safe, but help them perform better?

**JA:** It doesn't have to be hard. It doesn't have to be expensive. So what we've recommended for a while now in the pandemic is every school should target four to six air changes per hour through any combination of better ventilation or better filtration.

**AA:** That means the indoor air is completely recycled and replaced with fresher, cleaner air.

Allen has three key recommendations to accomplish that.

One: Maximize the intake of outdoor air. Design your building system to bring in as much fresh air as possible – that can be as simple as opening more windows.

**JA:** Two: upgrade the filters in your mechanical system to a MERV 13, or higher – M-E-R-V 13 or higher.

Three, you can supplement this with the use of portable air cleaners with HEPA filters.

If you do all those things, simple things, we know we can reduce the risk from COVID-19 and other infectious diseases and comes with all these other benefits.

**AA:** Allen is passionate about his work – and he's seized the opportunity, during COVID to inform as many people as he can about the importance of healthy buildings. But, he cautions:

**JA:** The healthy buildings movement will be a total failure, if it's not healthy buildings for all.

**AA:** There are blatant inequities – particularly within the school system – in this country and those inequities play out in building quality and maintenance. That can have very real health and safety implications for students in disadvantaged communities.

Allen says a standard classroom should be designed to get three air changes per hour. The average school building gets about half that. But it doesn't stop there...

**JA:** This is where it gets really interesting is that if you look at schools that are predominantly Hispanic or Black, you find that the ventilation rates are even lower. Right, so we have this disproportionate impact. And if you look at communities where the school has a higher percent of students on free or reduced lunch, so lower income student body, also there we see lower ventilation rates. So it's not only do we have a design based standard that isn't being met in most schools across the United States, we see this disproportionate impact on disadvantaged communities.

**AA:** But, Allen says, COVID-19 has presented us with a unique moment to make a change.

**JA:** It's this really generational opportunity to fix this. And one of our goals is to drive home the point that investing in the school building is an investment in student health, teacher health, student thinking, student performance, it's a way to address these historic inequities, if the money is spent right, and it provides benefits well beyond COVID-19.

**AA:** Allen says, children who go to school in healthier, better ventilated buildings have been shown to have lower rates of absenteeism and asthma attacks – and higher test results on cognition assessments.

Paying attention to our indoor environment may provide benefits that extend far beyond the pandemic.

**[Music comes up]**

I'm Ashley Ahearn. Thanks for listening to Environmental Health Chat.