UConn students built an air purifier out of furnace filters, a fan and duct tape and it traps COVID-19 virus. Here's how they did it.

By Ed Stannard
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A fifth-grade class at Noah Webster MicroSociety Magnet School will be building do-it-yourself air filters out of furnace filters, a box fan and its box. The finished product will be taken to the Whitehouse in Washington D.C. to be presented by Marina A. Creed, a family nurse practitioner, UConn Health. One was presented to the Office of Science and Technology Policy for the White House on Sept. 9. (Douglas Hook / Hartford Courant) (Douglas Hook)

Take four air filters, like you use in your furnace. Tape them together so they form a cube.

Buy a box fan of the same size — 20 by 20 inches — and attach it to the top of the cube.

Don't throw away the box but use one side of it as the bottom of the cube, the other on top of the fan with a hole cut in the round shape of turning fan blades.

What have you got? An air filter that traps 99% of the particles in the room, including those as small as the coronavirus that causes COVID-19, according to University of Connecticut researchers.

Leading a multidisciplinary team at UConn is Marina Creed, a neuroimmunology nurse practitioner in the UConn Health Multiple Sclerosis Center.

"This is a cross-campus initiative to study air pollution, both indoor and outdoor, and engage our undergraduate and community K-12 students in learning how, through simple materials available at a hardware store, they can create, in about 30 minutes, a high-efficacy portable air cleaner for only about $65 that works as well as the $500 air cleaners," Creed said.

The units use about as much electricity as a 60-watt light bulb (the old incandescent kind, not LED) "and they remove fine particulate matter from the air," Creed said. "So we're talking larger molecules like pollen, mold, dust and then smaller molecules ... that can be laden with COVID-19 viruses. And so they actually remove COVID from the air, along with influenza, along with mold, dust, allergens, cockroach allergens, you name it."

A group of students recently presented a box, decorated to look like the White House, to President Joe Biden's Office of Science and Technology Policy, which offered its official support in May. And they've received a $300,000 donation of cryptocurrency (pegged to the dollar so it won't fluctuate) from the Balvi Foundation, established by Vitalik Buterin, co-creator of Ethereum.

Creed is excited about the air filter, known as Corsi-Rosenthal box after its inventors, but she's also enthusiastic about the number of UConn groups involved, as well as the ability to engage grade-school students in building them. Besides the UConn Health Center, there are team members from the schools of medicine, nursing, engineering and education, plus the CT Area Health Education Center.

It's something Creed envisions "students doing as a STEM science project in schools, for schools, so that when the children are done making these you simply plug it into the wall and, boom, you have immediately improved indoor air quality, which is a solution to our country's long-standing indoor air-quality issue in K-12 schools."

Sofyia Green, 10, volunteers to help with the do-it-yourself air-filter under the tutelage of Marina A. Creed, a family nurse practitioner at UConn Health. The finished product was taken to the White House in Washington and presented by Creed to a representative from the Office of Science and Technology Policy for the White House. (Douglas Hook / Hartford Courant) (Douglas Hook)

UConn students have given 200 of the boxes to the Coventry Public Schools, one for every room in the schools. And they've given 100 to the West Hartford Public Schools for their dining halls and 10 to the Hartford Public Library. Creed and Dr. Kristina Wagstrom, associate professor of chemical and biomolecular engineering, recently taught a class on air pollution and helped fifth-graders make the boxes at the Noah Webster Microsociety Magnet School in Hartford.

"Some of the proposed science projects that I see children doing with this is how to make a machine, what is a machine, how to make a machine out of simple objects, understanding the physics of fluids, how air is a fluid and how it will travel through the path of least resistance and what is particulate matter? What is air pollution?" she said.

The tightly woven filters are rated MERV 13, which will remove 90% of particles between 1 and 3 microns in size. The shroud is meant "to improve the aerodynamic performance of this so that there was no dead air in the spaces in the corners," creating better pressure inside the box, Creed said.

“In some of these commercial air filters, the air will go upon the path of the least resistance,” she said. “So sometimes air goes around the filter. In this case the negative pressure created inside the box by the draw of the fan ... is sucking the air in. The air has nowhere to go but through these very tight filters. What happens to the stuff in the air when it goes through the filter? It gets stuck in the filter and clean air is discharged out of the top.”

Watching the filters get dirty over time reinforces the idea that invisible particles are being taken out of the air, which Creed said is important to drive home the issue of air quality. “I think one of the problems that people have with indoor air quality or air pollution is that, because we can’t see it, we don’t appreciate it,” she said “Unless you have asthma or allergies, you don’t realize that it’s affecting you.”

Once the filters get really dirty, the box is taken apart and a new one built.

Wagstrom said the boxes were tested in UConn classrooms with similar conditions to elementary school classes, including students, and “we saw that these boxes were really effective at removing particles from the air. ... Now, in the real world, the effectiveness is going to depend on a lot of different things. But in the preliminary tests we’ve done, we’ve seen decreases, pretty rapid decreases.”

The effectiveness is not just near the boxes. “We’re seeing them across the entire room,” Wagstrom said. “And we’re seeing pretty rapid decreases. Sometimes, down below 50 [percent] decreasing by 50 to like 85%. So, some pretty large decreases.”

She said the next step is more tests in real-world classrooms.

Fayekah “Faye” Assanah, assistant professor of biomedical engineering, taught her Foundations of Engineering students how to make the boxes as part of the core curriculum. More than 400 students built 100 of the boxes during last spring’s semester.

“As you can imagine, they were all first-year engineering students, and they just got out of COVID,” Assanah said. “When the schools were shut down, they were probably high schoolers, so they have lived through that pandemic situation where schools had to be shut down and they weren’t able to go to class. So they have lived through this pandemic, and ... making these DIY boxes for the new-generation students in the elementary schools, they really felt like they are giving something to their community.”

Douglas Brugge, chairman of the Department of Public Health Sciences in UConn’s School of Medicine, said there’s an even larger need for the do-it-yourself air filters.

“There’s a need for these outside the U.S. and low-income communities here,” he said. “In the entire world, people are breathing air that’s polluted or has COVID in it or mold or whatever. So there’s a global need for low-cost air purifiers that can be deployed broadly in people’s homes and schools and workplaces.”

Closer to home, the boxes have filled another need, Brugge said. “I think it’s admirable that UConn is engaging with communities and trying to help them,” he said. " I think that’s part of our mission as a public university. We should be out there working with the communities and in trying to help them address problems, in this case, a public health issue.”

Carson Kehmna, a civil engineering student, said in an email, “To me, the most important thing I learned while building the Corsi-Rosen filters is the capability I have as an engineer to make a tangible impact on the lives of others.

“This is the first project I have ever worked on where it has made a real impact on somebody else, and it made me recognize that I will have the opportunity to improve the lives of so many different people in my career as an engineer.”

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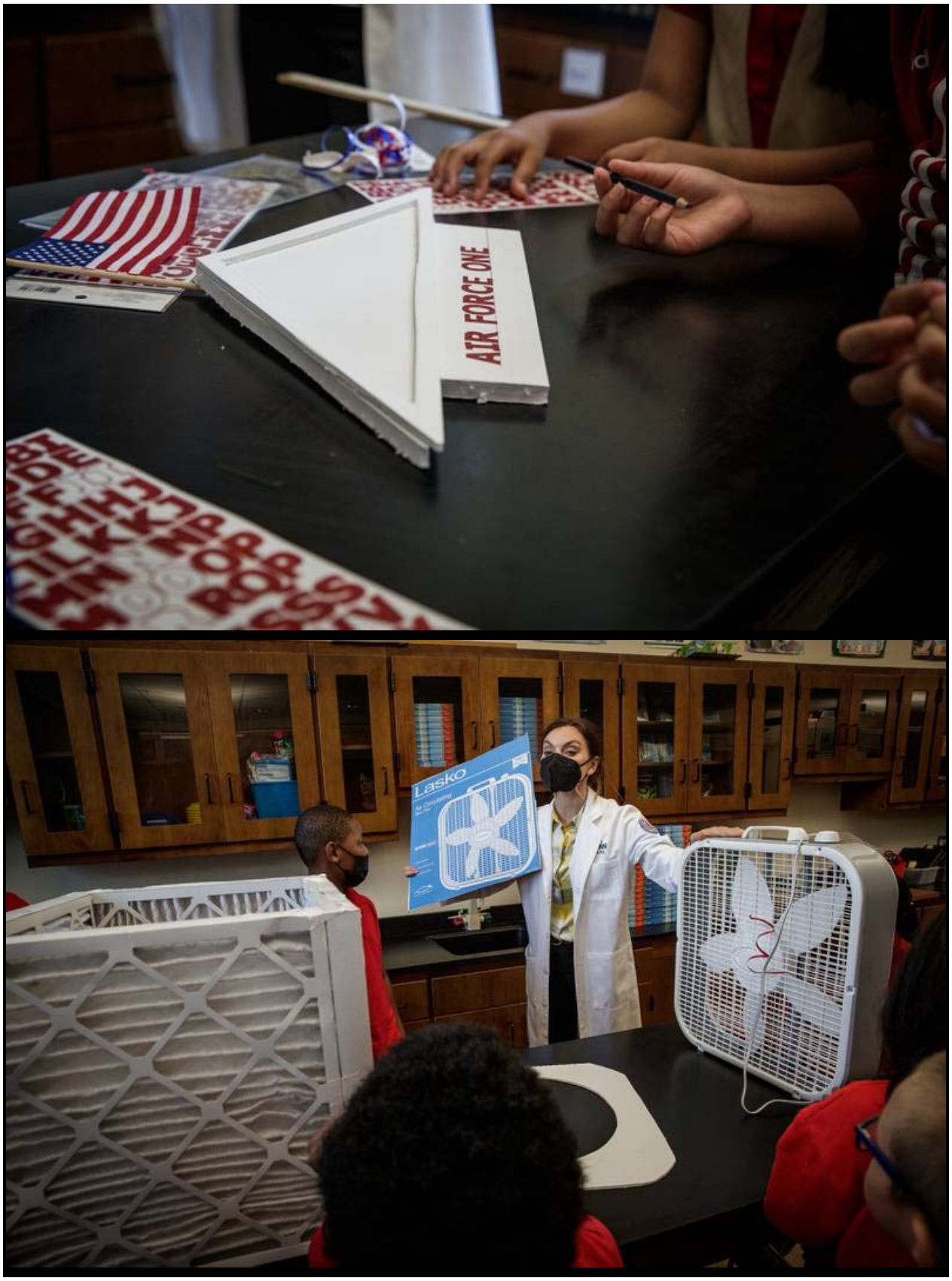
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From left: Mary LaFountain, the fifth-grade science teacher, Katherine Done, 10, and Sofyia Green, 10, listen to Marina A. Creed, a family nurse practitioner at UConn Health, on how to build a do-it-yourself air filter. The fifth-grade class at Noah Webster MicroSociety Magnet School will be building do-it-yourself air filters out of furnace filters, a box fan and its box. The finished product will be taken to the White House in Washington D.C. to be presented by Creed. It will be shown to a representative from the Office of Science and Technology Policy for the White House. (Douglas Hook / Hartford Courant) (Douglas Hook)