Air Quality Monitoring for Citizen Science

[music] Anne Johnson: Welcome to Environmental Health Chat, a podcast about how the environment affects our health, from the National Institute of Environmental Health Sciences Division of Extramural Research and Training. I'm your host Anne Johnson.

Air pollution is a major environmental health problem all over the world. It's linked with a number of respiratory problems, cardiovascular problems, cancers, and other health risks. In the United States, the U.S. Environmental Protection Agency monitors and reports on air quality to ensure compliance with regulations.

But a combination of technological advances and growing public awareness is leading more and more people to do their own air quality monitoring as part of citizen science initiatives. It's now possible to buy a sophisticated sensor and track pollutants in your house, as you ride your bike to work, [traffic noise] or just outside that factory down the road [machine sound].

But what exactly is that monitoring device telling you? [beeping noise] How do you interpret the numbers, and how do you know if the information is accurate?

Here to answer all these questions is Ron Williams of the EPA. He's a project lead in the Air, Climate, and Energy Emerging Technologies research area, part of EPA's Office of Research and Development. I asked him to start with a bit of context about air pollution and how it's measured.

Ron Williams: All of us are exposed to various air pollutants. EPA has a number of criteria pollutants that we are concerned about and which communities often have to monitor. Those include things like particulate matter—we might call that the dust that's in the air—and various pollutants like ozone and nitrogen dioxide, which are gases. There are also other pollutants such as carbon monoxide and sulfur dioxide. All of these are pollutants that exist in the atmosphere—some are manmade, others are naturally occurring—and a lot of different processes affect the level of pollutants that we are exposed to. And at EPA, we work with state and other communities to regulate air quality and ensure that the best air quality possible is being provided to the American public.

Anne Johnson: EPA does this with a network of air quality monitoring stations that can cost a hundred thousand dollars or more. These regulatory-grade instruments have to meet rigorous quality controls and are tested, operated and maintained by expert technicians.

By contrast, the commercial market today has air quality monitors that run from a few hundred to ten thousand dollars. Ron calls these next-generation air monitoring devices, or NGAM for short. And he says people should be aware of the potential and the limitations of these devices.

Ron Williams: Many of the NGAM technologies that are currently available often have not been fully characterized—that is, one may not know how they react under extremes of temperature, one may not understand will they produce data that's only reporting the pollutant of interest as compared to reporting data that might be influenced by an artifact or a co-pollutant? How well do they reproduce their data? For those regulatory-grade monitors, that's all established. Your data is only as good as your

quality assurance that evaluates that data. Many of the low-cost devices that we typically see and that are commercially available have not been tested to that extent, and so it's an unknown. And in some cases the instrument even under its very best operating status may not be sensitive enough, it may not be reproducible enough, it may not be accurate enough to go there are provide you useful data.

Anne Johnson: So the EPA has started a program to test NGAM devices in field and laboratory settings and even works with manufacturers to help them make their devices more accurate and reliable. Ron says these devices are still a far cry from what the EPA uses. But the fact is, not everyone needs a regulatory-grade air quality monitor.

Ron Williams: While it's very very hard for a lot of the next-generation air monitoring devices to meet regulatory-grade quality, that doesn't mean that those devices do not have a role in citizen science. And in fact, there are multiple roles that one might consider for devices that are not regulatory quality. The first is, of course, for informational purposes. A device doesn't have to be fully accurate to give you potentially a yes-no question: Is there more pollution, potentially, in this location as compared to another location? You can also use this type of technology for educational purposes. We see a lot of movement in schools to add devices like this as part of their curriculum to give students the experience of collecting air quality data, so there's also an educational aspect.

Anne Johnson: Whatever the reason you want to collect data about air pollution, Ron says it's crucial to know what you want to get out of your measurements.

Ron Williams: One typically should have a plan so that you can be assured that when you collect data that, one, that it's of value, and that you can interpret it. There are many nuances to that, but certainly, one has to think about: Am I collecting enough data? Am I using the proper instruments to collect data? And do I have the ability to understand what the data is telling me? For professional scientists, we have to develop statistical plans before we collect any data, and we encourage citizen scientists to think about those questions, and if needed, team with others who can provide that expertise. Often, that expertise does exist in the community, and one wants to tap into that at the very earliest part of the process. One can be very frustrated if you collect a bunch of data but you really don't have a plan for analyzing it and at the end you've just got data and you're just left looking at it.

Anne Johnson: You also need to have a clear picture of your device's capabilities and limitations. If you're moving around while collecting data, be sure you know what the lag time is between data being collected and pollution being reported, and account for that lag time when you're mapping air pollution measurements collected at different locations and times.

EPA has these tips as well as detailed technical information about many commercially available air quality monitors in their online Air Sensor Toolbox for Citizen Scientists. The toolbox even has an up-to-date list of grants and funding opportunities for citizen science. You can find the link on our website, niehs.nih.gov/podcasts.

Thanks again to today's guest, EPA's Ron Williams.

You've been listening to Environmental Health Chat. I'm your host Anne Johnson, and our podcast is brought to you by the Division of Extramural Research and Training at NIEHS, part of the National Institutes of Health, an agency of the U.S. Department of Health and Human Services. [music]