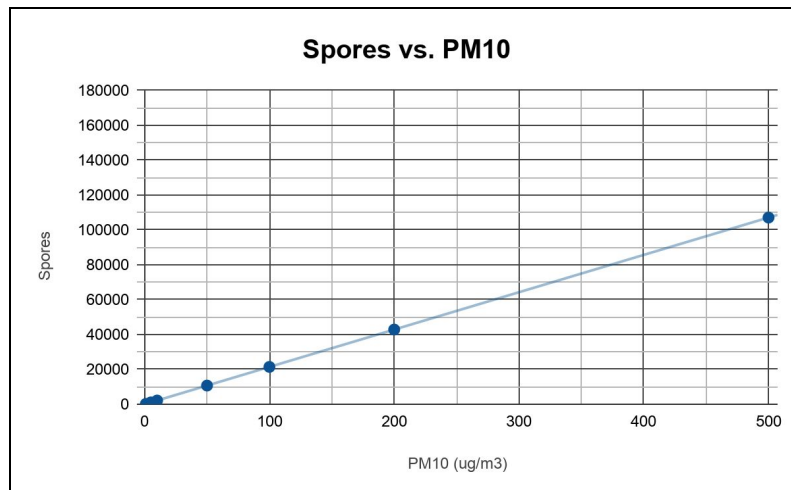


## How Does It Work?

The Particle Plus sensor measures particulates in the air near two different sizes, 2.5 microns (PM 2.5) and 10 microns (PM 10). These are the two particulate sizes typically measured when assessing air quality because they affect human health. This is because particles of

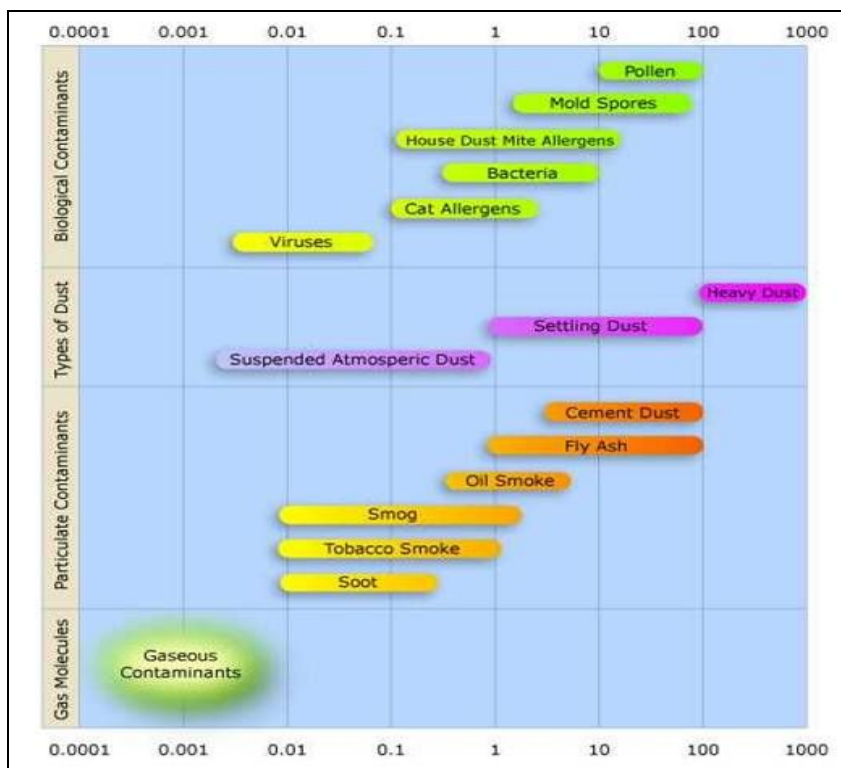
these sizes are capable of entering the lower respiratory tract. The PM10 particles are capable of penetrating to the very deepest parts of the lungs while PM2.5 particles or smaller can cross the blood barrier. The EPA has more information on the effects of particulate pollution<sup>1</sup>. You can see the particle size of some PM 2.5 and PM 10 pollutants here. The concentration of each particle size in air is measured separately and the sensor reports the value in micrograms (of each particle size) per cubic meter (of air). This unit of measure is what is used for industrial health evaluations and is abbreviated ug/m<sup>3</sup>.



The sensor uses a fan to move air past a laser that determines the amount of particulate present in the air. After turning the sensor on the mobile app, it will take a few seconds to warm up and then both PM2.5 and PM10 measurements will be shown on the SmartEnv Mobile App. The measurements update every second. Mold spores will

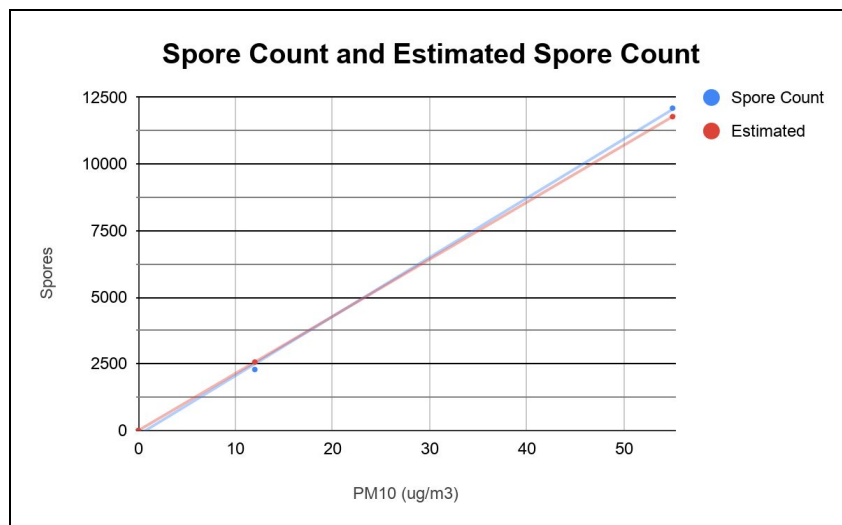
<sup>1</sup> <https://www.epa.gov/pmcourse/particle-pollution-exposure>

typically show up as elevated 10 micron readings. You can find more information on mold spores from the EPA<sup>2</sup>.



Mold spores are typically between 3 to 30 microns and will show up on the PM 10 channel of the Particle Plus sensor. The readout from the Particle Plus detector is micrograms per cubic meter. A rough conversion can be made using this number and the mass of a mold spore. The mass of an average mold spore has been estimated to be  $1.4 \times 10^9$  grams<sup>3</sup>. Using this conversion, across the entire range of mold spore sizes (3 to 30 microns) the PM10

channel is roughly 30% efficient at measuring the spores. Therefore, a PM10 reading of 10 micrograms per cubic meter would correspond to 2100 spores per cubic meter.



A townhouse with mold contamination in a water heater closet was evaluated by the Particle Plus sensor as well as sampled by a mold professional deploying traps. The results from the lab show good agreement with the estimated mold spore concentration

<sup>2</sup> <https://www.epa.gov/mold/brief-guide-mold-moisture-and-your-home>

<sup>3</sup> [Plant Relationships](#)

measured by the Particle Plus sensor.

## What Else Is Detected?

You can also detect other types of particles that have a similar particle size. We have observed that pollen will set off the PM 10 channel. Excessive amounts of household dust will also likely be detected on both the PM 2.5 and PM 10 channels. For PM 2.5 channel only, we have found that smoke will be detected even when it is difficult to smell. Second hand smoke from cigarettes has been found to be detectable for several hours, even if ventilation is attempted. Smoke from cooking or fireplaces is also easily detected. Smog from car exhaust can also be detected on the PM 2.5 channel. Regardless of source, excessive particulate matter present in building has been shown to cause a wide range of health issues<sup>4</sup>, including inducing asthma attacks, sick building syndrome, and increased incidence of respiratory infections.

## What are VOCs?

VOCs are volatile organic compounds that evaporate at room temperature. These include things such as gasoline, perfumes, vinegar, and paint thinner. Elevated VOC levels could be caused by a mold infestation, gas leak, or off gassing of building materials and is a concern for overall indoor air quality. These compounds include a number of toxic compounds, including benzene, toluene, and formaldehyde. Mold can produce a number of VOCs. These compounds are what produce the “musty” smell associated with mold infested dwellings. While most of the compounds are innocuous, there is experimental evidence that some of these compounds could be toxic<sup>5</sup>. Detection of VOC is yet another tool that can be used to detect and locate an active mold infestation, as they are only produced by actively growing mold colonies.

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<sup>4</sup> <https://iaqscience.lbl.gov/air-summary>

<sup>5</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4591661/>