How Do Daily Activities Affect Indoor CO_2, VOC, and PM2.5 Levels?

By: Precious Bassey, Londyn King, Alana Peermal

Mentors: Kendra Krueger, Evelyn Roman Lazen, Ricardo Toledo Crow

Glenn W. Bailey Foundation · Altman Foundation · Advanced Science Research Center, The Graduate Center, City University of New York · Community Sensor Lab, Advanced Science Research Center · American Museum of Natural History · The Pinkerton Foundation · NYCSRM Consortium · RISE Rockaway Initiative for Sustainability and Equity

INTRODUCTION

As technology and industry continue to advance, concerns about air quality persist—both outdoors and indoors. Indoor air quality is crucial to human health since we spend most of our time inside at home, school, or work (National Institute of Environmental Health Sciences, 2025). Yet, it is often overlooked, as many assume it is safe and regulated, despite being less monitored than outdoor air. This study will examine how daily activities such as cooking, cleaning, running the AC, and using household appliances affect indoor air quality compared to outdoor measurements. We will focus on volatile organic compounds (VOCs), gases released from certain solids or liquids; fine particulate matter (PM2.5), tiny airborne particles; and carbon dioxide (CO_2). The normal level for VOCs is below 500 parts per billion, for PM2.5 µg/m³ it is 9 and for CO_2 it is 400 and below. By tracking these pollutants, we aim to understand how everyday routines contribute to indoor air pollution and its potential impacts on health.

HYPOTHESIS

Human activities such as cooking, cleaning, using an electrical fan will increase the carbon dioxide (CO_2), volatile organic compound (VOCs) and fine particulate matter (PM2.5) levels, compared to levels of an sensor that is placed outside with little to no extreme weather conditions other than temperature.

GOAL

The goal of this study is to determine how common indoor activities, such as cooking, cleaning, and using electrical appliances affect indoor air quality by measuring changes in carbon dioxide (CO_2), volatile organic compounds (VOCs), and fine particulate matter (PM2.5).

METHODS

Parts to the air sensor

- Feather M0 WiFi (WINC1500- Microcontroller and Wifi Radio
- Featherwing Logger (RTC microSD)- Real-time Clock and MicroSD Reader
- Featherwing OLED 128x64- Display Screen
- Adafruit SCD41 CO2- CO2 Sensor
- BME280- Temp. Pressure Humidity Sensor
- Sensirion SEK-SEN5X - Particulate Matter/VOC/NOX Sensor
- Additional parts include screws, a cable and pin headers which were saturated on the breadboard

Code

- Merging sample and example codes using the Arduino language

Challenges

- When we were importing the code into the feather it took time because you could not do two at once

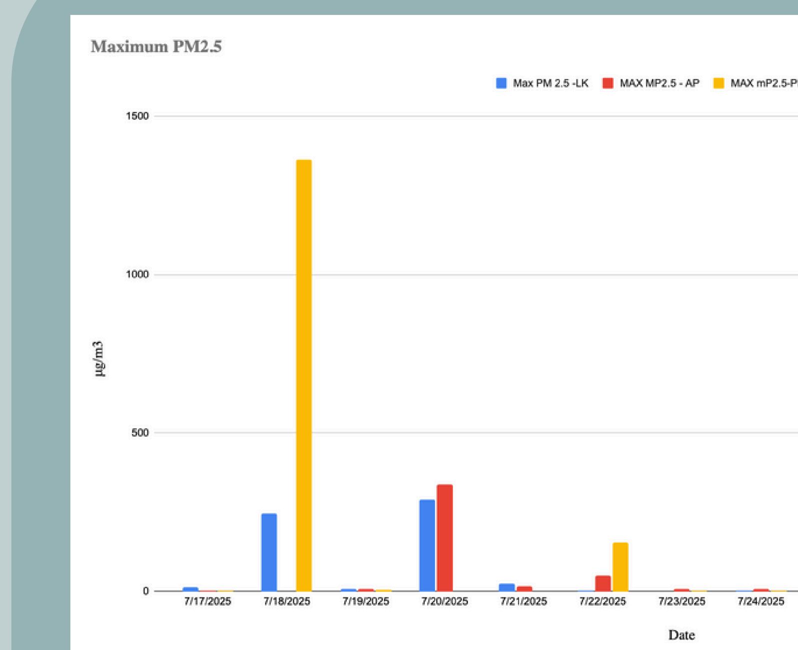
Sensor Groups

- **Control -** placed outside in stable weather conditions
- **Variable Sensor 1 -** placed indoors in the kitchen next to the gas stove
- **Variable Sensor 2 -** placed indoors next to a fan

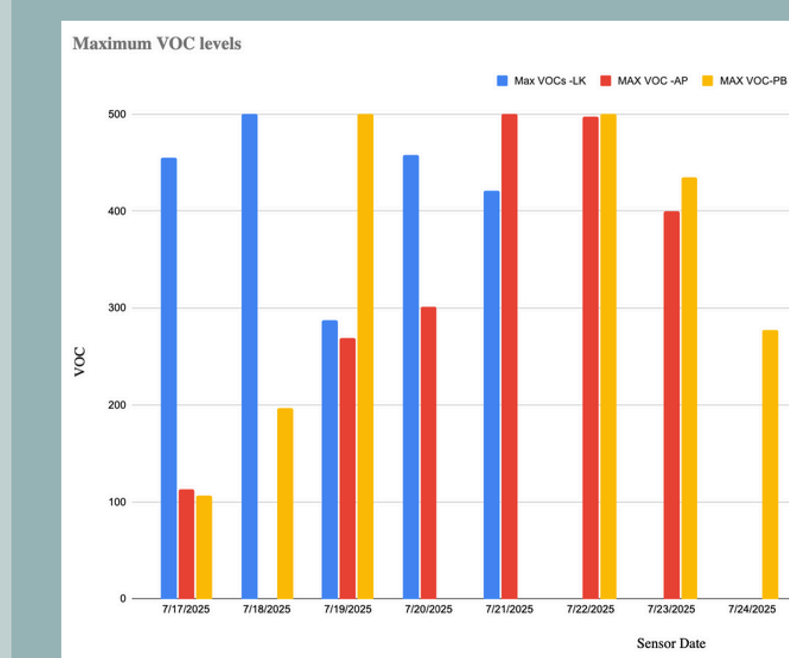
Data Collection

- Every two minutes the sensor would upload its data to a google sheets

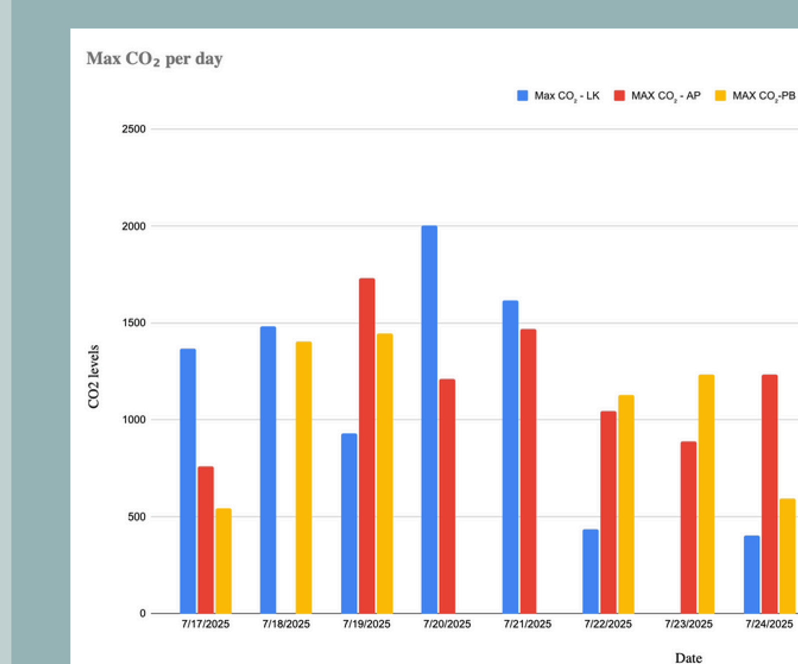
RESULTS/GRAPHS



Precious (yellow) had the highest level of PM2.5 due to her fan being on.



Londyn (blue) had the highest VOCs levels on 7/17/25, 7/18/25, and 7/20/25 as she was cooking.



Londyn (blue) had the highest level of CO_2 due to her cooking at the time.

According to the findings from our data, on the dates 7/17, 7/18 and 7/20 Londyn's VOCs levels and CO2 levels were the highest as she was cooking during that time frame. When she wasn't cooking her levels were the lowest. Additionally, Precious PM2.5 levels were the highest throughout the time period due to the fan being on at almost all periods.

CONCLUSION

In conclusion, our data shows that VOC, CO_2, and PM2.5 levels increased during cooking and when the fan was on. This suggests that restaurants, industrial indoor spaces, and homes with frequent activity may pose health risks. Increasing indoor air sensors can raise awareness, while better ventilation, air purifiers, and regular HVAC filter changes can help reduce the levels.

REFERENCES

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