*Note: This detailed proposal was written before reaching out to Tom Peters to see if I can/should do the experiment at the Oakdale campus so this will be written assuming that it will be done in my apartment.*

TITLE: Investigating Indoor Home Air Quality Using Particulate Matter Measurments

ABSTRACT:

The goal of this project is to investigate the effects that different emission sources have on the air quality in a home environment. This effect is evaluated by the particulate matter levels read by a sensor compared to baseline values from prior experiments and external sources. The two main emission sources being tested are those from cooking on the stove and the use of a 3D printer

LEARNING OBJECTIVE:

There are a few things that I want to learn in this experiment. The main thing I want to learn is truly how the different sources affect the air quality in my living space and if they might have any negative health effects. The next thing I want to learn is how the sensors used in this experiment work both in their measurements and their internal calculations. Another thing I will learn through the setup of the experiment is how to properly set up sensors to read data and store it in a readable format.

EXPECTED RESULTS:

The main expected results for this experiment come from experimental results and the resulting data analysis done on those results.

The first experiment will involve monitoring the PM levels (1, 2.5, 10) while cooking a stir-fry meal on a stove. This will be repeated for three trials while maintaining constant airflow (no windows open), if time is available three additional trials may be performed with windows open.

The second experiment will involve monitoring the PM levels while running a print on a 3D printer for ~2-3 hours. This will be repeated for 3 trails while maintaining constant airflow, as before additional trials with windows open may be run if time permits.

Both experiments will also collect temperature and humidity data to allow for identification of trends based on those changes. *Note: The PM 2.5 sensor itself does have output values adjusted to standard temperature, pressure, and relative humidity and regular values so those values could just be compared directly*

As an additional point of comparison, a set of trials may be run outdoors, which can then be compared to other local measurements after converting the PM 2.5 levels to an AQI value. As the data and is readily available and the sensor the use are very similar to the one I have this comparison would be done using PurpleAir.

For the data analysis section, statistical analysis will be done on the results from the individual experiments across the three trials. This will be done for the all of the measured PM levels. Additional analysis will also be done on the periods during and after running each experiment including the time of the peak value, rate of change, and rate of decay back to normal levels. Looking at the intervals for each experiment, including the decay period, an integrated exposure level will also be calculated. One last section of data analysis will involve comparing the results to other experiments.

PRESENTATION OUTLINE:

Introduction to the experiment

* Brief overview of the goal of the experiment
* Brief overview of the experimental methods

Results of cooking experiment

* Overview of results
* Comparison to other results
* Lessons learned
* (Potential): Comparison with and without ventilation

Results of 3D printer experiment

* Overview of results
* Comparison to other results
* Lessons learned
* (Potential): Comparison with and without ventilation

(Potential): Comparison of indoor and outdoor results

* Overview of results
* Comparison to other values

(If time) Interactive Section:

* Some sort of demo of the data changing in real time with a local source of PM 2.5 (cleaning product, lighter, etc.)

Conclusion

DIFFICULTIES:

The main projected difficulties of the project are listed below:

* Limiting effects from other variables in the environment on the experiment
  + Due to the high changes in PM 2.5 likely present from most experiments this may introduce much error
* Consistency within the experiment trials
* General setup of the sensors and data collection system

EQUIPMENT NEEDED:

|  |  |  |
| --- | --- | --- |
| Equipment | Provided by: | Link |
| PM sensor | Me | <https://cdn-shop.adafruit.com/product-files/4632/4505_PMSA003I_series_data_manual_English_V2.6.pdf> |
| Temperature and humidity sensor | Me | <https://www.adafruit.com/product/1899> |
| STEMMA QT connection cables | Me | <https://learn.adafruit.com/introducing-adafruit-stemma-qt/what-is-stemma> |
| Raspberry Pi 4 | Me | <https://datasheets.raspberrypi.com/rpi4/raspberry-pi-4-datasheet.pdf> |
| Various food | Me | - |
| 3D printer | Me | <https://www.prusa3d.com/en/product/original-prusa-i3-mk3s-3d-printer-3/> |

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ORIGINAL CONTENT:

The original content produced for this project will be the data from the experiments and the analysis done on it.

SOURCES:

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Liu, Y., Ma, H., Zhang, N., & Li, Q. (2022). A systematic literature review on indoor PM2.5 concentrations and personal exposure in urban residential buildings. *Heliyon*.

Patel, S., Sankhyan, S., Boedicker, E., DeCarlo, P., Farmer, D., Goldstein, A., . . . Nazaroff, W. (2020). Indoor Particulate Matter during HOMEChem: Concentrations, Size Distributions, and Exposures. *Environmental Science & Technology*, 7107-7116.

Yong, Z. (2018). *Digital universal partical concentration sensor: PMSA0031 series data manual.* Retrieved from 2018 product data manual of PLANTOWER: https://cdn-shop.adafruit.com/product-files/4632/4505\_PMSA003I\_series\_data\_manual\_English\_V2.6.pdf