

DETERMING PARTICULATE MATTER CONCENTRATIONS WITHIN A NEW YORK CITY PUBLIC SCHOOL

By: Jah-Vin Vaughan

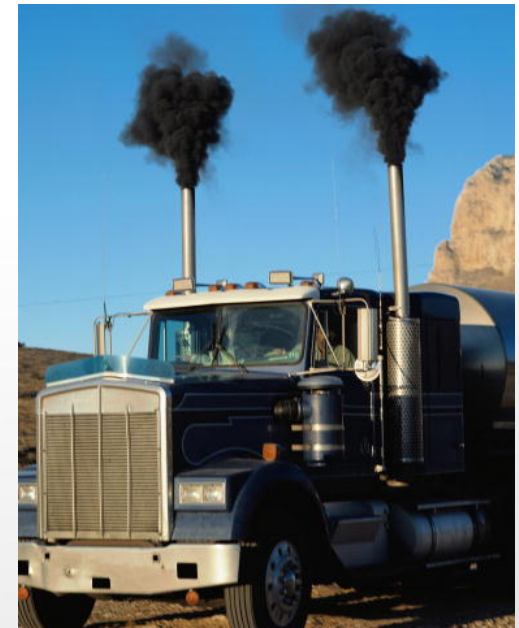
Directed by Mauricio Gonzalez

Background on Particulate Matter (EPA, 2009)

- ▶ Particulate Matter are solid and liquid particles suspended in the air. Most are hazardous. They can contain for instance dust, pollen, soot, smoke, liquid droplets, and carcinogenic chemicals.
- ▶ Particles that are smaller than 10 microns will impact human health – in particular their respiratory system.
- ▶ PM smaller than 3 microns cause cancer because they penetrate the body, its cells, and nuclei damaging the DNA.

Background on Particulate Matter (EPA, 2009)

- ▶ PM smaller than 3 microns is a byproduct of diesel engines found on the very trucks that deliver our goods.
- ▶ Most places in Harlem have a high incidence of PM proven to be the cause of at least 1 cancer patient out of every 10,000 inhabitants.

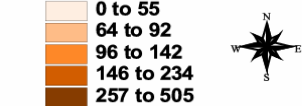


- ▶ Notice the roads in yellow.
- ▶ Notice the bus depots in red.
- ▶ Now notice the darker shades for incidence of asthma in the order of 257 – 505 children between the ages of 0–4 per zip code.
- ▶ (We Act, 2009)

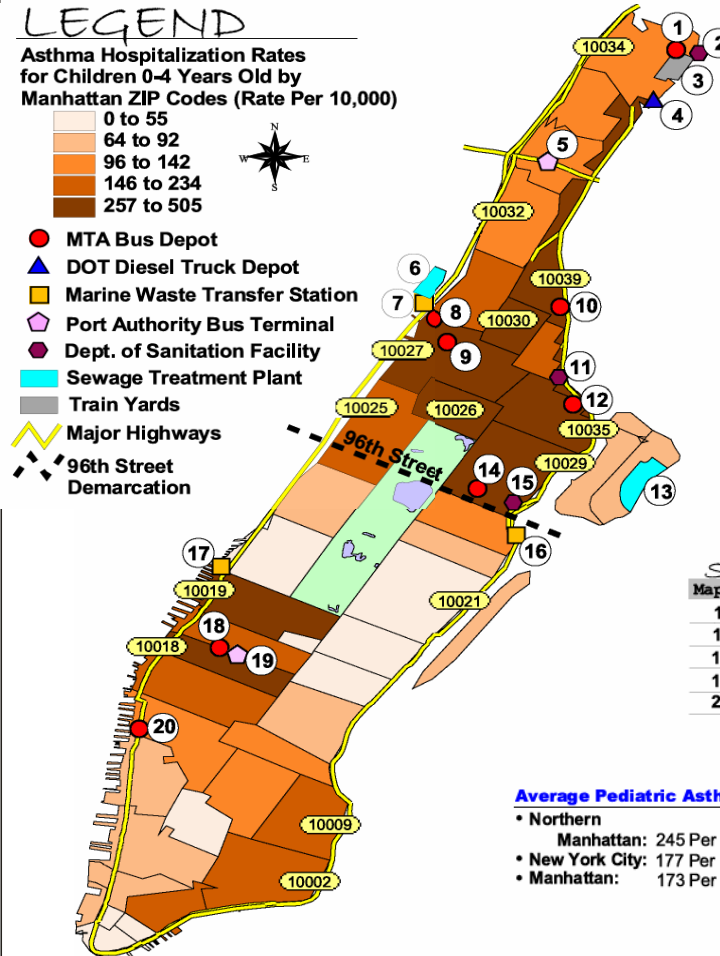
Asthma Hospitalizations Rates by ZIP Code Children Aged 0-4, Manhattan, 2000

LEGEND

Asthma Hospitalization Rates
for Children 0-4 Years Old by
Manhattan ZIP Codes (Rate Per 10,000)



- MTA Bus Depot
- ▲ DOT Diesel Truck Depot
- Marine Waste Transfer Station
- ◆ Port Authority Bus Terminal
- ◆ Dept. of Sanitation Facility
- Sewage Treatment Plant
- Train Yards
- Major Highways
- 96th Street Demarcation



Average Pediatric Asthma Rates:

- Northern Manhattan: 245 Per 10,000 Children
- New York City: 177 Per 10,000 Children
- Manhattan: 173 Per 10,000 Children

Northern Manhattan Facilities

MapID	Facility Name
1	Kingsbridge MTA Bus Depot
2*	DOS Garbage Truck Depot (Two Large Depots, One Services Residents of the Upper East Side)
3	MTA Train Yards
4	Department of Transportation / Division of Highways Diesel Truck Depot
5	George Washington Bridge Port Authority Bus Terminal
6	North River Sewage Treatment Plant / Riverbank State Park
7	135th Street Marine Waste Transfer Station
8	Manhattanville MTA Bus Depot
9	Amsterdam MTA Bus Depot
10	Mother Clara Hale MTA Bus Depot (Scheduled to Expand)
11	DOS Garbage Truck Depot
12	126th Street MTA Bus Depot
13	Wards Island Sewage Treatment Plant
14	100th Street Bus Depot (Currently Expanding)
15	DOS Garbage Truck Parking Lot (Out Door Parking Lot)

Southern Manhattan Facilities

MapID	Facility Name
16	91st Street Marine Waste Transfer Station
17	59th Street Marine Waste Transfer Station
18	41st Street MTA Bus Depot
19	42nd Street Port Authority Bus Terminal
20	Hudson MTA Bus Depot (Scheduled to Close)

Source: NYC Department of Health SPARCS 2000 data on Asthma Admission Rates for children ages 0 to 4 years.

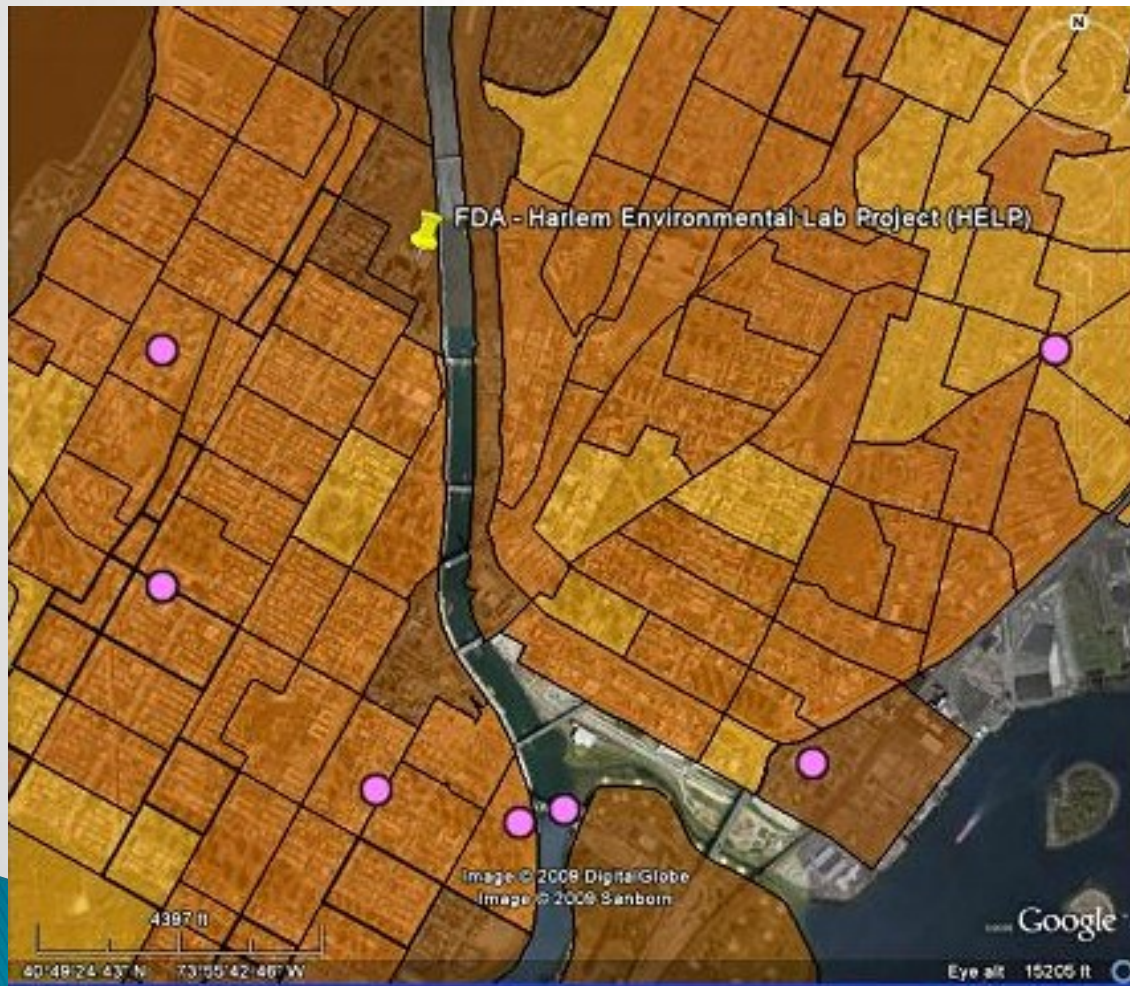
Map prepared by West Harlem Environmental Action, Inc. (WE ACT) with the Columbia Center for Children's Environmental Health (CCCEH), using ESRI ArcView® GIS v3.1.1. If you have any questions or concerns, please contact the WEACT GIS Mapping Specialist, Carlos M. Jusino, at (212) 961-1000, ext. 307.

Funded in Part by W. Alton Jones and the National Institute of Environmental Health Sciences (NIEHS).

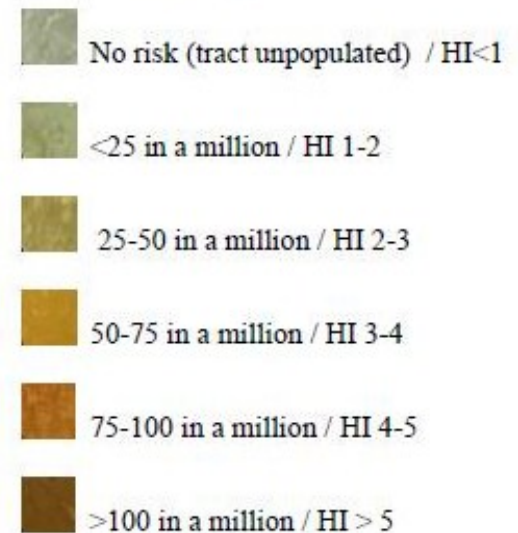


February 18, 2003
Release 2.25B - 4NR

Air Quality & Cancer (EPA, 2009)



Cancer Risks / Noncancer Risks



Project Design Chart

Scientific Problem

Where in the Public School Building has the highest P.M. concentration?

Objectives

Determine Particulate matter concentrations from different classrooms

Compare P.M. Levels in different localities

Determining sources of PM and prevailing winds

Independent Variable

The different localities

Project Design Chart

Dependent Variable

P.M. concentrations

Constants

Time in a locality

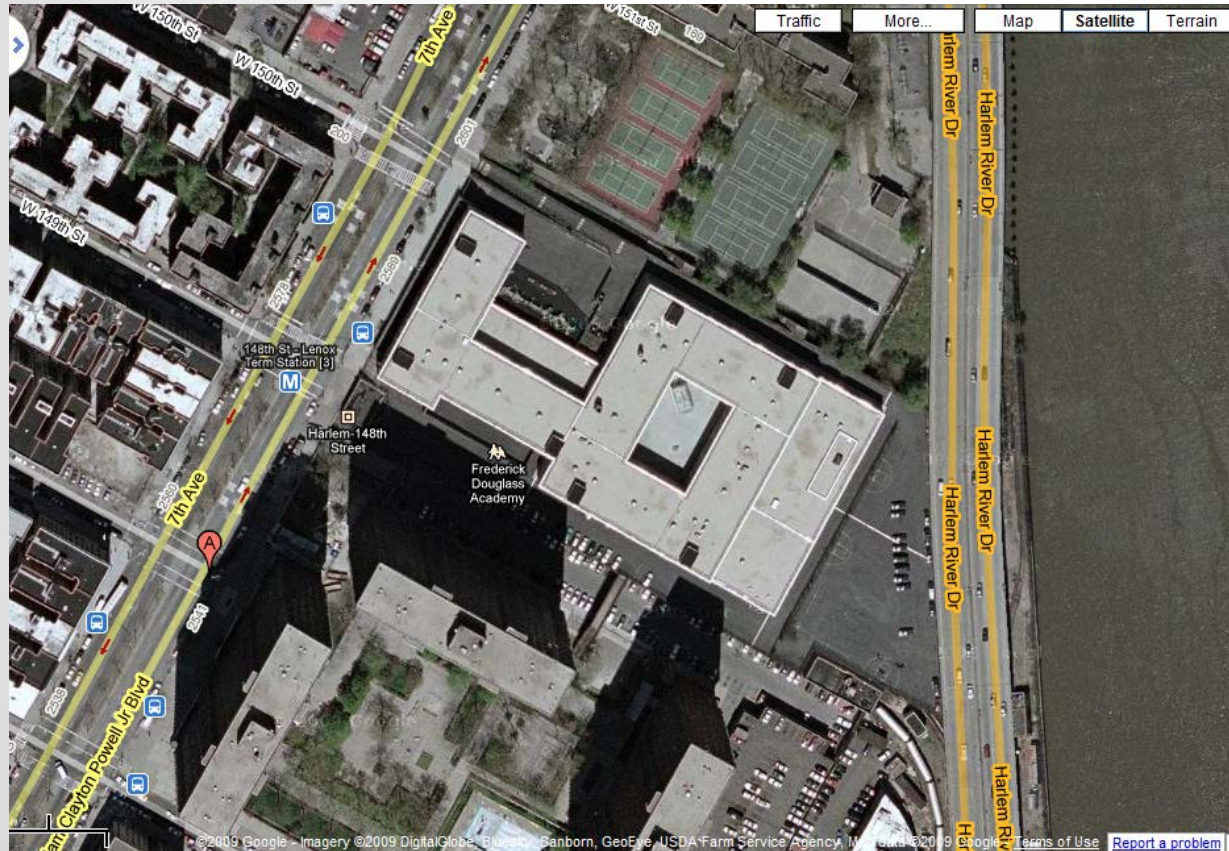
Assumptions

P.M. concentrations does change within time experimentation

Sample time is sufficient

P.M. sensor is running correctly

Locality



This Experiment was conducted in several localities at the Frederick Douglass Academy. 2581 Adam Clayton Powell Jr. Blvd New York NY 10039.

Materials List

Materials	Quantity	Description
PM sensor (Aero 212 manufactured by MET one)	1	Used to collect Particulate Matter
Cart	1	Used to move the materials around
Stopwatch	1	Used to keep count of time
Cart Battery	1	Used to power the P.M. sensor
Computer	1	Used to hold the data that is collect my the Sensor
HyperTerminal(program)	1	The program used to display the data from the Pm sensor
Camera	1	To take pictures of the set- up

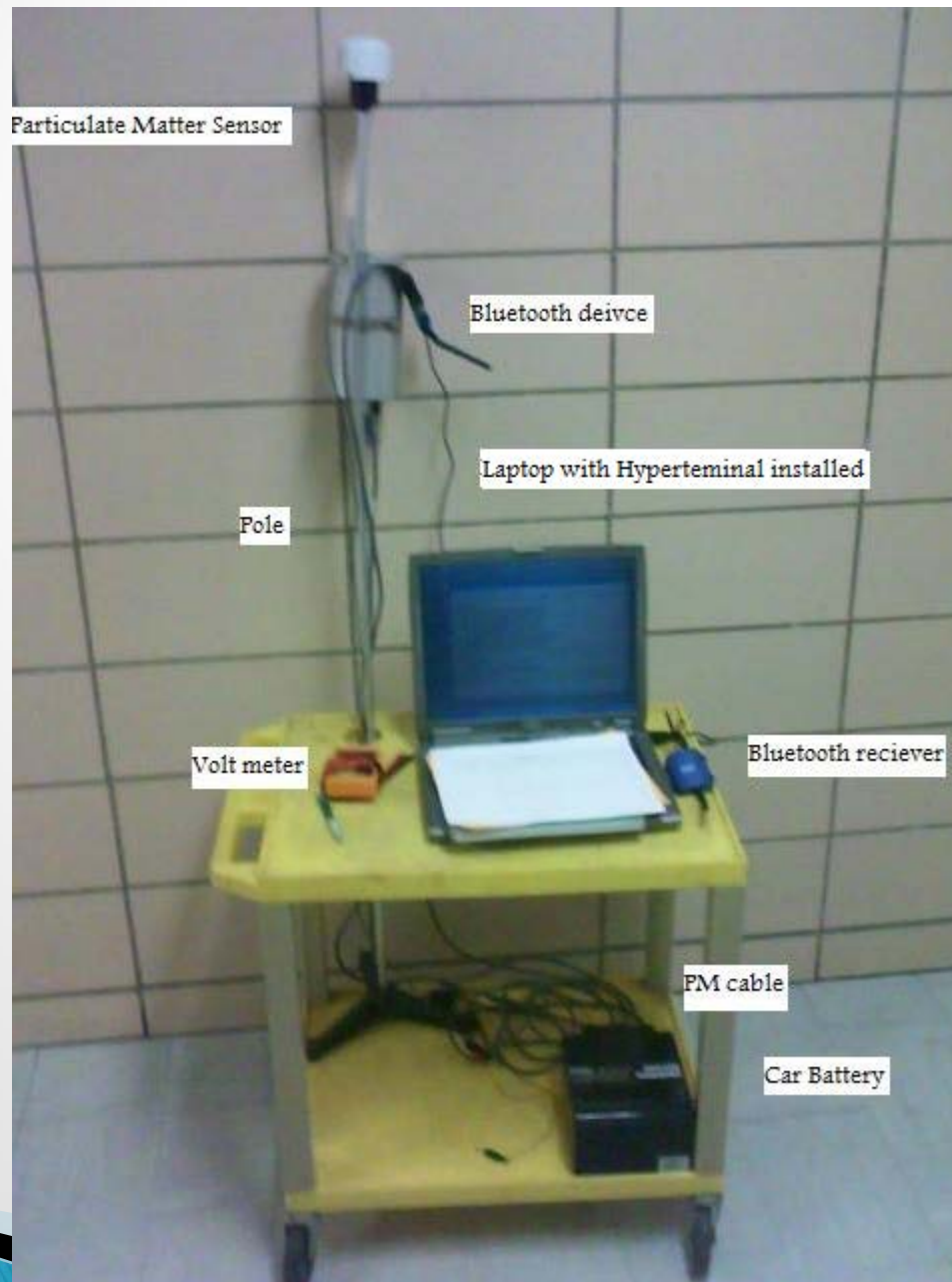
Microsoft Excel	1	To make graphs
Bluetooth device	1	To collect data from the PM sensor
Locality Chart	1	To record what time (From the sensor that is displayed by HyperTerminal) and match it with the locality that you are taking the data.
Video Camera	1	To record procedures
Volt meter	1	Used to find out the power level of the car battery

Pencil	1	To write
Bluetooth receiver	1	To connect to the computer, so the data can be sent from the P.M. sensor to the computer so that data can be displayed on HyperTerminal
PM Sensor Wire Alligator clips	1	Used to power the P.M. sensor while using a Car Battery
TI-84	1	Used to create Box Plots

Procedures

Steps for gathering Obtaining PM data

1. Gather Materials
2. Connect pm sensor with the computer to turn it on
3. Place sensor on the cart and connect to battery
4. Make sure the sensor is running and connected to HyperTerminal
5. Go to the first room
6. Take readings for a minute and record what time the readings started
7. After a minute has passed, tell the others to come in the room and walk around. Record what time those people have entered
8. When finish, move to next room and record time of exit. Recording time is important in order to know at what time a room was entered and what time the room was exited.



Converting counts to concentrations

Formula $D=M/V$

Calculating Density

1. It is assumed that the Density is $2,000 \text{ Kg/m}^3$. This is assumed because this is a reasonable density between the density of water and of a solid rock.

2. Using a conversion factor, $2,000 \text{ Kg/m}^3$ is equivalent to $2,000,000 \text{ ug/m}^3$

•Calculating Mass

Within 60 seconds of sampling, 1 Liter of air would of past through the Aero 212 machine.

1. It is assumed the particles are spherical objects

2. The diameter of the particles that were being measured are 2 microns

3. After using the equation for volume of a sphere, with 2 as the diameter, 4.2 um^3 would be the volume of the sphere.

4. In this example, there were 1156 particles that were found in a Liter of air. (The sensor had been on for one minute). To find the total volume, multiply the number of particles found in a minute by the volume of the particle

$$5. 1156 * 4.2 \text{ um}^3 = 4855.2 \text{ um}^3 * (1.0 * 10^{-12} / 1 \text{ um}^3) = 4.86 * 10^{-9} \text{ cm}^3$$

•Calculating the Volume

1. Insert the values for Density and Mass to find the Volume. $D=M/V$

$$2,000,000 \text{ ug/cm}^3 = M / 4.86 \text{ ug-}9\text{cm}^3$$

$$1. M = .00972 \text{ ug}$$

•Calculating Concentrations

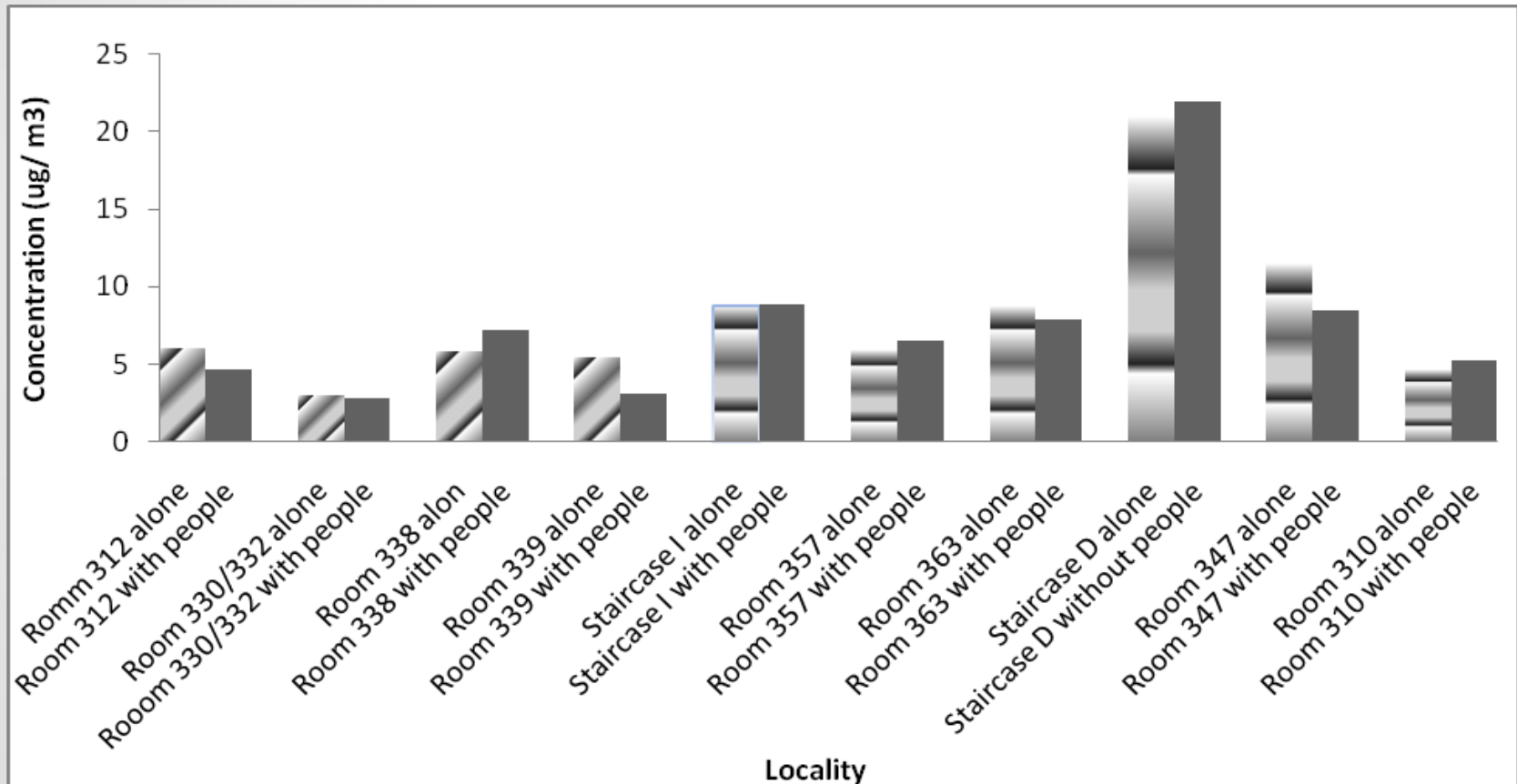
$$1. \frac{.00972 \text{ ug}}{\text{Liter}} \quad \frac{(1,000 \text{ Liter})}{(1 \text{ m}^3)} = \frac{9.72 \text{ ug}}{\text{m}^3}$$

Making Box Plots

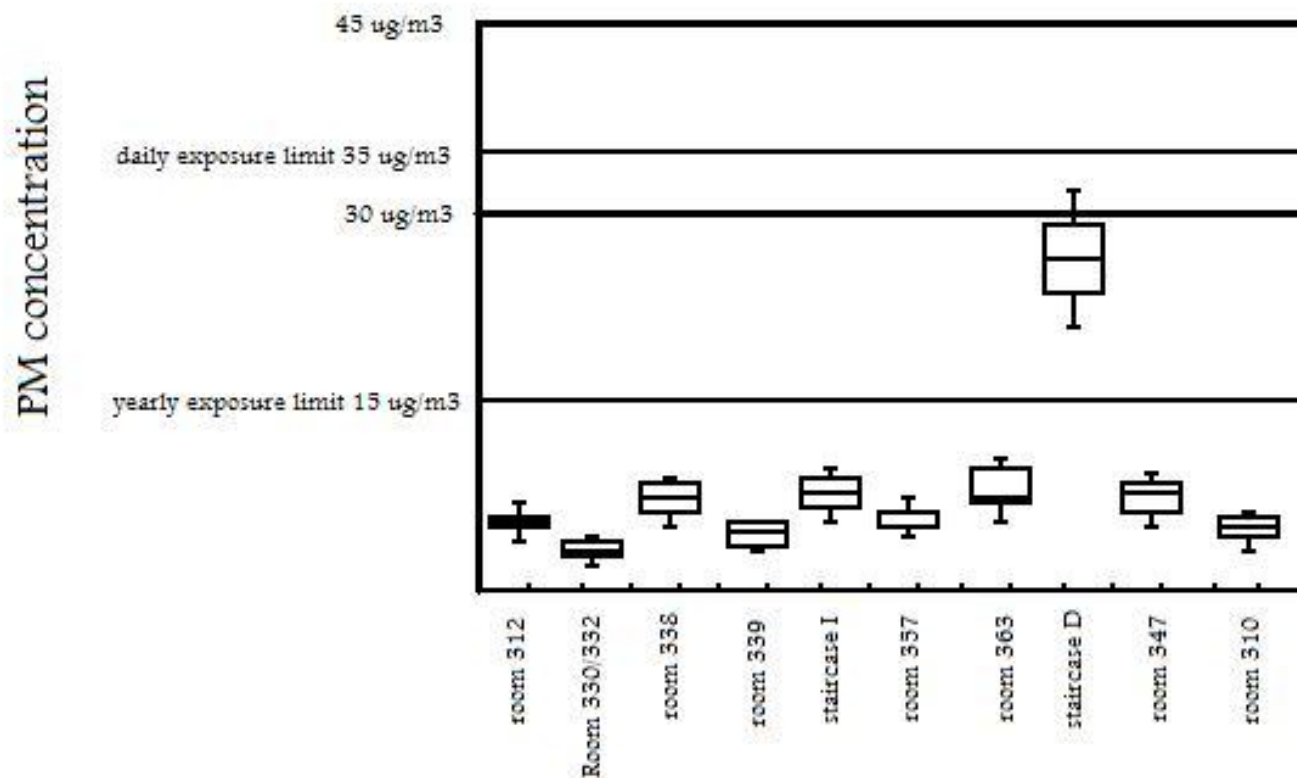
Box Plots are used to show the spread of data. By using box plots, people looking at the data will be able to see how spread out the data is for one room, compared to the other rooms. Steps to make Box plots:

1. Take all points and place them in numerical order
2. Find the median, (If there is an even set of numbers, take the middle two, and find the mean)
3. Looking at the lower portion of the data, find the median this will be Q1. Do the same for the upper half, and that would be Q3.
4. The smallest number and largest number will stand alone as a point and Q1, the median, and Q3, will be in a box showing the middle 50% of data.

Results

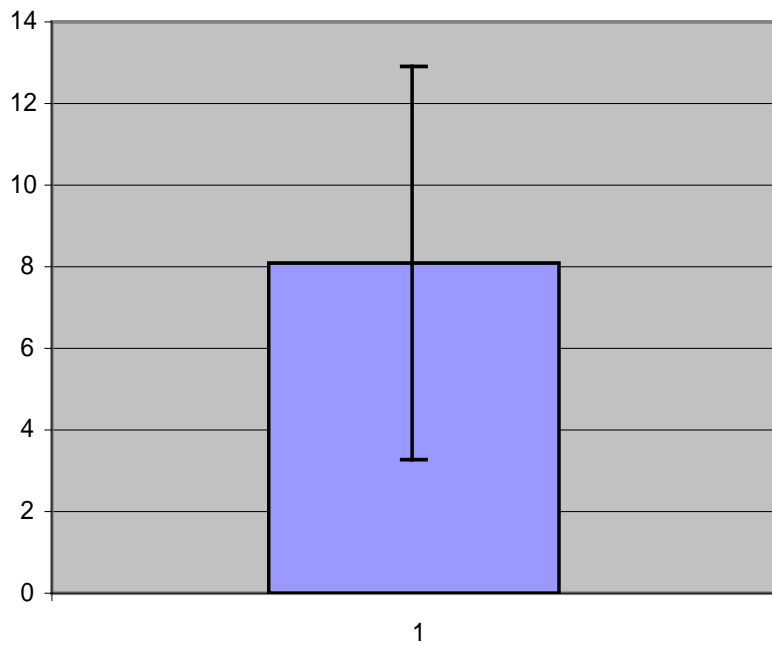


Particulate Matter Concentrations in Different Localities in the Frederick Douglass Academy

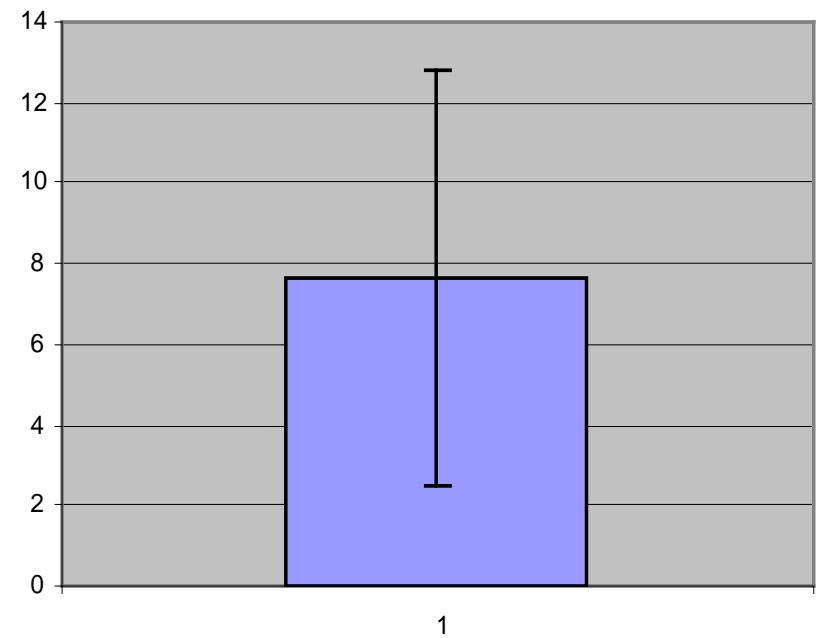


Spread of PM levels of different localities

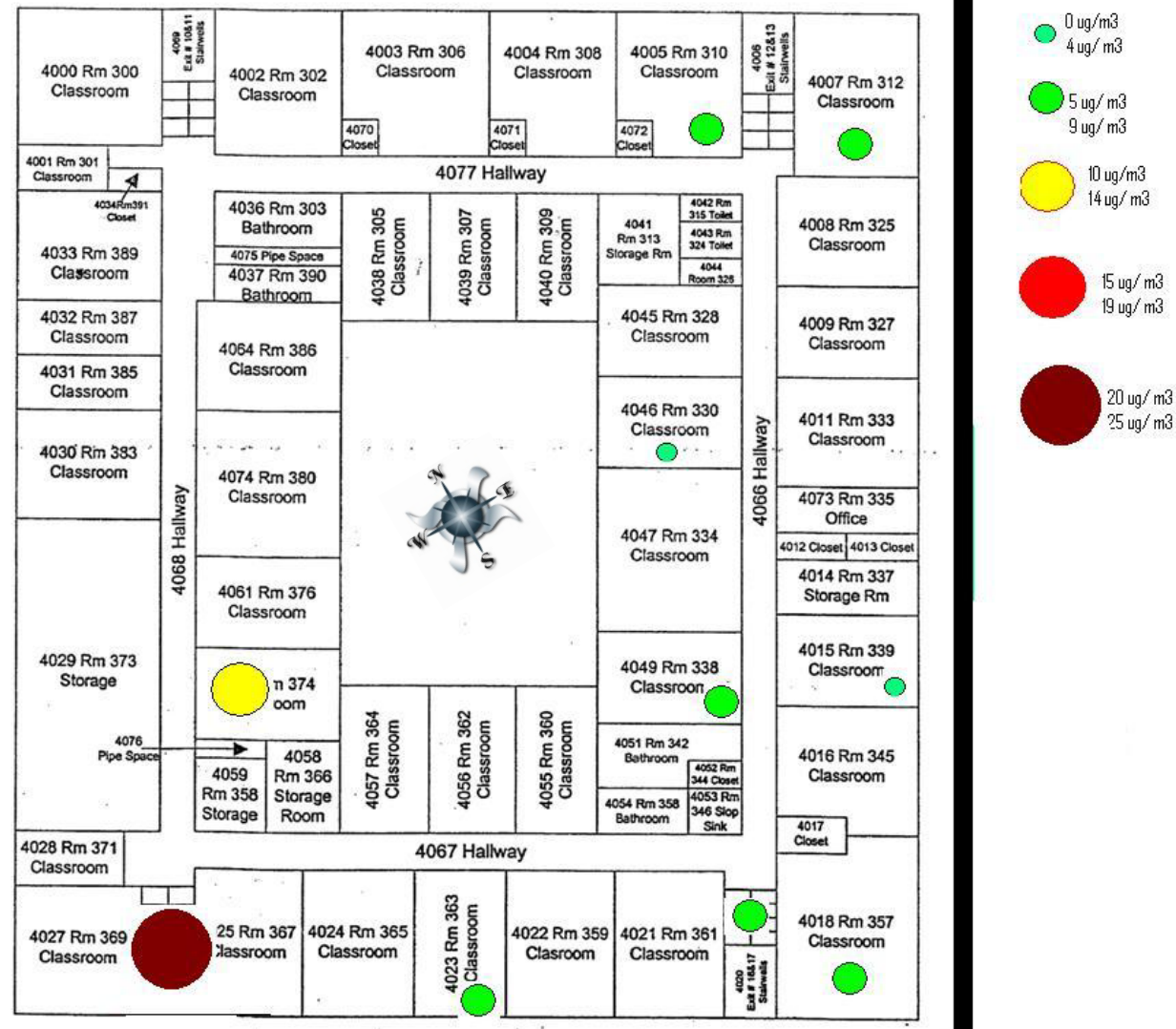
PM concentrations without people



PM concentrations with people



Frederick Douglass Academy Third Floor



Suggestions For Improvement

- ▶ Collect more than one days worth of data
- ▶ Collect data on the first and second floor
- ▶ Use Air quality machines that can categorize each substance
- ▶ Measure Black Carbon

Thank you to...

- Mauricio Gonzalez
- Philip Orton, Ph.D
- Gregory Hodge, Ph.D
- Wade McGillis, Ph.D
- Andres Alonso
- Adam Turay
- Randy Garcia
- Environmental Protection Agency
- Frederick Douglass Academy
- Lamont Doherty Earth Observatory
- Columbia University
- Purdue University