# DETERMING PARTICULATE MATTER CONCENTRATIONS WITHIN A NEW YORK CITY PUBLIC SCHOOL

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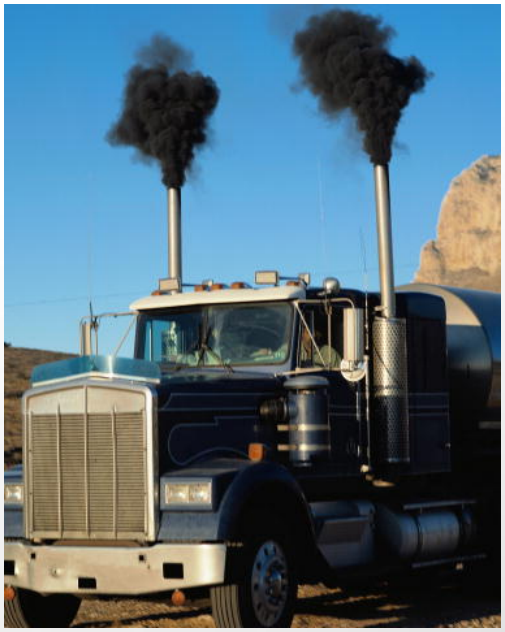
# Background on Particulate Matter (EPA, 2009)

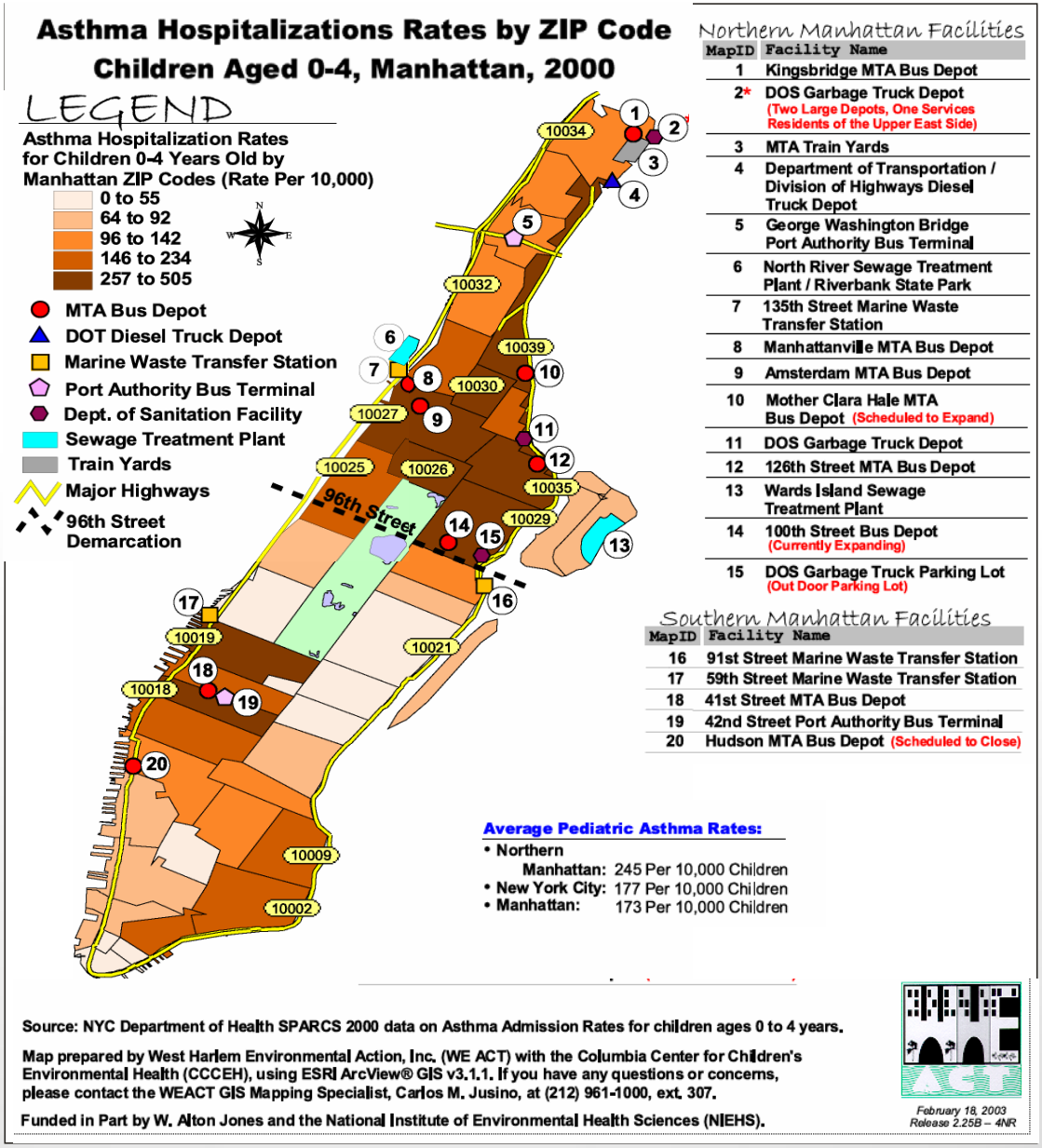
- Particulate Matter are solid and liquid particles suspended in the air. Most are hazardous. They can contain for instance dust, pollen, soot, smoke, liquid droplets, and carcinogenic chemicals.
- Particles that are smaller than 10 microns will impact human health – in particular their respiratory system.
- 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)



# Air Quality & Cancer (EPA, 2009)


Cancer Risks / Noncancer Risks

- No risk (tract unpopulated) / HI<1
- <25 in a million / HI 1-2
- 25-50 in a million / HI 2-3
- 50-75 in a million / HI 3-4
- 75-100 in a million / HI 4-5
- >100 in a million / HI > 5

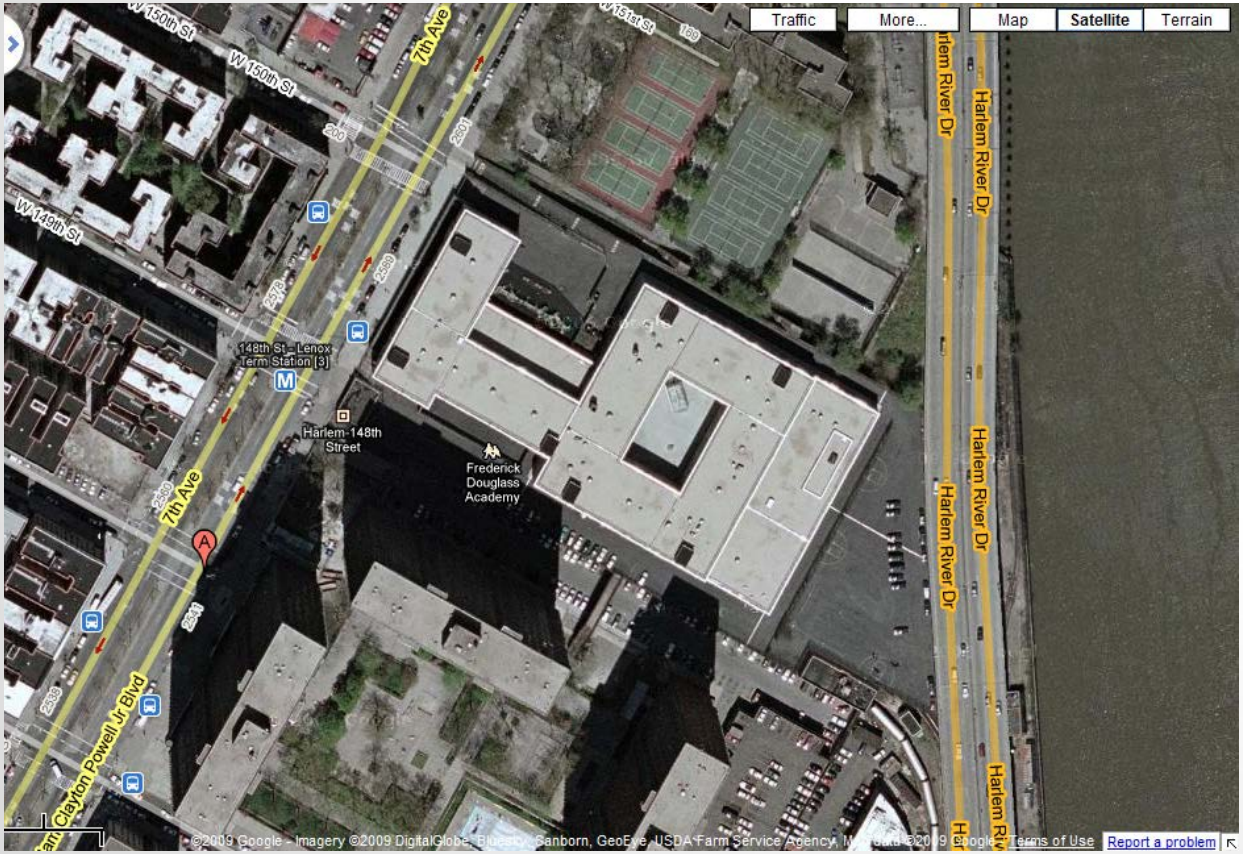
# Project Design Chart

| |
|---|
| **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 | Quality | 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 |

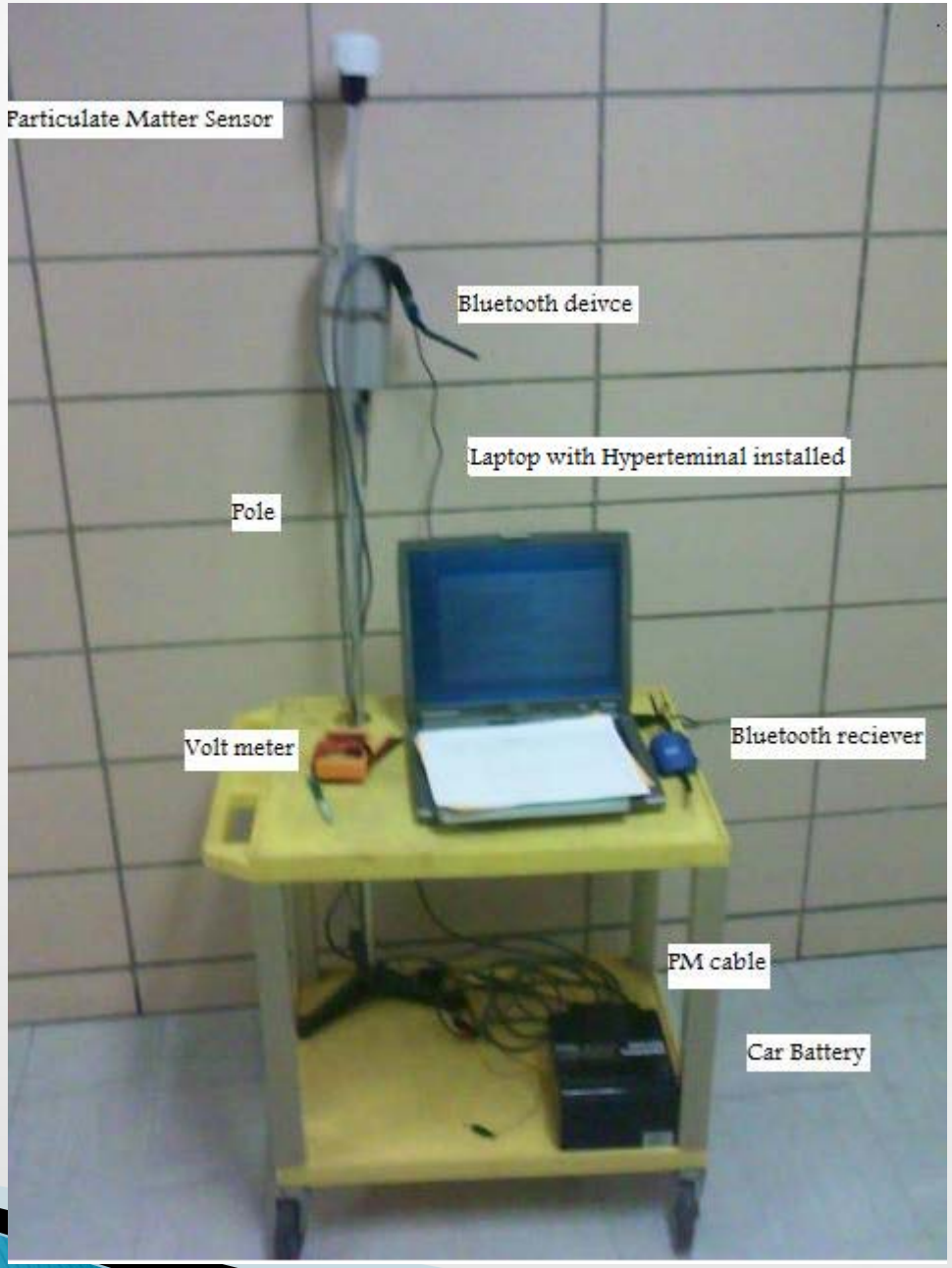
| | | |
|---|---|---|
| Microsoft Excel | 1 | To make graphs |
| Bluetooth device | 1 | To collect data from the PM sensor |
| Locality Chart | 1 | To record what time (From the sensor that is displayed by HyperTerminal) and match it with the locality that you are taking the data. |
| Video Camera | 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.


Particulate Matter Sensor
Bluetooth deivce
Laptop with Hyperteminal installed
Pole
Volt meter
Bluetooth reciever
PM cable
Car Battery

# *Converting counts to concentrations*

Formula D=M/V

## Calculating Density

1. It is assumed that the Density is 2,000 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 Kg/m3 is equivalent to 2,000,000 ug/m3

## •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 um^3 =4855.2 um^3 * (1.0* 10^-12 / 1 um^3) =
4.86* 10^-9 cm^3

## •Calculating the Volume

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

2,000,000 ug/cm^3 = M/ 4.86 ug-9cm^3

1.M= .00972 ug

## •Calculating Concentrations

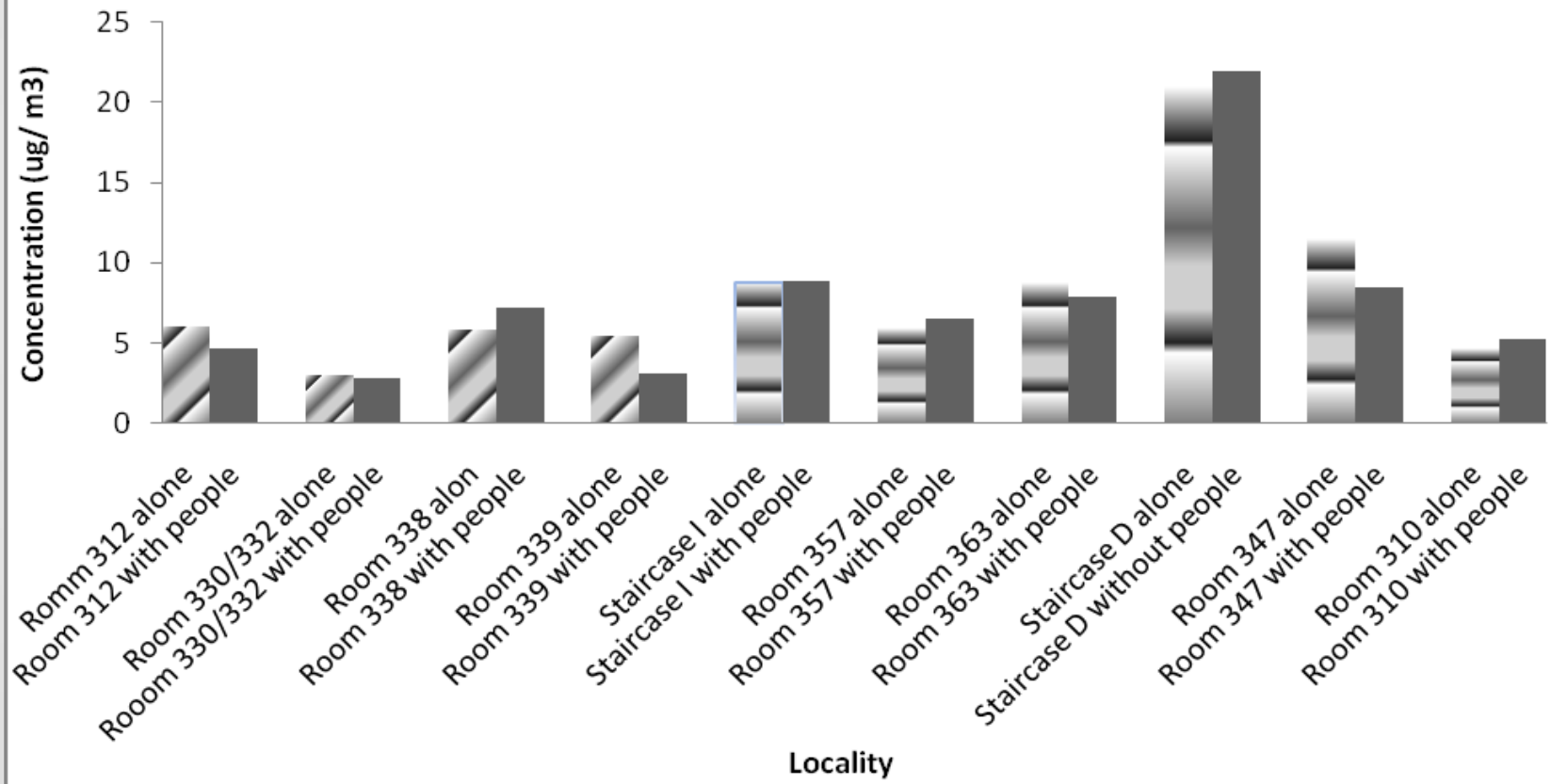
1. $\frac{.00972\text{ug}}{\text{Liter}} \quad \frac{(1{,}000\text{ Liter})}{(1\text{ m}^3)} = \frac{9.72\text{ug}}{\text{m}^3}$

# *Making Box Plots*

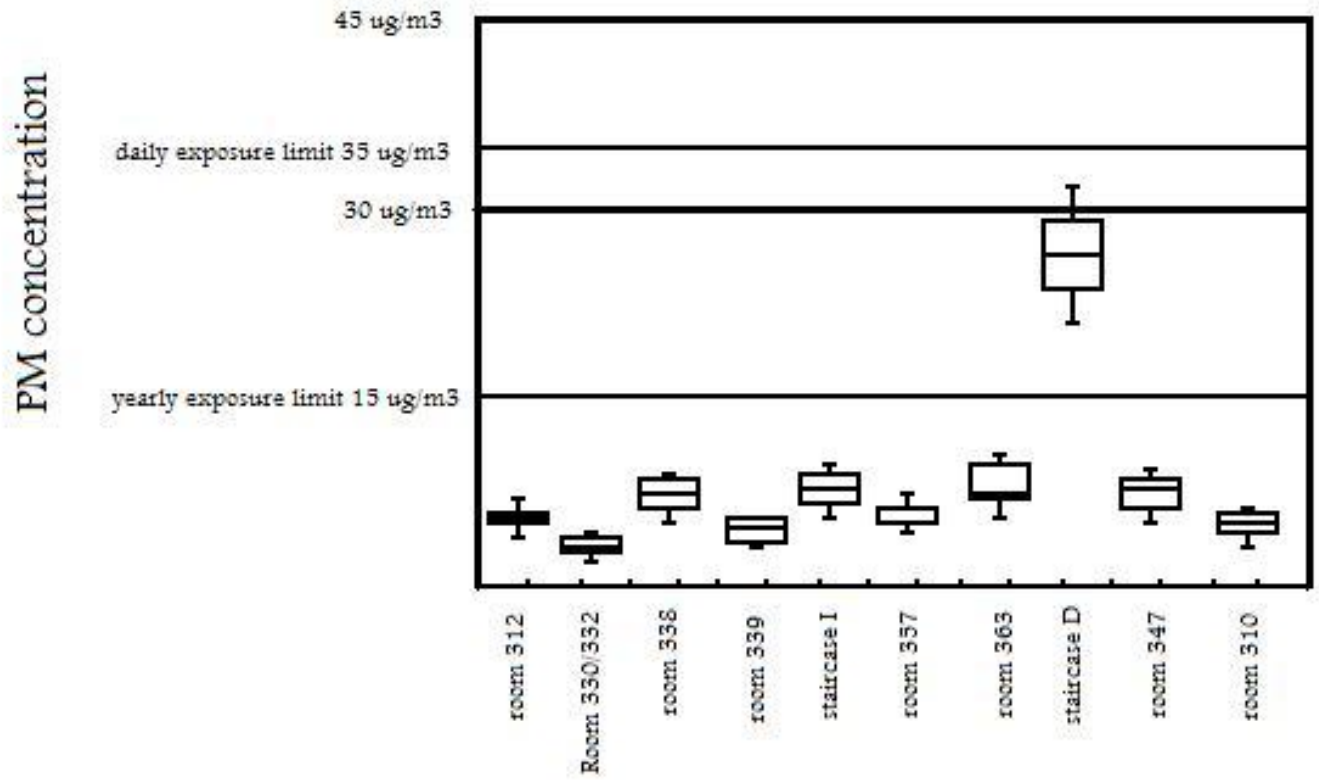
Box Plots are used to show the spread of data. By using box plots, people looking at the data will be able to see how spread out the data is for one room, compared to the other rooms. Steps to make Box plots:

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.

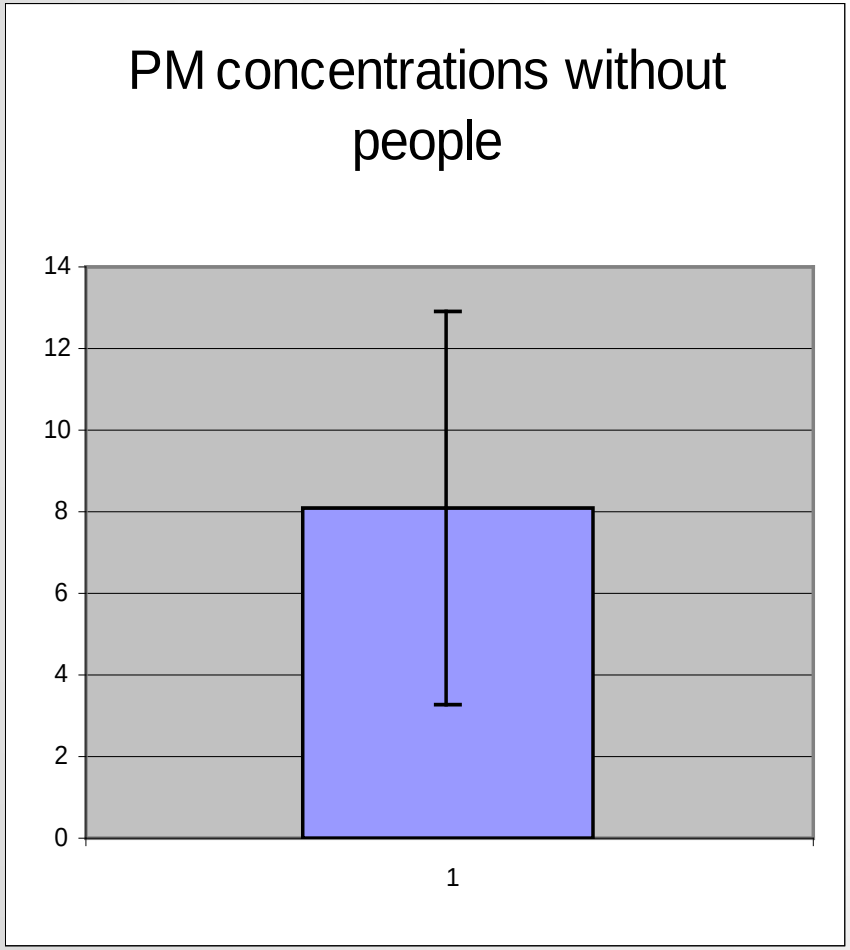
# Results

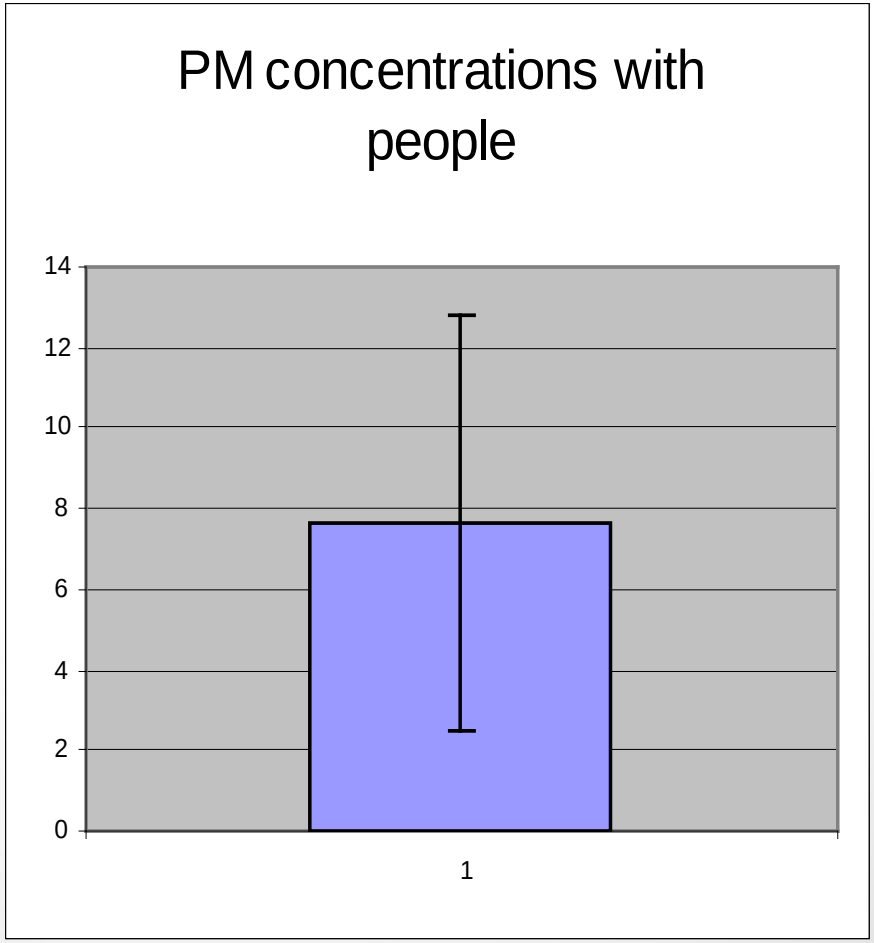



**Particulate Matter Concentrations in Different Localities in the Frederick Douglass Academy**

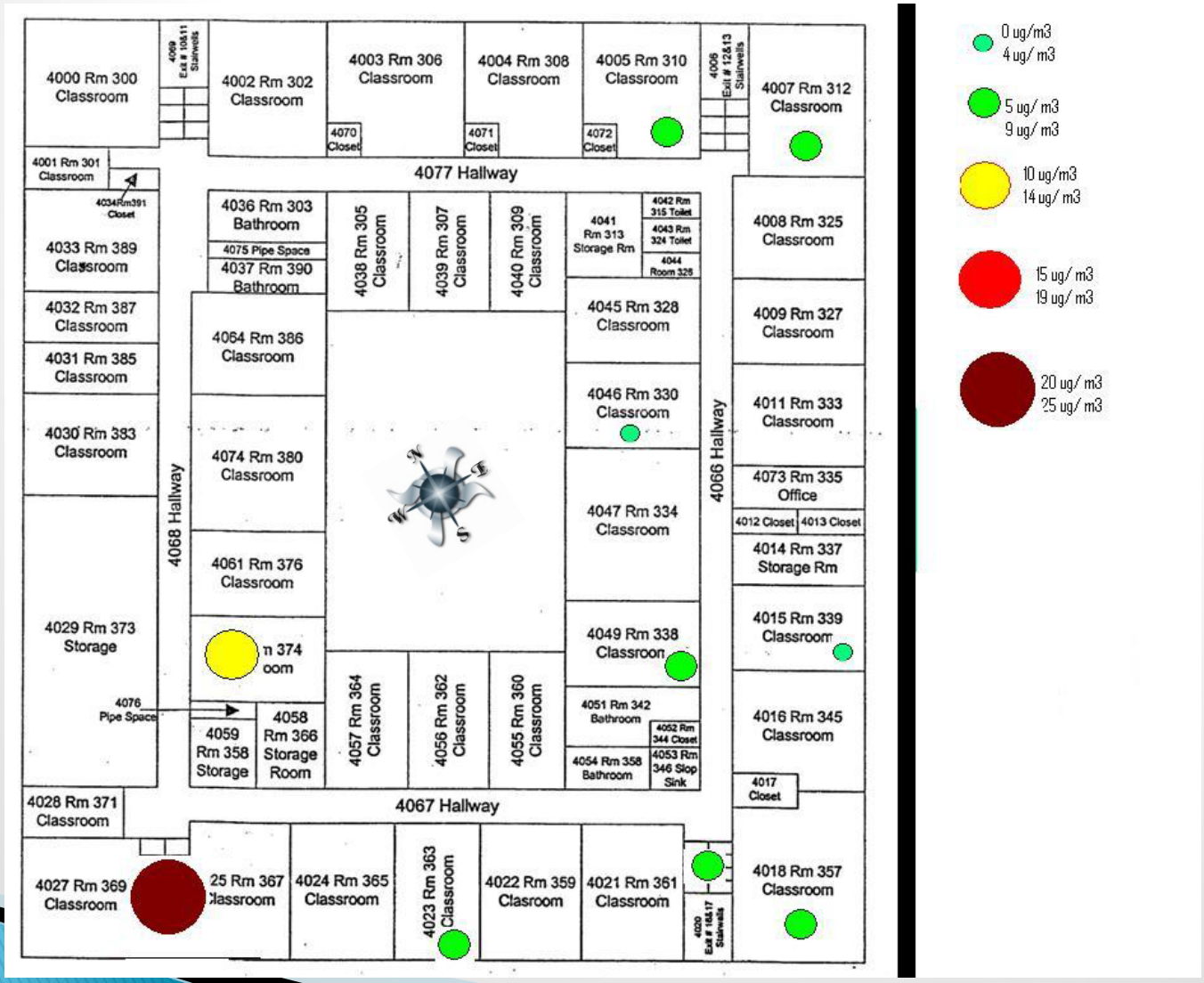



Spread of PM levels of different localities


PM concentrations without people
14
12
10
8
6
4
2
0
1


PM concentrations with people
14
12
10
8
6
4
2
0
1

# 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…

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