Indoor and Outdoor Air Quality in and around a High School in the Fruitvale District of Oakland, California, U.S.A

Javier Urzua, Luis Martinez, Alfredo Pantoja, Sergio Peña and Tony Marks-Block

East Bay Academy for Young Scientists, Lawrence Hall of Science, UC Berkeley 1 Centennial Drive, Berkeley, CA 94720 or EBAYS@Berkeley.edu

Introduction:

This study is focused on investigating the quality of air in the environment that surrounds the Fruitvale district of Oakland, California, the community within which our research team lives and attends school (Figure 1). As a starting point, we decided to investigate particulate matter (PM) concentrations. Burning fuel is only one of the ways that particulate matter is produced. Other sources are from construction activity and factories.We are studying air quality because we are concerned about the health of people living in this community. Our concerns result from the fact that many people in this community suffer from asthma, and heart diseases caused by particulate matter traveling in our respiratory and circulatory systems.

Investigation Setting:

The Fruitvale district is located in Southeast Oakland with a central business district on International Boulevard bounded by Fruitvale Avenue and 38th Avenue (Figure 1).We first decided to study the sources of air pollution before we chose locations to collect our data. We figured that the burning of diesel and gasoline fuels produces high levels of PM, and hypothesized that the nearby freeway (Interstate 880) would be a major source of PM. Consequently we collected our air samples along Fruitvale avenue going North/Northeast from the freeway, as well as inside our school (4 blocks from the freeway on East 12th Street) because that is where we spend the majority of our time.

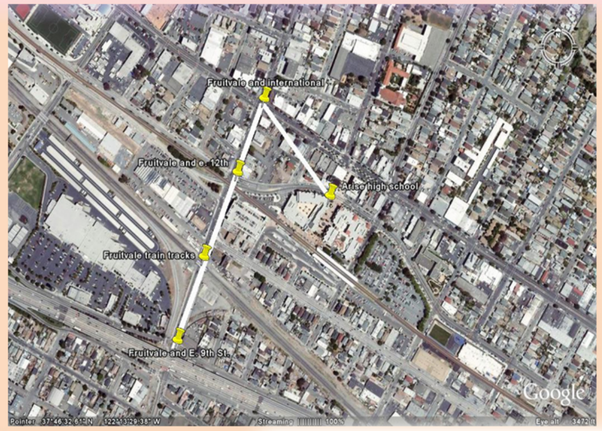

Figure 2: Fruitvale Transect

Figure 1: San Francisco Bay Area

Methods:

We identified the 880 freeway as a source of local particulate matter due to high levels of vehicular and industrial traffic, and we developed a North/North East transect along Fruitvale Avenue, a major road in the district, away from the freeway (Figure 2). At every intersection (East 9th Street, Train Tracks, East 12th Street, International Boulevard) for four blocks we collected a liter of air using a Fluke particle counter (Figure 6), which then detects concentrations of particles of the following sizes: 0.3, 0.5, 1, 2, 5 and 10µm. We also collected samples in two rooms at ARISE High School, our science teacher Chris' room, and the Boy's Bathroom.

We collected samples on Wednesday afternoons from March 11, 2009 to May 13, 2009 at all sample locations. We also collected various samples to assess other variables, such as how a train passing on the Train Tracks affects PM counts, and how opening a door to the outdoors in Chris' science room affects PM count in the room.

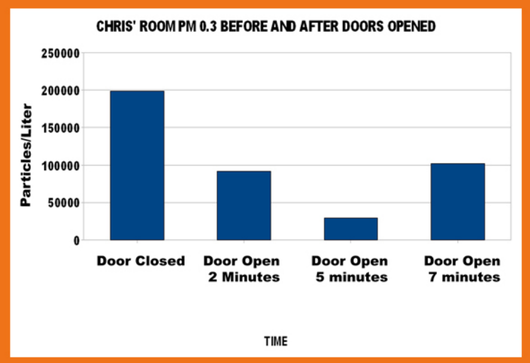

Figure 3

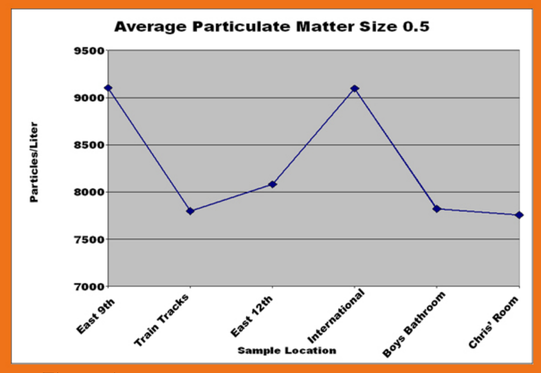

Figure 4

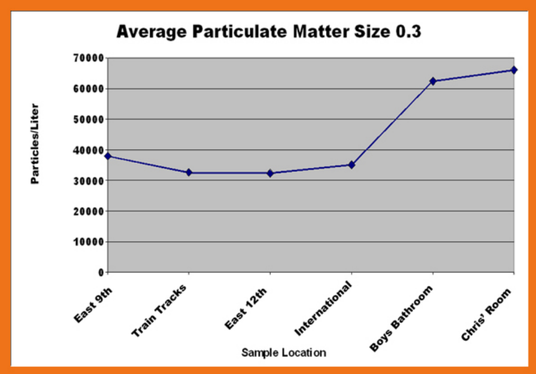

Figure 5

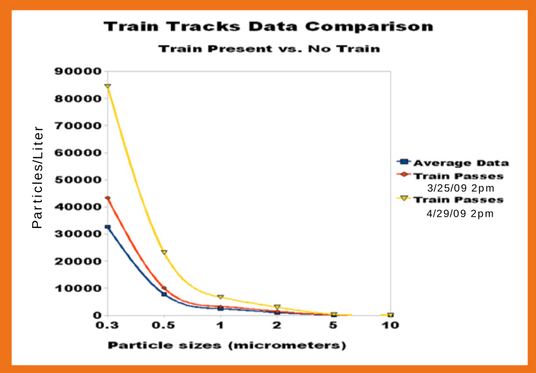

Figure 6

Results and Discussion:

We found that our science classroom and bathroom were the sample locations with the highest average levels of 0.3 µm particulate matter (Figure 5). We believe that the classroom and the bathroom have high levels of smaller PM because the school ventilation system prevents the larger particles (0.5 µm and above) from entering the school building. On the other hand the ventilation system may not filter out 0.3 µm particles, which may lead to their accumulation in the school building. This finding does not correlate with our original hypothesis, which was that outdoor areas with vehicular traffic would have higher PM levels than indoor sample locations.

Based on this finding, we hypothesized that opening the door to Chris' classroom would increase the flow of outdoor air into the room, and then lower the PM levels. Indeed, PM levels in Chris' classroom decreased after approximately 5 minutes after we opened the classroom door to allow the inflow of air from the school courtyard (Figure 3). Opening the door let outside air flow into the room, and we found a seven fold decrease in levels of all PM particle sizes. However, soon after the PM levels decreased upon opening the door, we began to smell barbecue from a nearby restaurant, and PM counts in the room immediately increased again (see Figure 3).

Along our outdoor transect on Fruitvale Avenue we found that the Fruitvale Ave. and East 9th St. and Fruitvale Ave. and International Blvd. intersections have the highest 0.5 µm particulate matter levels due to vehicular traffic (Figure 4). This information supports our hypothesis because we thought that the highest level of 0.5 µm particulate matter would be in areas near the freeway and areas with high levels of vehicular traffic. We found that there was a higher count of size 1,2,5 and 10 µm sized particles in two of our sample locations both the Fruitvale and East 9th and East 12th street intersections, which we also believe is the result of heavy vehicular traffic.

When our research group collected data from the Fruitvale and Train tracks intersection as the train passed, the particles per liter of all PM sizes increased significantly (Figure 5), most likely because of the trains' diesel fuel exhaust combined with the accumulation of dust particles swept up from the ground as the train passes with great speed.

Figure 6: Author Alfredo Pantoja with Fluke Particle Counter in Chris' Room.

Conclusion:

High 0.5 and 0.3 µm particle concentration levels at International Blvd and Fruitvale Ave and E.9th Street and Fruitvale Avenue are most likely due to higher levels of vehicle traffic at those intersections. Higher levels of 0.3µm particles and lower levels of larger PM levels indoors at our school site may be caused by the ventilation system filtering out those larger sizes. The fact that PM levels increase noticibly when trains pass by the Fruitvale Ave. and Train Tracks intersection is likely due to diesel exhaust from the train.

To further our study, we intend to collect data at other locations and compare results. For example, we would like to go to other neighborhoods in Oakland as well as Richmond, CA and San Leandro, CA to see if our results are similar. At our school we want to see if the problem of high PM levels indoors is due to the filter in the ventilation system, and try to learn about how those systems function and operate. We also plan on surveying students in the school who have respiratory problems, to see if their respiration becomes more difficult in certain locations.

Through our study we have found that mainly, as a result of the burining of certain fossil fuels, PM enters the environment in varying amounts. These particles are then moved around in the air by wind and human activities. If we as a community want to reduce PM levels and limit the impact of PM pollution, we must find better ways to fuel human activities in the future.