

TITLE: Air Pollution

ABSTRACT: The purpose of the Air Pollution lab was to discover the amount of fungi and other microorganisms present indoors. Four Petri dishes were placed in various indoor locations, and one Petri dish was placed outside (the control). The growths and number of colonies in each Petri dish were analyzed in order to deduct and compare the quality of indoor air pollution versus that of outdoor air pollution. Results of the experiments demonstrated that the quality of indoor air is actually much worse than outdoor air quality. Growths in the Petri dishes from indoor locations far outnumbered the one growth that was present in the Petri dish from the outdoor location. Thus, although many feel that breathing indoor air is the safest way to go, in reality, the opposite is true. In today's world, outdoor air quality far surpasses the quality of any air indoors.

HYPOTHESIS: If 5 Petri dishes are placed around South High Campus (four indoors and one outdoors) for one hour, then the Petri dish placed in Dr. Flynn's Backroom will contain the most colonies of bacteria due to the closed area and present moisture from the ecocolumns.

MATERIALS: The materials used in this experiment were:

1. 5 Petri dishes with nutrient agar

PROCEDURES: The procedures used in this experiment were:

Part One:

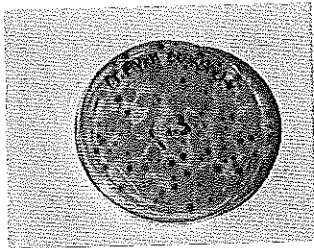
1. Individuals will select locations for sampling. Choose 4 indoor and one outdoor as the control. Try to think of a variety of different places- both public and private.

- A. Top of Dr. Flynn's Bookshelf
- B. Dr. Flynn's Backroom
- C. Ms. O'Donovan's Class
- D. Mrs. Woodward's Class
- E. (Outside) Gutter

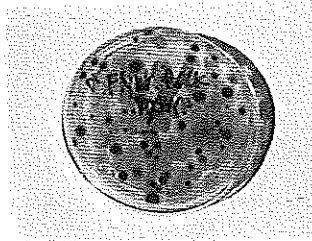
of buildings are most susceptible, c) what are the warning indicators for that type of pollution and d) how does one clean up the pollution once it is detected. Make sure to list the website.

DATA:

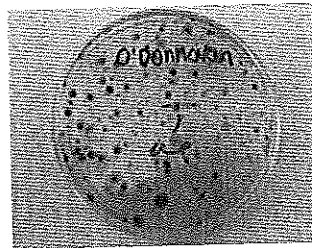
	LOCATION	# OF COLONIES	COMPARISON TO OUTSIDE PLATE
A	Top of Dr. Flynn's Bookshelf	192	.0052
B	Dr. Flynn's Backroom	141	.0071
C	Ms. O'Donnovan's Class	200	.0050
D	Mrs. Woodward's Class	140	.0071
E	(Outside) Gutter	1	1.0
	AVERAGE	135	.2049



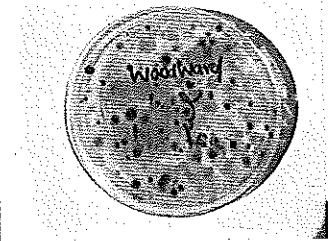
A



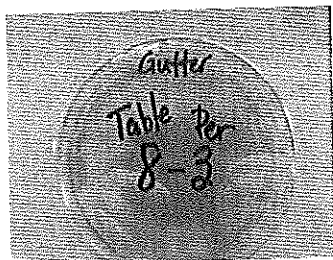
B



C



D



E

FINDINGS: After the Petri dishes were collected, the present bacteria, mold and yeast colonies were counted. The Petri dish with the most colonies present was the one placed in Ms. O'Donnovan's classroom having 200 colonies, followed by the Petri dish placed on Dr. Flynn's bookshelf, which had 192 colonies. Next came the Petri dish that came from Dr. Flynn's

2. Label the bottom of each Petri dish containing nutrient agar with the following:
 - Date
 - Location where Petri dish will be placed
3. Carry the Petri dishes to the chosen locations. Record the time each dish was opened in the space provided. Expose the Petri dish to the air for exactly one hour.

Location	Time Petri Dish Uncovered
Top of Dr. Flynn's Bookshelf	11:00 a.m.
Dr. Flynn's Backroom	11:00 a.m.
Mrs. O'Donovan's Class	11:00 a.m.
Mrs. Woodward's Class	11:00 a.m.
Outside Gutter	11:00 a.m.

4. Cover and place the exposed Petri dishes upside down in a warm draft free place (temperatures above 25°C are best if possible) for 72 hours. Since no organisms are being incubated, bacteria may not grow or be taken over by mold. Molds should grow fine.
5. Before examining the plates, write a hypothesis which indicates which agar plates are expected to have the most mold growth and why. For example, if plate A is placed in the high school locker room, plate B in the post office, plate C in the kitchen, and plate D in the living room. One might write:

It is expected that plate A will have the highest number of mold colonies because it was placed in a place with lots of people, and warm, moist conditions conducive to mold growth. Plate C will have the next highest number of colonies because...And so on.

6. Check the dishes for growth. Count the number of colonies and observe the physical appearance of the colonies: shape, color, wet/dry appearance. Record the results in the data chart.

Part Two: Learning more about indoor air pollution

Go to the web and look up indoor air quality. One good site is EPA Indoor Air, but there are a variety of others one may wish to examine.

1. Write a paragraph describing all the possible sources of air pollution. There are at least 5-6 different types, so make sure to visit a site with plenty of information. Please list the website.
2. Pick one of the sources described above, and investigate it in more detail. Find out a) how this source of pollution gets into homes and offices, b) what types

backroom containing 141 colonies, and then the Petri dish from Mrs. Woodward's classroom, which had 140 colonies present. Lastly, the Petri dish placed in the gutter outside contained only 1 colony. The average number of colonies present was 135. In comparison to the outdoor Petri dish, the ratio of colonies from Ms. O'Donovan's class to the outside Petri dish was .0050 (1/200). The ratio of colonies from Dr. Flynn's Bookshelf to the outdoor Petri dish was .0052 (1/192), and the ratio of colonies from Dr. Flynn's backroom to the outdoor sample was .0071 (1/141). Lastly, the ratio of colonies from Mrs. Woodward's classroom sample to the outside sample was .0071 (1/140) and the ratio of outside to outside was of course 1. The average number in comparison to the outside Petri dish was .2049.

The Petri dish placed in Ms. O'Donovan's classroom contained the most yellow yeast colonies, and an even number of black fungi colonies and white mold colonies. The Petri dish from Dr. Flynn's bookshelf contained numerous black and yellow colonies (yeast and fungi) but few white mold colonies. The Petri dish from Dr. Flynn's backroom had both large black and yellow colonies (again, yeast and fungi) with few white mold colonies. The Petri dish from Mrs. Woodward's classroom contained a majority of yellow yeast colonies and black fungi colonies with sporadic white mold colonies. The Petri dish placed outside in the gutter contained one small white mold colony.

Analysis:

In analyzing the data, it became clear that the quality of outdoor air is much higher than that of indoor air, seeing as the Petri dish samples taken from indoor locations contained well over 100 times more colonies of fungi and microorganisms than that of the Petri dish sample placed outside in the gutter. Of all the indoor Petri dishes, the sample taken from Ms.

O'Donovan's classroom contained the most colonies (200). The reason Ms. O'Donovan's classroom produced the most bacterial colonies, and thus had the worst indoor air pollution, is because the classroom contained the most dust particles and had the least amount of air circulation of all the indoor locations. Ms. O'Donovan's classroom rarely has more than one door open, the windows are often closed, and the class contains many crevices and nooks for dust particles to accumulate and thus constantly circulate within the classroom. The Petri dish from an indoor location with the least amount of colonies was the sample taken from Mrs. Woodward's classroom, containing 140 colonies. This Petri dish contained the least amount of colonies of all the indoor locations because Mrs. Woodward's classroom has excellent air circulation, little dust, and with numerous open windows and both doors always open, outdoor air is constantly entering and exiting, removing harmful indoor air pollution with it.

The Petri dish placed outside in the gutter was found to have only 1 colony present, whereas the average amount of colonies found in a Petri dish from an indoor location was 168.2 colonies. This enormous difference in the number of fungi and microorganisms colonies present clearly indicates that the quality of outdoor air is much higher than the quality of indoor air, and that contrary to popular belief, indoor air pollution is much worse than outdoor air pollution.

In looking at the data, it becomes clear that the dustier areas with less circulation resulted in Petri dishes with the most colonies (Ms. O'Donovan-200 and Dr. Flynn's Bookshelf-192). Strangely, the Petri dish that was placed in Dr. Flynn's backroom did not have as many colonies as the samples taken from Mrs. O'Donovan's classroom and the top of Dr. Flynn's Bookshelf. This proved the originally stated hypothesis wrong, seeing as Mrs. O'Donovan's Petri dish sample contained 59 more colonies than the Petri dish placed in Dr. Flynn's backroom. This may have occurred due to the fact that the backroom door is often left open, and it situated right

by the door to the outside (which remains open all the time as well) allowing for air circulation and the exit of any indoor pollutants. This also proved that moisture (present from the ecocolumns) has very little effect on the quality of indoor air.

The accuracy of the results above may be slightly skewed due to the difficulty in counting the number of colonies, by hand, present in each Petri dish. Had a more accurate method of counting been used, the results would be more precise, yet most likely would not differ too much. As was stated above, the reasoning behind the results was based on the amount of air circulation in the room. However, the results may also have turned out as previously stated due to how close the Petri dishes were placed to doors that opened to the outside. Also, depending on how high up in the room or low to the ground may have had a significant effect on the results, seeing as most dust settles near the ground versus floating around up high.

As the results dictated, indoor air pollution can prove to be much worse than outdoor air pollution. Sources of indoor air pollution include Asbestos, biological pollutants, carbon monoxide, formaldehyde and pressed wood products, lead, nitrogen dioxide, pesticides, radon, respiratory particles, second hand and environmental smoke, volatile organic compounds, as well as stoves, heaters, fireplaces, and chimneys. These sources can be emitted from combustion sources, including oil, gas, kerosene, coal, wood, and tobacco products, deteriorating building materials, old insulation, carpet and cabinetry, space heaters and furnaces, as well as paint thinners, solvents, and other household cleaning products. (U.S. EPA Indoor Air Quality)

As stated above, a common indoor air pollutant is lead, which enters households and offices by way of lead based paint, contaminated soil, dust, and drinking water. Most often, lead is found in average households in lead based paint that was legal to use before it was outlawed in 1978 or in drinking/bath water. Inhaling paint chips with lead, or drinking water with lead can

lead to lead poisoning. Indicators of lead poisoning include stomachache, cramping, nausea, vomiting, fatigue, headaches and muscle weakness. In order to “clean up” this lead pollution, the EPA recommends following proper EPA certified requirements for removing lead based paint from houses, which include using lead-safe certified contractors.

Conclusion:

The purpose of this experiment was to discover the amount of indoor air pollution that exists in comparison to outdoor air pollution. As was previously stated, the hypothesis for the experiment said that the Petri dish placed in Dr. Flynn’s backroom would contain the highest number of colonies of all the Petri dishes. This hypothesis was formed, based on the fact that Dr. Flynn’s backroom was located in the back of the classroom, and being a small space with moisture present from ecocolumns, would have little air circulation. However, the results showed that the Petri dish in Ms. O’Donovan’s classroom contained the most bacterial, fungi, and yeast colonies. In truth, looking at Ms. O’Donovan’s classroom showed that there was much more dust present and less air circulation than the backroom which happened to be located right next to an outside door. And, surprisingly, the Petri dish placed outside contained only 1 colony, leading to the discovery that indoor air pollution is definitely much worse than outdoor air pollution. Despite the amount of air circulation or particles of dust that were present though, the experiment unveiled that indoor air is of much poorer quality than outdoor air, with many sources including those listed above (ex. asbestos, carbon monoxide, lead, nitrogen oxide, volatile organic compounds...).

Looking at the data table above, and the coinciding pictures, it becomes clear that the Petri dish with the most colonies of bacteria, fungus and mold was the one from Ms.

O'Donovan's classroom, followed by the one placed on Dr. Flynn's bookshelf, the Petri dish placed in Dr. Flynn's backroom, the Petri dish placed in Mrs. Woodward's classroom, and lastly, the Petri dish placed outside in the gutter. As seen in the picture, the Petri dish placed outside was practically clear compared to the four other Petri dishes. When all is said and done, it is quite a shock to see just exactly how 'clean' the inside air breathed by all truly is.