UCLA
Sustainability
Action Research

UCLA Recreation Team

2016 Sustainability Action Research

Final Report

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Introduction

This quarter the SAR Recreation Team focused our efforts on indoor air quality testing at the John Wooden Center, surveying students, working with SLEAC on lighting protocol, and developing an action plan for the Wooden Center moving forward. Our main mission throughout our project was to ensure the continued health and environmental safety of students using the Wooden Center facilities, specifically in relation to air quality. Additionally, we came up with strategies to reduce electricity usage in order to save energy and money. To accomplish our goals, we performed multiple indoor air quality tests, and with this data, we were able to develop a plan for the Wooden Center to combat the levels of dust in the particular trouble areas. To gain personal perspectives, we surveyed students at the Earth Day Fair to determine their awareness of indoor air quality, and discovered that many were unaware of the potential health risks associated with poor indoor air quality. In addition to our work on air quality, we discussed lighting protocols with SLEAC and how to best utilize student employees in our efforts to decrease energy usage. We developed a lighting protocol plan which will be implemented in new hire training for Wooden employees to pass the knowledge forward. Through our Sustainability Action Research, we gained new insights and goals and look forward to sharing our ideas with the UCLA Recreation administration.

Background

Indoor air quality is becoming of increasing concern as people currently spend around 90% of their time indoors, with extended exposure to indoor pollutants (EPA, 2001). Asthma occurrences are on the rise according to The National Academy of Sciences (NAS) and the Institute of Medicine, and indoor air quality is the most likely culprit. In its report, NAS

confirmed that dust mites and other allergens, microorganisms, and some chemicals found indoors are triggers for asthma (EPA, 2001). Recently, a device was brought in and installed on one of the air handlers in the John Wooden Center to improve air filtration. A large part of the motivation for our study was to determine the effectiveness of this device. The device, called AtmosAir™, is specifically designed to target indoor air quality and protect against high levels of allergens and pollutants. As stated in the buying guide, the product uses ionization to help neutralize viruses, fungi, bacteria, and allergens by sending in positive hydrogen and negative oxygen ions to disrupt the surfaces of these cells, rendering them inactive even if they enter the body (Air purifier Buying Guide). The most dangerous and harmful indoor pollutants are nearly impossible to remove with most air purifiers, since they come in the form of gases; however, if an air filter is able to pull out substantial particulate matter for how much air it sucks in, then it is determined to be beneficial (EPA, 2001).

The minimum standard for indoor air quality requires MERV filters, while the most effective one is the HEPA air filter, reducing 99.97% of particles 0.3 microns (μm) or larger. Consequently, P.M. 2.5 (particulate matter that is 2.5 μm in diameter or smaller) becomes quite dangerous as these particles are able to pass through the HEPA air filters. Most air pollutants can also be rid of by removing the point source of the air pollution, whether that is something causing mold to accumulate or keeping windows and doors open to allow air circulation naturally (EPA, 2001). AtmosAir™ claims to rid affected areas of a range of negative substances such as: particulate matter, odors, volatile organic compounds, dust, molds, bacteria and viruses. While this sounds beneficial, it should be taken into account how prevalent these are in an area like the John Wooden Center. AtmosAir also claims to lower levels of bacterium such as E-Coli, which is more commonly associated with foodborne illnesses, and S. saprophyticus, which is

another intestinal bacteria. Neither are a large risk for gyms and thus aren't as important to our study. Volatile organic compounds are generally found outdoors especially during the summer and aren't as much of an issue indoors either (NLM). Dust particles and mold are probably the biggest air quality related health hazards in gyms and further analysis of the extent to which this purification system affects them should be monitored.

With direct usage of the purification device, no matter how much research we have done on the product itself, we were not been able to find any other university or sports arena who has researched the product the way we intended to. No other group has compared the air quality after installation to the air quality before in a public space. Nor has a group compared the air quality after installation to a similar area unaffected by the installation. The closest thing to this form of research was done in an office building in Los Angeles. According to a handout from the AtmosAir™ folder provided to UCLA Recreation before installation, the study found noticeable decreases in the amount of bacteria, particulates, and allergens after their system was installed. However this was a private office building and not a public space like the Wooden Center where thousands of students, employees, and community members come daily.

Gyms have heavy carbon footprints because they are open long hours, have many electrically-powered machines, and require constant air circulation. To reduce energy usage, gyms can turn off non-essential lighting or install motion sensor lighting, program thermostats to run air conditioning only during business hours (Scanlin, 2007), and install fluorescent lighting and Energy Star appliances (Ericson, 2014). Other more extreme solutions include converting ceilings into skylights to use more natural light, or to install solar panels to offset electricity consumption (Scanlin, 2007). In terms of machines, gyms can choose to turn off electrically-powered machines when not in use, or they can choose to only purchase self-powered machines

(Ericson, 2014). To go above and beyond, there are even machines that add electricity back into the system to power building lights (Ericson, 2014). Furthermore, last year's Recreation ART Team found that most of the lighting through Wooden was fairly up-to-date with efficiency models with only a few exceptions. These exceptions were not significant enough to implement light changes cost-effectively.

Methodology

Phase I: Planning and Organizing

At the beginning of the quarter we approached our stakeholder, Katie Zeller, with several small project ideas. The project we chose was recommended by Katie and involved performing an indoor air quality audit specifically focused on the AtmosAir™ system. We were told that the system had recently been installed in the air handler that affects Yates Gym and were given a large folder full of testimonials for AtmosAir™ products. The subsequent few weeks involved researching the company and their products, while waiting for some answers from the AtmosAir™ representative on the product that was installed. In our literature review, most of our attention was on the AtmosAir™ component of the project. However, we still wanted to focus on working with the Student Leadership Employee Advisory Council (SLEAC) to formulate and train employees with a standardized lighting protocol extending from last year. Last year's Recreation Team surveyed employee lighting protocol, and found that employees were not only uncooperative, but also did not know standardized lighting protocol.

Our initial plans and progress dates were forced to change while only weeks into our research due to the shutdown of three John Wooden Center air handlers from April to August. Because of this, we required to finish all air quality testing by the end of Winter Quarter, and had

to push back the SLEAC lighting protocol project until Spring Quarter. For our air quality measurements, we contacted Yifang Zhu, a professor at the UCLA School of Public Health. Professor Zhu was not optimistic regarding the time constraint and the need for compensation of her graduate students. We also reached out to UCLA Environmental Health and Safety Department to find out if there was any previous data that we could utilize or if there was somebody in the department who could assist with the air quality audit. This put us into contact with Gillian Marks, the Environmental Programs & Industrial Hygiene Division Manager, who redirected our needs to the EHS Certified Industrial Hygienists (CIH) Neil Mansky and Gabe Jasso. However, to this day the Recreation Team has yet to hear back from either of them. During this time, the Recreation Team drafted a survey for the gymnastics team in order to find out if they noticed any observable differences from the AtmosAir™ system we were told had recently been installed.

The Recreation Team was finally able to schedule a tour of the six main air handlers units (AHUs) that powered the Wooden Center with the building manager and engineer. On this tour we found out many important details pertinent to our research. The building engineer for the John Wooden Center took us downstairs into Parking Lot 4 to see AHUs #1, 2, and 3. AHU #2 ventilates Yates Gym and has the AtmosAir™ system attached. While observing the device, we were informed that the AtmosAir™ system had been installed almost two years ago and that the system had not been functioning for at least six months. This was shocking information, both due to the fact that the bulk of our previous research had been on AtmosAir™ as well as the fact that Rich Mylin, the UCLA Recreation Associate Director of Facility and Event Operations who had the system installed, was unaware that it had not been functioning. We decided to forego research on the AtmosAir™ system and instead focused on a general air quality audit. This tour

also gave us details including which air handlers service which rooms in the building and what types of filters UCLA uses. Currently, the John Wooden Center utilizes the MERV (Minimum Efficiency Reporting Value)-14 filter, which is the minimum university standard filter that filters approximately 75% of particles (Inspectapedia.com.).

After deciding to focus on indoor air quality in the John Wooden Center, we got back in contact with Professor Yifang Zhu. We set up a conference call between us, her, and her two graduate students, Charlene Nguyen and Amy Sen. During the conference call we arranged to meet with Charlene the following week to coordinate days and times for testing, and discuss a proper method of compensation. At the meeting we discussed three specific days to test the six rooms affected by the six AHUs in the John Wooden Center, and times in which the testing would be done.

Phase II Execution

Testing began on Tuesday, March 8th when the entire Recreation Team met with Charlene Nguyen. Charlene is one of Professor Yifang Zhu's graduate students studying Environmental Health. With her, we discussed the types of indoor air quality testing that would be most valuable for the John Wooden Center. We decided to test carbon dioxide (CO_2) and particulate matter (PM 2.5) which required the use of two machines: the Q-Trak and the DustTrak, respectively. Before testing, Charlene calibrated both machines in order to maximize our air quality testing time. The DustTrak is calibrated by putting a zero-level particulate matter filter on and setting the standard measurement to 0. The Q-Trak is a little harder to calibrate because you must create a bag with a known carbon concentration. In the case that the Q-Trak data was incorrect, we would need to know the difference between the control bag measurement

and reading on the Q-Trak. Since this machine is especially hard to calibrate, it was beneficial that Charlene was able to bring it pre-calibrated for us to use.

We performed our initial testing in six rooms on both the first and second floors of the John Wooden Center. The first floor test zones were Pardee Gym, Collins Court, and Yates Gym (Figure 1). Each room corresponds to AHUs # 5, 4, and 2 respectively. The second floor test zones were Racquetball Court 8, the offices, and the Blue Room (Figure 2), which each corresponds to AHUs # 6, 3, and 1 respectively. It was at this point in the testing that Katie asked us to test the air quality in the cardio room as a possible seventh site which is linked to an air handler system, but not directly connected to the six main air handlers. In Katie's opinion, having air quality audit data on the cardio room could prove to be crucial considering it is the area in the gym where most of the heavy breathing is done.

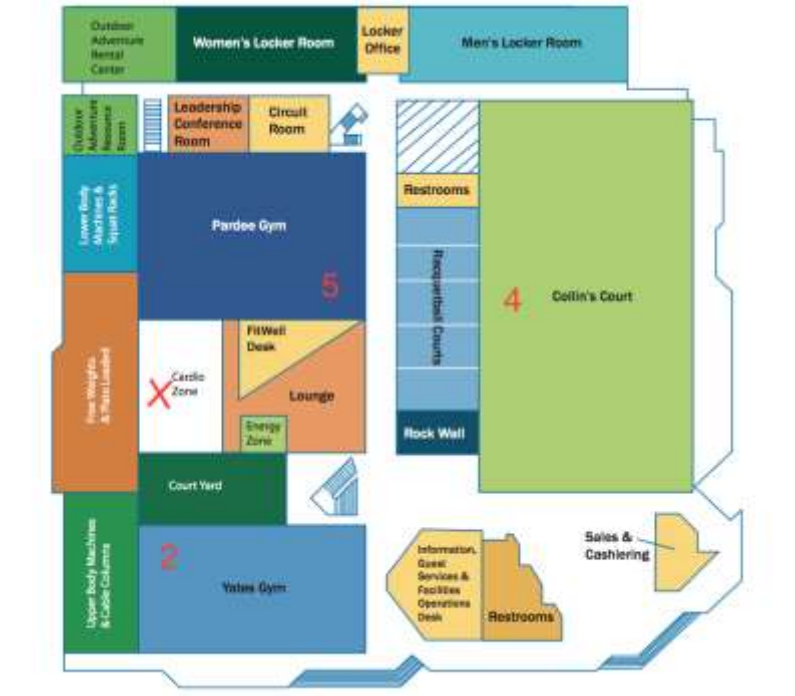

Figure 1: First Floor Map of the John Wooden Center

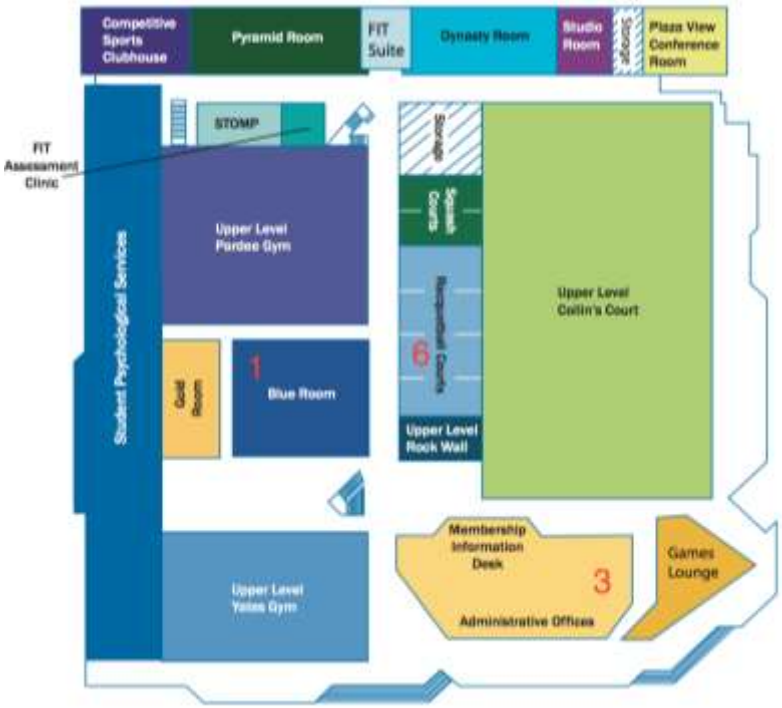

Figure 2: Second Floor Map of the John Wooden Center

The data from each test point is stored as a data file based on changeable settings within each machine itself. Charlene showed us how to track the measurements by first ensuring the time and date were exactly accurate on each machine. Then, we needed to choose the measurement frequency of each machine. Per Charlene's recommendation, both machines were set to take a measurement every minute. We then took note of each measurement time, as mentioned above. This means that there were 20 measurements per room per test day, which decreased the risk of getting an inaccurate reading**.** Our three main tests days were the evening of Tuesday, March 8th, the morning of Sunday, March 13th, and the afternoon of Tuesday, March 15th. We did the three separate timed readings to get data at different parts of the day and to assess if indoor air quality is any better or worse at varying times.

On the last day of testing, our team accidentally came across a disturbing fact: the Weight Room, which we previously decided not to test, had higher PM 2.5 levels than the minimum

health standard. The graduate student helping us, Charlene Nguyen, informed us that a value of 0.015 ppm or higher was worrisome. Due to this, we decided to return to for subsequent testing on the Weight Room. The final data set now involves eight rooms of data collection, as detailed in the updated first floor map in Figure 3. At our eighth testing location, when we returned to test the Weight Room we simulated the original experiment by testing at three times of the day. However, we took the data one step further due to our preliminary finding of unhealthy PM 2.5 levels by also testing in three separate locations within the room itself. With this, the Recreation Team wanted to determine whether there were certain spots in the room more prone to particulate matter than other parts. On Tuesday, May 3rd, we returned to complete the supplemental testing on the Weight Room alone. We did three twenty minute tests in the morning, afternoon, and evening. Each of the three tests were in a separate sub-room of the larger Weight Room as whole. The Weight Room is partially divided into three segments by two different mirrored walls.

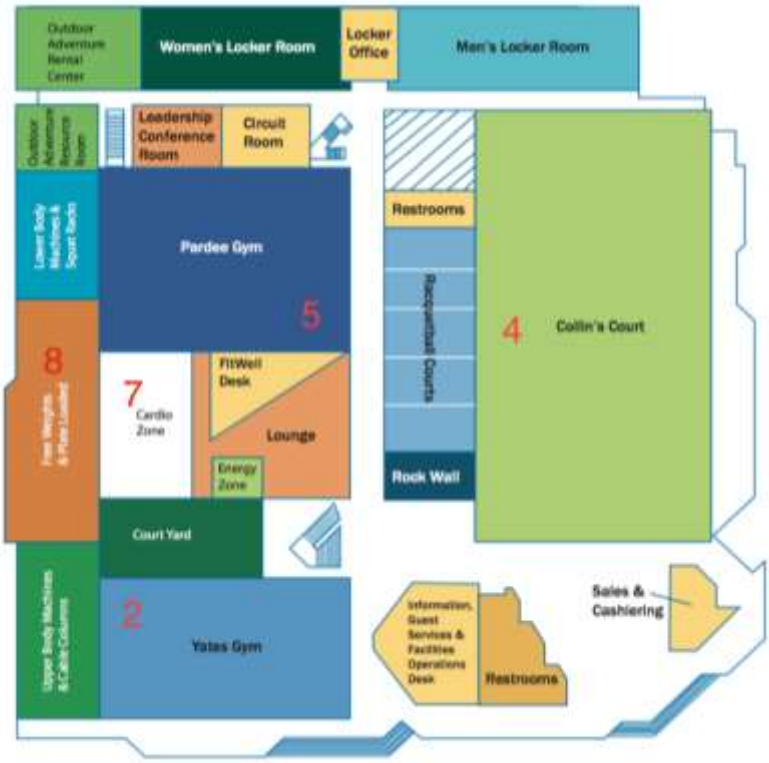

Figure 3: Updated First Floor Map of the John Wooden Center

Phase III: Lighting Protocol

After completing the air quality audit, our team recognized there was a serious need for stricter lighting protocol in the John Wooden Center (JWC) so we approached Katie about how to best tackle this issue. Since she is a faculty advisor of the Student Leadership Employee Advisory Council (SLEAC), she scheduled us a time slot at the weekly SLEAC meeting where we asked UCLA Recreation student employees what they thought about the current lighting protocol. The responses were mostly negative, as many JWC staff members felt that the lighting protocol was either difficult to adhere to, or almost non-existent. One major takeaway from the meeting was that that janitorial staff have a hard time following lighting protocol, meaning when they finish cleaning, they often forget to turn off all lights for the duration of the night.

Our next two weekly meetings were spent brainstorming the most efficient way to improve lighting protocol for the John Wooden Center employees. We looked up lighting protocols at other university gyms to get an idea about how to implement the most effective model at UCLA, but found very little information regarding the subject. After much consideration, we settled on a few concrete recommendations which are mentioned in the conclusion of this report.

Results

As mentioned above, we performed indoor air quality testing in ten different locations throughout the John Wooden Center. The first six locations - Blue Room, Yates Gym, Upstairs Offices, Pardee Gym, and Racquetball Court - are correlated with the six main Air Handler Units (AHUs). We also performed supplemental testing in the Cardio Room and each of the three sections of the Weight Room. We tested each location three times - morning, afternoon, and evening - then took a daily average of all values for each carbon dioxide (CO_2) and particulate matter (PM 2.5) reading. These values provided us with some very interesting, but not completely unexpected, results.

Our carbon dioxide values initially appeared very low, until we found out from Charlene Nguyen, our UCLA Environmental Health Sciences graduate student helper, that the Q-Trak had an error which caused it to report CO_2 values that were roughly half of what the actual levels were. To compensate for this mechanical error, we doubled all values in each room, for each test day. Figure 4 shows the combined results of all carbon dioxide testing. It should be noted that the highest average CO_2 levels occur in the Cardio Room and two sections of the Weight Room. These results confirm our early hypotheses in which we predicted smaller areas with many

heavy-breathing people would lead to high CO_2 levels. Figures 5 and 6 show carbon dioxide levels at or above 1000 parts per million (ppm) in six of the ten rooms tested. It is also interesting to note that for many of the rooms (excluding the three Weight Rooms), CO_2 levels were much higher in the morning than in the afternoon or evening. The three Weight Rooms are not consistent with this trend, as their highest CO_2 concentrations occurred in the evening.

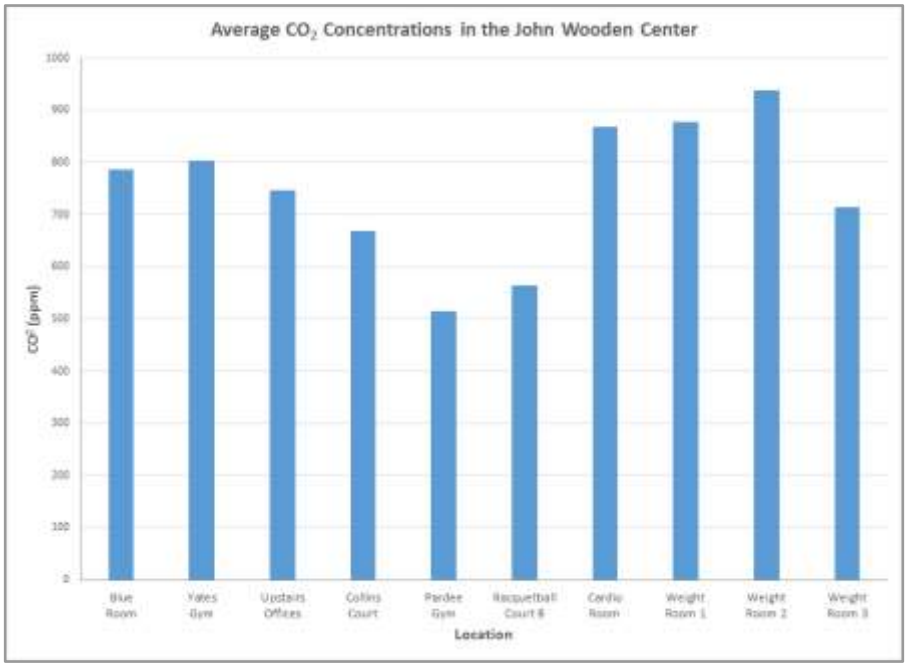

Figure 4: This graph shows the average concentration of carbon dioxide (CO_2) in ten different rooms at the John Wooden Center.

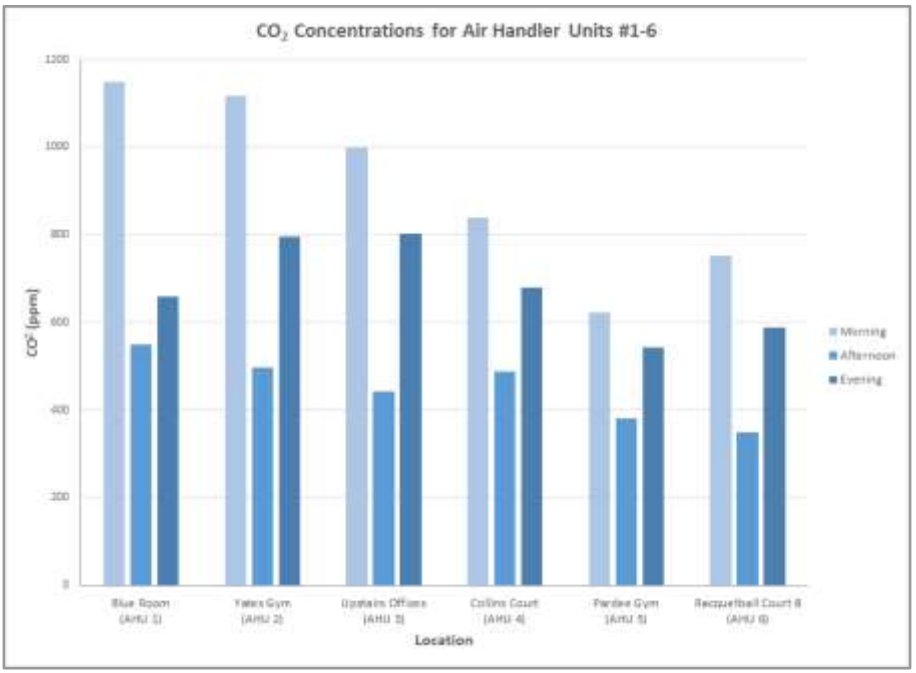

Figure 5: This graph shows the concentration of carbon dioxide (CO_2) during three different time intervals - morning, afternoon, and evening - in rooms according to each of the six Air Handler Units (AHUs) at the John Wooden Center.

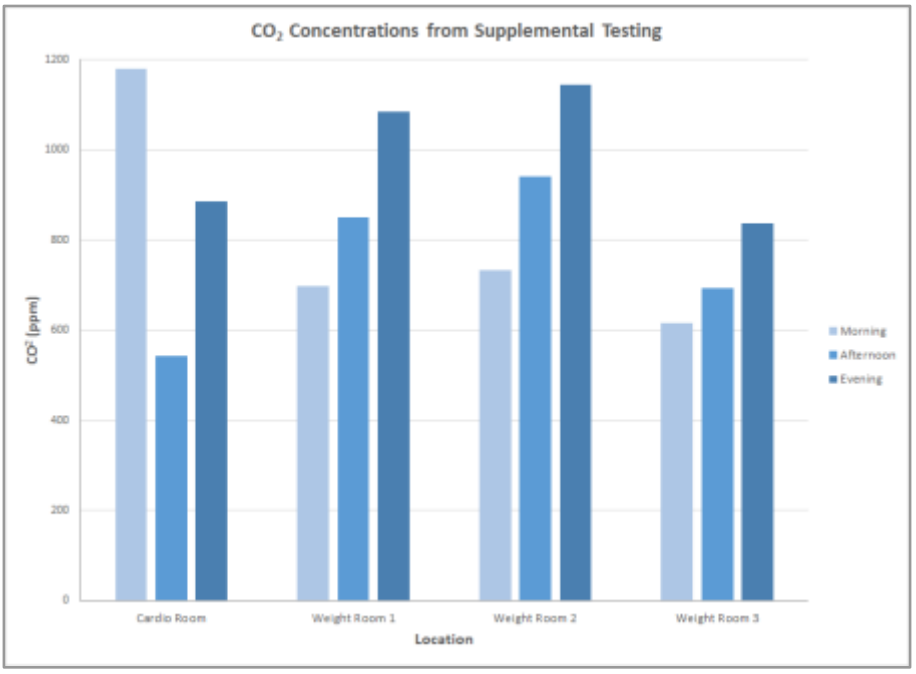

Figure 6: This graph shows the concentration of carbon dioxide (CO_2) during three different time intervals - morning, afternoon, and evening - in four supplemental rooms at the John Wooden Center.

As mentioned in the methodology, we had not originally intended to do indoor air quality

testing in the Weight Rooms. Rather, we stumbled upon incredibly high particulate matter (PM 2.5) values that encouraged us to take a second (and third) look at the air quality. It is evident in Figure 7 that the highest particulate matter levels among the ten rooms we tested were in the the three sections of the Weight Room. These values (all at or above 0.2 milligrams per cubic meter) are nearly an order of magnitude higher than most of the seven other rooms! There does not seem to be a consistent temporal trend among the PM 2.5 concentrations in the ten rooms (Figures 8 and 9). In Yates Gym, Collins Court, Pardee Gym, and the Racquetball Court the lowest readings occur in the morning while the highest readings occur in the afternoon. By contrast, in the Upstairs Offices and the three Weight Rooms the lowest readings occur in the afternoon while the highest readings occur in the morning.

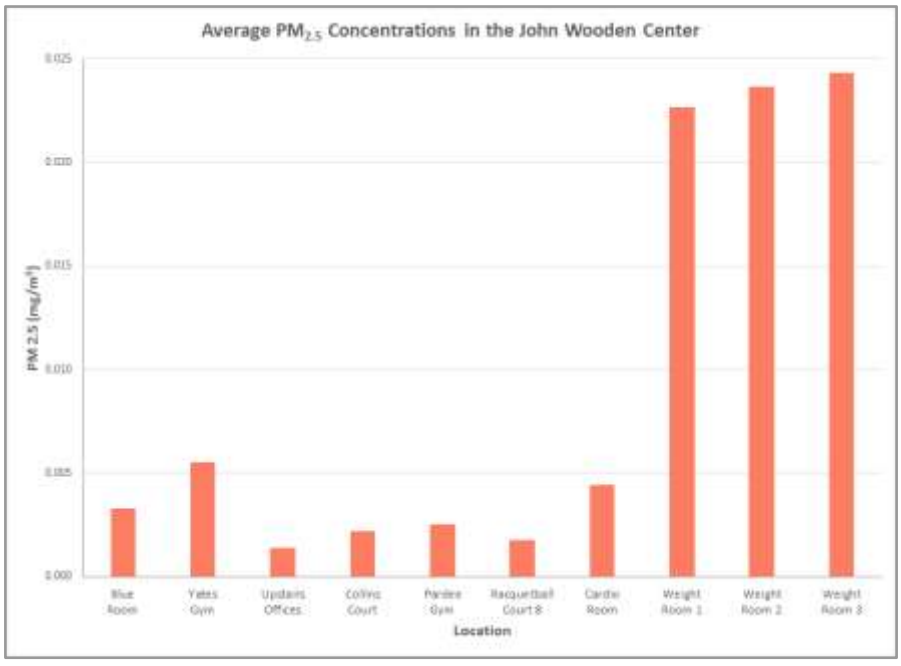

Figure 7: This graph shows the average concentration of particulate matter (PM 2.5) in ten different rooms at the John Wooden Center.

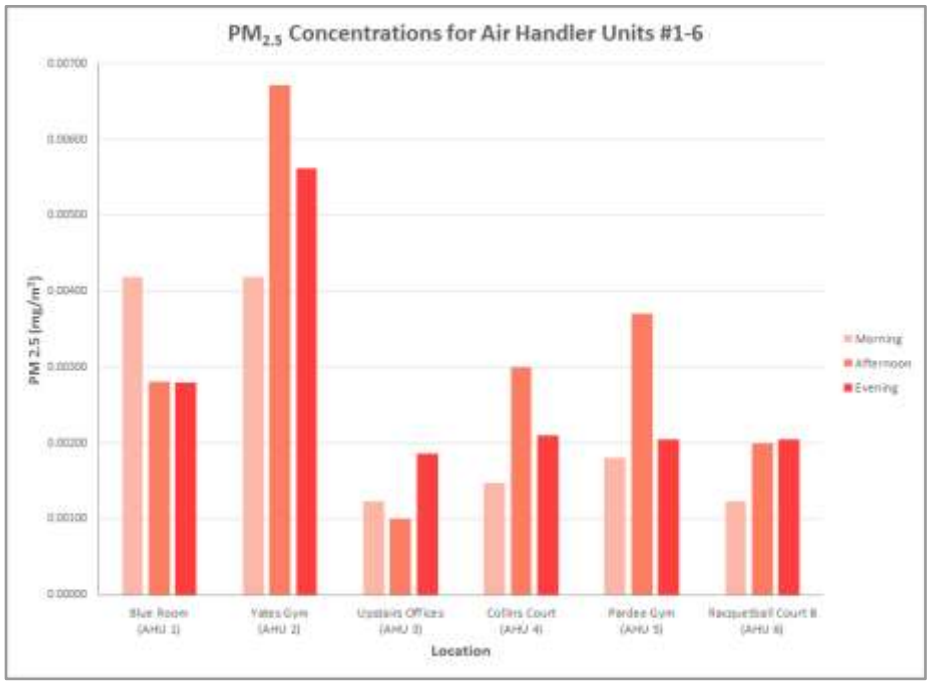

Figure 8: This graph shows the concentration of particulate matter (PM 2.5) during three different time intervals - morning, afternoon, and evening - in rooms according to each of the six Air Handler Units (AHUs) at the John Wooden Center.

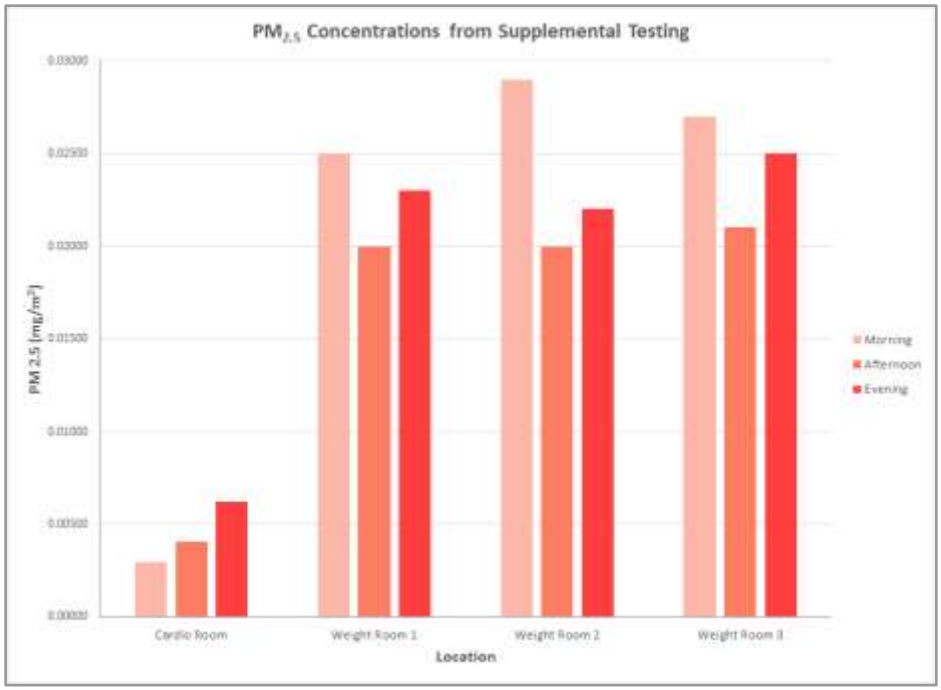

Figure 9: This graph shows the concentration of particulate matter (PM 2.5) during three different time intervals - morning, afternoon, and evening - in four supplemental rooms at the John Wooden Center.

At the Earth Day fair we developed a survey to interview students about their view on the

relationship between the John Wooden Center and air quality. We asked a number of questions related to their exercise habits, their level of care for indoor air quality, and their thoughts on current air quality at Wooden. The results of the survey were especially relevant since we found that many people were very concerned with air quality and how it affects their exercise performance (Figure 10). There were a significant amount of answers (78.1%) from people that go to the gym at least once a week, which means a majority of students are being exposed to the air in Wooden. Coupled with our data from our own testing, this is concerning for student health on campus. Over 75% of students answered the that they believed the air quality in Wooden to be neutral or good, proving that many are unaware of the level of particulate matter they are being exposed to while working out at the gym. The majority of students asked about the cleanliness of the Weight Room believed it to be relatively clean, which directly contradicts our findings.

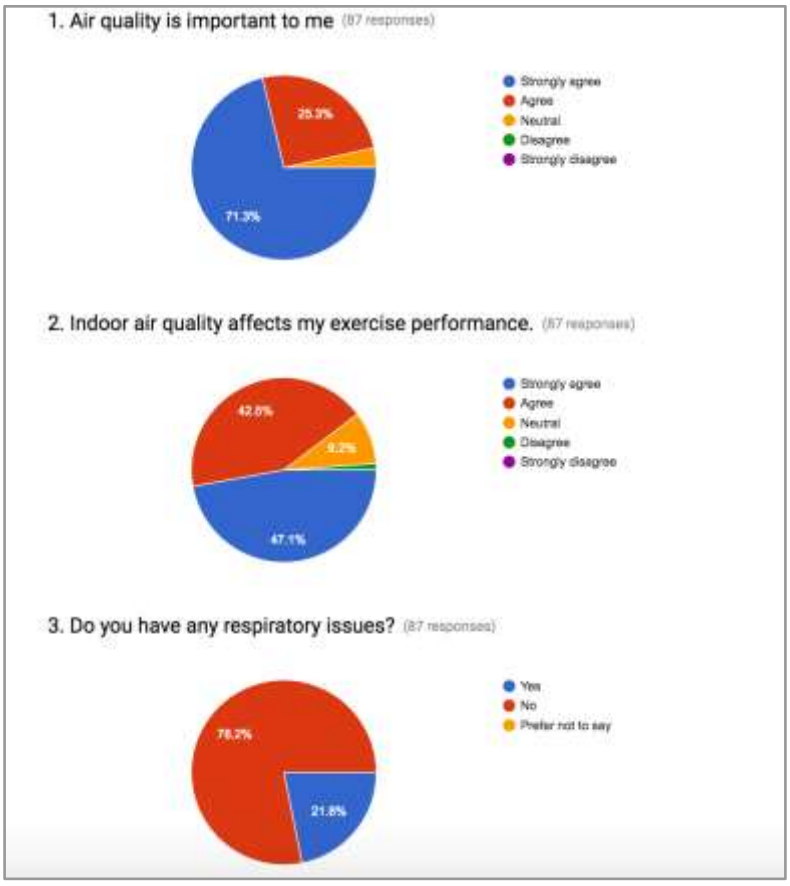

Figure 10: Results for Questions #1-3 of our John Wooden Center Indoor Air Quality survey.

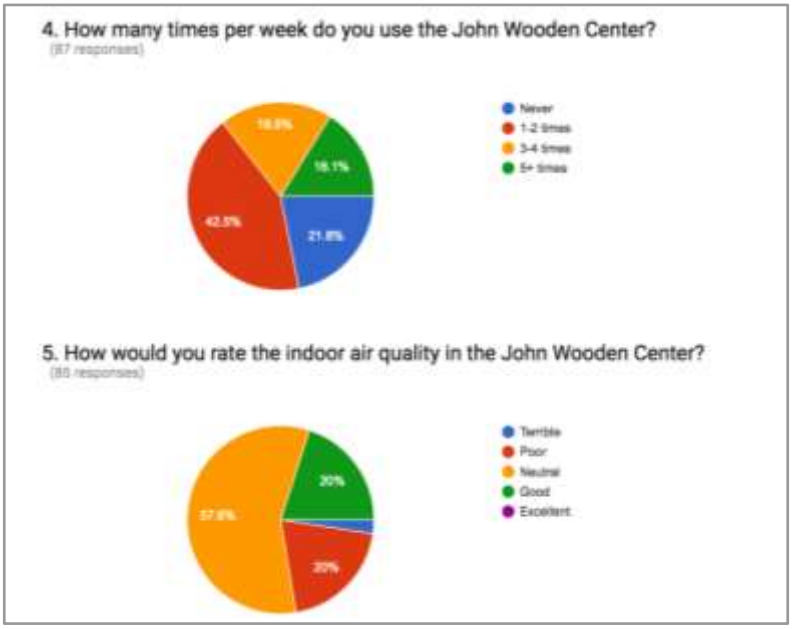

Figure 11: Results for Questions #4 & 5 of our John Wooden Center Indoor Air Quality survey.

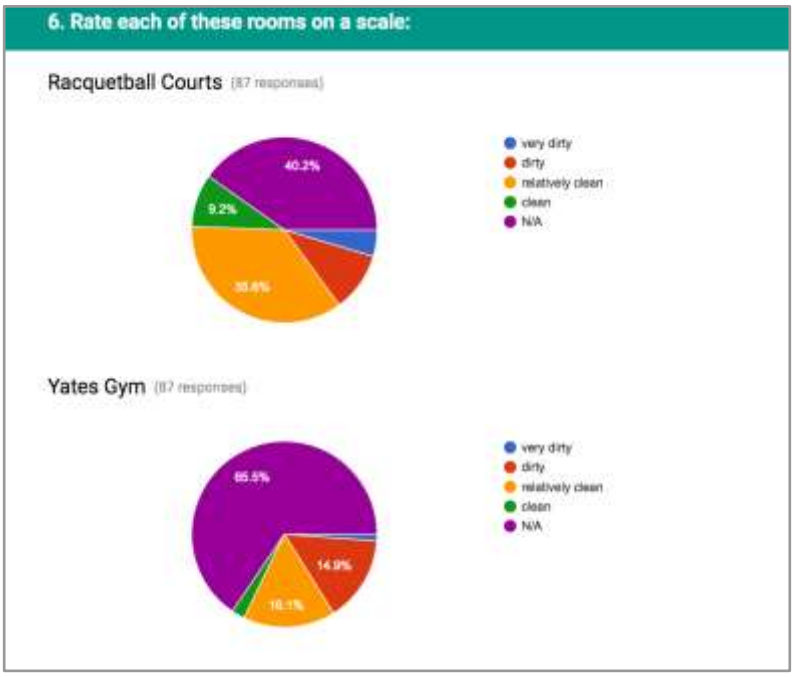

Figure 12: Results for Question #6 of our John Wooden Center Indoor Air Quality survey.

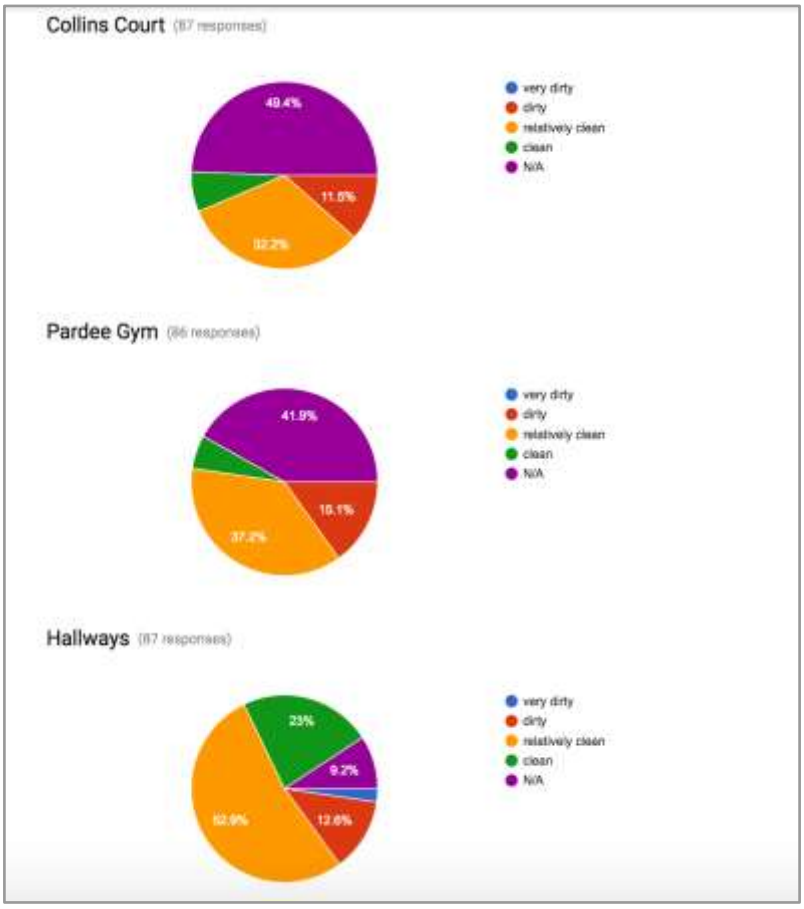

Figure 13: Results (continued) for Question #6 of our John Wooden Center Indoor Air Quality survey.

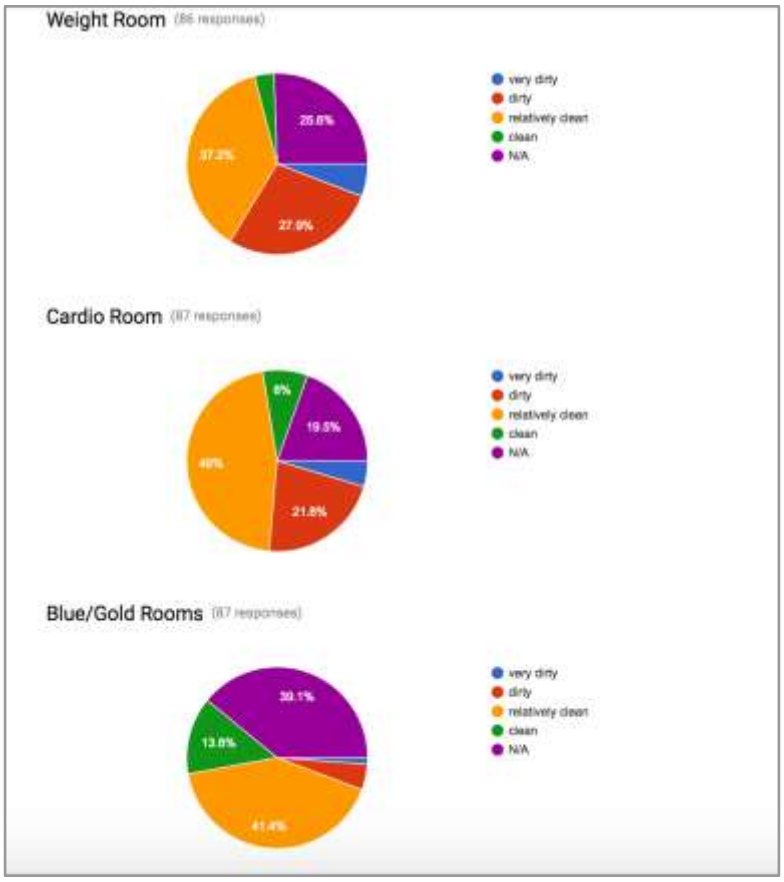

Figure 14: Results (continued) for Question #6 of our John Wooden Center Indoor Air Quality survey.

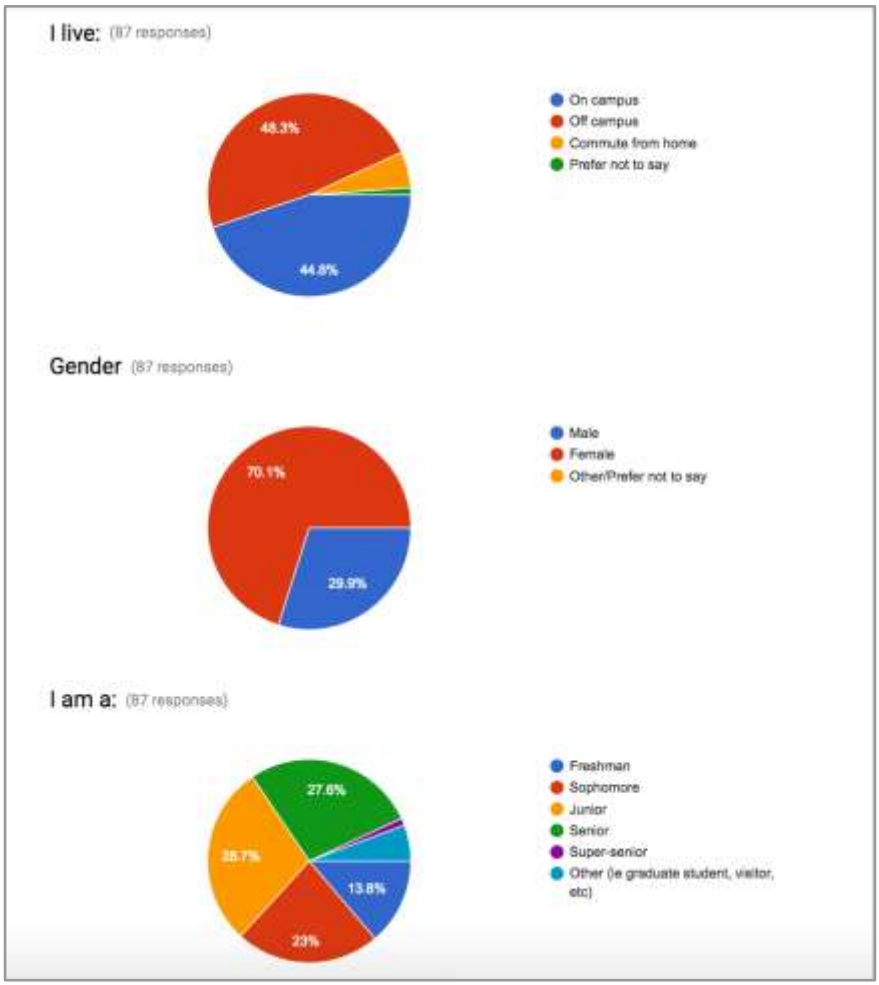

Figure 15: Results for Questions #7 - 9 of our John Wooden Center Indoor Air Quality survey.

Discussion

Six of the ten rooms studied had carbon dioxide concentrations at or above 1000 parts per million (ppm). According to the National Institute for Occupational Safety and Health (NIOSH), carbon dioxide levels above 1000 ppm indicate poor ventilation. At very high levels - above 5000 ppm - carbon dioxide can cause people to experience headaches, drowsiness, or reduced performance. Though levels below this threshold are not usually associated with direct health risks, CO_2 concentrations can be used as an indicator for other aspects of indoor air quality such as indoor odor, ventilation rates, and general comfort. NIOSH recommends that carbon dioxide

levels be within 600 ppm of local outdoor CO_2 levels, unless of course outdoor levels are exceedingly unhealthy. Though the John Wooden Center's level of carbon dioxide are not high enough to pose substantial health risks to gym-goers and full-time staff members, they indicate that there may be a need for increased ventilation for overall comfort.

In terms of particulate matter, we initially predicted that the particulate matter levels in Yates Gym would be the highest because of the amount of chalk and dust present in the gym. Though they were the highest of the six rooms associated with the Air Handler Units (Figure 8), the Weight Rooms clearly exceeded Yates Gym's PM 2.5 concentrations. The U.S. Environmental Protection Agency recently updated its PM 2.5 outdoor air quality standards to require less than 12 micrograms per cubic meter (ug/m3) - equivalent to 0.012 milligrams per cubic meter (mg/m3) - annually, and less than 35 ug/m3 - equivalent to 0.035 mg/m3 - daily (24-hour standard). In our testing, the Weight Rooms varied between 0.02 and 0.0295 mg/m3, which is higher than the annual standard and just short of the 24-hour standard. This is concerning because, according to the American Lung Association, the size of PM 2.5 particles (less than 2.5 microns) makes them very harmful to the respiratory tract, especially for people with asthma and other health issues.

Through our indoor air quality testing and gym patron survey, we discovered that there is a disconnect in information available to students about the environment in which they are exercising. We hope to change this discrepancy and work with the Wooden Center to improve the air quality in the Weight Room and keep students informed on the factors affecting their health.

Challenges and Difficulties

Our biggest challenge over the course of the last two quarters has been a lack of solid communication between our team and UCLA faculty members and advisors. After the first few weeks of winter quarter it quickly became apparent that in order to get in contact with professors and the Environmental Health and Safety Office on campus, one phone call or e-mail simply was not going to cut it. It took until week eight (winter quarter) to get a hold of Professor Yifang Zhu who eventually put us in contact with her graduate students and enabled us to test indoor air quality in the John Wooden Center during finals week.

Another major challenge was our pivot away from focusing on the AtmosAir system as we launched into a full air quality audit. Originally Katie had asked to assess the effectiveness of the air purification system AtmosAir on Yates gym, but after taking a tour of the air handlers at the Wooden Center, we discovered the AtmosAir system had not been on or working for the past few months, even though it had been installed a couple years ago. This shed light on the fact that there were some ongoing distinct miscommunications between the building maintenance and those who initially installed the system, which was concerning for us. This caused us to change our project plan, and to focus more on the overall indoor-air quality, rather than focusing solely on the AtmosAir unit.

Looking ahead, the most substantial challenge that remains is the question of how to improve indoor air quality in the Weight Room of the Wooden Center while effectively minimizing the level of PM 2.5 present. The need for improved ventilation in the form of windows that can actually be opened and closed is becoming more and more important as the dangerous levels of particulate matter building up in the air are affecting everyone’s workouts negatively.

Conclusion

The Recreation Sustainability Action Research team's research over the past two quarters affected the campus and students overall in three ways: providing baseline data, allowing for educational outreach, and establishing helpful recommendations to make our campus more sustainable. Prior to our project our stakeholder, Sustainability Coordinator of Recreation Sport Venues & Event Operations Katie Zeller, had no prior data on the Wooden Center's indoor air quality. Good air quality helps employees and gym-goers stay happy and healthy, in turn creating a more efficient and sustainable body of students and workers. Knowing whether the air quality that thousands of Wooden Center users experience per day is the first step in ensuring their health and happiness. Upon receiving this information, Katie Zeller and/or future teams now know what rooms or policies to make changes to. Our second campus impact has been on educational outreach. At the Earth Day Fair, our team opened up a discussion on indoor air quality and spread the word about our research findings. Through this we were able to accomplish two major educational items. The first was getting people to start thinking about indoor air quality within their everyday lives. The second was educating people on the indoor air quality that directly affects their regular experiences and hopefully create a knowledge base for them to spread the words to others. Without widespread knowledge, it is much harder to make changes occur on our campus.

Our final campus impact is establishing recommendations to further the health quality and sustainability of the John Wooden Center. Improving the air quality of the Weight Room should be a major focus of future teams, students, and employees of the Wooden Center. The Recreation has a few ideas on how to reach this goal. Our first would be to upgrade the air handler filters that serve the Weight Room. This is not one of the main six air handlers, but

improving its filters has great potential in decreasing the Weight Room's harmful particulate matter. As aforementioned, the current air handler filters are MERV-14 which is UCLA's minimum air filter standard. We recommend installing instead the HEPA-grade air handler filters, which are top of the link and 99.97% efficient (inspectapedia.com, n.d.) While the entire gym does not need to retrofit filters, seeing how the Weight Room has such surprisingly high levels of PM 2.5 more efficient filters are necessary. Furthermore, the Recreation Team recommends further testing in order to determine the exact cause of the particulate matter. Future teams should look into whether there are instruments available to students that can actually read what types of particulate matter is circulating through the air. If this were possible, it would be much easier to improve air quality by attacking the actual source of particulate matter. Our final Weight Room recommendation is looking into changing the windows of the Weight Room. Currently, the John Wooden Center does not have windows in any room that opens to allow outside air to circulate inside. Improving air circulation by installing openable windows is one potential solution the the particulate matter problem in the Weight Room.

In terms of our secondary research project, we also have recommendations in regards to the John Wooden Center's lighting protocol. Our first suggestion would be to enforce existing lighting protocol. During our meeting with SLEAC, members of the council informed us that there was official lighting protocol already in place. This lighting protocol needs to be mandated within training and all current employees also need to be reminded to strictly adhere. Secondly, we advise SLEAC, Katie Zeller, and future teams to coordinate with UCLA Facilities Management in regards to turning off lights at night. This may be an issue with the upcoming policy change after which the Wooden Center will be open for extended hours certain days a week. However, it would be extremely beneficial for energy saving to coordinate with UCLA

Facilities Management to ensure the lights are off at night currently and in the future on days that there are not extended hours. A third recommendation is to undergo a rewiring of the stairs from the first to the second floors and Blue room lights. Currently, these lights are connected, a design flaw that forces the Blue room lights to be on whenever there is a risk a person will walk down an unlit staircase. Rewiring this could prevent future safety hazards in the case that someone turns of the Blue Room lights and forgets that they connect to the staircase. It also could save money on energy bills and light bulb replacements. Our final recommendation in terms of lighting protocol is to invest in light timers for racquetball courts. Having a light timer on the outside of the room allows racquetball players to determine how long they would like to play for. This also would prevent inefficiency caused by John Wooden Center customer relations employees having to regularly make rounds to check whether the lights in the courts need to be turned on or off. Having a timer outside would also be better than our initial proposed idea, having lighting sensors within each racquetball court. Using timer inside the courts pose a risk to the sensor itself as well as to the players utilizing each court. These are all of our recommendations, as well as an outline of how our research project impacted the campus overall.

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Appendix

Recreation 2016 Literature Review

I. Introduction

Many people, especially in the Los Angeles region, worry about air quality. Health concerns around air pollution have been an issue for a long time, and efforts have been put in place in improve air quality since the 1960s. However, indoor air quality is a health concern that many people do not even consider. In order to combat indoor air pollutants, allergens, bacteria, fungi, and other contaminants, many public places have decided to implement air purification systems. UCLA's John Wooden Center has implemented one such system made by AtmosAir™ in its gymnastics gym, Yates Gym. AtmosAir™ is specifically designed to target indoor air quality and protect against high levels of allergens and pollutants. Indoor air quality is becoming of increasing concern as people currently spend around 90% of their time indoors, with extended exposure to indoor pollutants (EPA, 2001). The level of asthma is on the rise according to The National Academy of Sciences (NAS)/Institute of Medicine indoor air quality is the most likely culprit. Through its report, NAS confirmed that dust mites and other allergens, microorganisms, and some chemicals found indoors are triggers for asthma (EPA, 2001).

Furthermore, last year's Recreation ART Team found that most of the lighting through Wooden was fairly up-to-date with efficiency models with only a few exceptions. These exceptions were not significant enough to implement light changes cost-effectively. The one contribution last year's team realized could be made is through lighting protocol.

II. Research Compilation

AtmosAir™ began targeting the athletic industry a decade ago when the Dallas Cowboys became the first sports team to officially strike a deal with them. At first the entire team and its management was extremely skeptical of this company that had never before been used in a public sports facility. Apparently, the system was only installed after "head trainer Jim Maurer...agreed to test the system in his home since his dog suffered from chronic allergies"(Lefton, 2015). When the dog's previous persistent allergy symptoms improved significantly, Maurer was convinced and a deal was signed. However, it is questionable whether one's decision to invest in and install these units should be based on a dog's testimony.

Since its initial installment, many more deals and installations have taken place. It is safe to say that these facilities, including the Staples Center, The New England Patriots' Gillette Center, the USC John McKay Center, and several more, provide sufficient evidence that the AtmosAir™ air purification systems are gaining traction. Not only is this attributed to the copious amount of mold, dust, and bacteria that the systems are able to remove, but the systems also prove to be extremely cost-efficient. While installing an air purification seems like it may utilize more energy, these systems actually decrease the need for energy in a facility. This is due to the fact that HVAC systems constantly recirculate air and make up 70%-80% of a facility's total energy usage (Lefton, 2015). AtmosAir™ systems targets indoor air pollutants and contaminants which directly reduced the amount of air circulation needed to keep the air breathable. Some places have found that installing these systems result in up to 20% in energy savings (Lefton, 2015).

Most common air conditioning and heating systems do not draw from outdoor air, thereby limiting the amount of circulation the building can get (EPA, 2001). The most dangerous

and harmful indoor pollutants are nearly impossible to remove with most air purifiers, since they come in the form of gases; however, if an air filter is able to pull out substantial particulate matter for how much air it sucks in, then it is determined to be beneficial (EPA, 2001). Most air pollutants can also be rid of by removing the point source of the air pollution, whether that is something causing mold to accumulate or keeping windows and doors open to allow air circulation naturally (EPA, 2001). As stated in the buying guide, the product uses ionization to help neutralize viruses, fungi, bacteria, and allergens by sending in positive hydrogen and negative oxygen ions to disrupt the surfaces of these cells, rendering them inactive even if they enter the body (Air purifier Buying Guide, n.d.). This is equated to what UV sunlight does naturally for outdoor air, which is something most indoor buildings suffer a lack of.

While all of the testimonials and the statistics seem to encourage installation of the AtmosAir™ system, there are a few factors we will need to keep in mind. AtmosAir™ claims to rid affected areas of a range of negative substances ranging from particulate matter, odors, volatile organic compounds, dust, molds, bacteria and viruses. While this sounds beneficial, it should be taken into account how prevalent these are in an area like the John Wooden Center. The data provided by AtmosAir about bacteroides claims to lower levels of bacterium such as E-Coli which is more commonly associated with foodborne illnesses and S. saprophyticus which is another intestinal bacteria. Neither are a large risk for gyms and thus aren't as important to this study. Volatile organic compounds are generally found outdoors especially during the summer and aren't as much of an issue indoors either (NLM). Dust particles and mold are probably the biggest air quality related health hazards in gyms and further analysis of the extent to which this purification system affects them should be monitored.

Furthermore, no matter how much research we do on the product itself, we have not been able to find any other university or sports arena who has researched the product the way we want to. No other group has compared the air quality after installation to the air quality before in a public space. Nor has a group compared the air quality after installation to a similar area unaffected by the installation. The closest thing to this form of research was done in an office building in Los Angeles. According to a handout from the AtmosAir™ folder provided to UCLA Recreation before installation, the study found noticeable decreases in the amount of bacteria, particulates, and allergens after their system was installed. However this was a private office building and not a public space like the Wooden Center where thousands of students, employees, and community members come daily.

There are many routes a fitness center can take to becoming more sustainable, including: energy reduction, waste reduction, water conservation, and general environmentally friendly procedures. Gyms have heavy carbon footprints because they are open long hours, have many electrically-powered machines, and require constant air circulation. To reduce energy usage, gyms can turn off non-essential lighting or install motion sensor lighting, program thermostats to run air conditioning only during business hours (Scanlin, 2007), and install fluorescent lighting and Energy Star appliances (Ericson, 2014). Other more extreme solutions include converting ceilings into skylights to use more natural light, or to install solar panels to offset electricity consumption (Scanlin, 2007). In terms of machines, gyms can choose to turn off electrically-powered machines when not in use, or they can choose to only purchase self-powered machines (Ericson, 2014). To go above and beyond, there are even machines that add electricity back into the system to power building lights (Ericson, 2014).

To reduce waste, fitness centers can consciously choose to buy products that come in less plastic packaging, such as using hand dryers instead of paper towels, or by going paperless in communications with patrons, including forms and flyers (Ericson, 2014). Some general environmentally friendly procedures include purchasing products that are made out of recycled materials (Scanlin, 2007), using non-toxic cleaners (Ericson 2014, Scanlin 2007), and educating staff on sustainable practices (Green Business Bureau).

III. Discussion

In order to test the effectiveness of the AtmosAir™ system installed in the UCLA gymnastics Yates gym, we are going to need to get in contact with a professor or laboratory that can aid us in testing indoor air quality. Our team will reach out to several professors in the environmental research field, and potentially bring in masters or doctorate students if they are knowledgeable as well. We will utilize resources including our student directors and any stakeholders who may have connections in the field of air quality research. Upon finding someone or a group of individuals who can aid us in the comparison, we are going to take air samples from Yates, and a few other gym rooms, potentially the weight/cardio room or Collins Court. This way we can directly test whether the purifier is eliminating the items it claims it can eliminate in a noticeable way. Furthermore, we want to directly collaborate with the gymnastics team. The Recreation Team would like to survey gymnasts, especially those who were on the team and practiced in Yates last year. In theory, this survey would be accurate if none of the team members knew about the new installation. In order to properly engineer the survey, we will make sure our stakeholder Katie Zeller approves of the questions before administering.

Another aspect of our team's goals this year is to ensure that employees of the John Wooden Center follow a stricter lighting/energy protocol. For example, the lights in unoccupied

racquetball courts on both the first and second floors of the gym should be turned off when not in use. In order to do this, we hope to coordinate with the Student Leadership Employee Advisory Council (SLEAC), and lead an informational session with Wooden supervisors present where we lay out procedures to follow in an effort to conserve energy. Our stakeholder is currently in contact with the Wooden Center to find out if there is actually a standard lighting protocol that exists but simply is not emphasized to employees. Our goal is for every employee to be knowledgeable of the standard lighting procedures so that less energy will be wasted during standby power. If a standard protocol does exist, we will review it and see if there are any further energy-saving plans we can implement. In the case that we believe the current protocol is sufficient, we will move ahead on our plans with SLEAC. If there is no true standard protocol, we will write up one detailing what we believe would best save energy while still being efficient for employees.

IV. Conclusion

Our preceding research concerning the use of AtmosAir in other prominent sports and recreational facilities around the United States proves to us that these systems have real concrete potential to improve indoor air quality. Furthermore, our project will benefit greatly from the research completed for this literature review because we now understand what kinds of harmful indoor pollutants AtmosAir targets. Lastly, our knowledge of the circumstances under which AtmosAir was installed in Yates Gym will aid us in constructing a survey that provides the most accurate results.

Currently, no extension of the government monitors indoor air quality in gyms. In 2014, an article published in the New York Times reviewed a study done in Portuguese gyms, which concluded that on average the observed gyms had above (European indoor air) standard levels of

airborne dust and carbon dioxide (Reynolds, 2014). If AtmosAir can help to provide a solution to reduce substances like these, then their technology may be a worthwhile investment for UCLA recreation.

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UCLA Yates Gym Air Quality Testing Summary

June 6, 2014

Re: Indoor Air Quality Testing Summary UCLA Yates Gym

Intent

The purpose of the testing was to take air quality samples in the Yates Gymnasium at UCLA where two (2) AtmosAir model 508 bi-polar polar ionization air purification systems were installed at the main air handling unit that serves the gym. Testing was performed in a "before and after" format, one test with the AtmosAir system not operating and second test with the AtmosAir system operating. Intended was to see what affect the AtmosAir system would have on air quality readings.

Test Conditions

The area chosen for the study was the Yates Gym at UCLA. The gym design is very typical of gyms of this type and is used primarily for gymnastics activities. There is a great dust of dust and particulate from the rosin typically used in gymnastics and odors from training and gymnastics and the equipment used.

IAQ testing was performed on April 1st and April 2nd 2014. An Aircuity Optima 500 Monitor serial # 100-0248 was used to perform the air quality testing. The following elements were measured:

Temperature
Relative Humidity
Carbon Dioxide
Particles (PM10)
Particles (PM2.5)
TVOC (Total Volatile Organic Compounds)
Radon
Carbon Monoxide

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Ozone

Baseline testing without the AtmosAir unit operating was performed starting at approx. 12:00 pm on April 1st for 24 consecutive hours Testing with the AtmosAir system operating was performed starting at approx. 2:43 pm for 24 consecutive hours.

Results

See below summary charts showing the results of the various sensor readings taken.

Baseline Readings taken without the AtmosAir system operating

	Comfort and Ventilation				Air Cleanliness			Building Pollutan		
	CO2 (ppm)	Temperatu (°F)	Relative Humidity (%)	**CFM (Outdoor A PP)	PM 10 (µg/m3)	PM 2.5 (µg/m3)	TVOC (index)	CO (ppm	Radon (pCi/l)	Ozone (ppm)
Gym Area	1087	72	47	15	62	2	22	0	0	0
Typical/Com	< 1100	71 - 74	20 - 60	> 15	< 40	< 20	< 10	< 3	< 2	< 0.1
Recommend	< 1100	68 - 78	20 - 60	> 15	< 40	< 20	< 35	< 9	< 4	< 0.1

Readings with the AtmosAir system operating

	Comfort and Ventilation				Air Cleanliness			Building Pollutan		
	CO2 (ppm)	Temperatu (°F)	Relative Humidity (%)	**CFM (Outdoor A PP)	PM 10 (µg/m3)	PM 2.5 (µg/m3)	TVOC (index)	CO (ppm	Radon (pCi/l)	Ozone (ppm)
Gym Area	776	70	47	28	17	1	18	0	0.1	0
Typical/Com	< 1100	71 - 74	20 - 60	> 15	< 40	< 20	< 10	< 3	< 2	< 0.1
Recommend	< 1100	68 - 78	20 - 60	> 15	< 40	< 20	< 35	< 9	< 4	< 0.1

In looking at the results of the sensor readings, the measurements which indicate air cleanliness show the following reductions:

PM 10 Particles -72%
PM 2.5 Particles -50%

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TVOC **-19%**

PM10 is particulate matter 10 microns or less in size. These are particles that are small enough to be breathed in and enter into the throat. PM 2.5 is particulate matter 2.5 microns or less in size. These are particles that are small enough to be breathed in and enter the lungs.

TVOC (Total Volatile Organic Compounds) are gaseous elements that can cause odors and irritations. Chemicals, materials off-gassing, etc typically produce TVOC. TVOC exposure can be irritating and sometime toxic.

Conclusions

In comparing the results, readings taken in the Yates Gym with the AtmosAir system operating showed definite improvement in air quality by reduction of Particles and TVOC. Also notable, measurements with the AtmosAir system operating showed no measurable amount of ozone found. Ozone production has in the past been linked to some electronic air purification technologies.

Sincerely,

Anthony M Abate CIE CMI
Clean Air Group

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Air Quality Survey

To what extent do you agree with the following statements:

1. Air quality is important to me

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly disagree

2. Indoor air quality affects my exercise performance.

- ○ Strongly agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly disagree

3. Do you have any respiratory issues?

- ○ Yes
- ○ No
- ○ Prefer not to say

4. How many times per week do you use the John Wooden Center?

- ○ Never
- ○ 1-2 times
- ○ 3-4 times
- ○ 5+ times

5. How would you rate the indoor air quality in the John Wooden Center?

- ○ Terrible
- ○ Poor
- ○ Neutral
- ○ Good
- ○ Excellent

6. Rate each of these rooms on a scale:

Racquetball Courts

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Yates Gym

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Collins Court

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Pardee Gym

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Hallways

- ○ very dirty
- ○ dirty

- ○ relatively clean
- ○ clean
- ○ N/A

Weight Room

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Cardio Room

- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

Blue/Gold Rooms

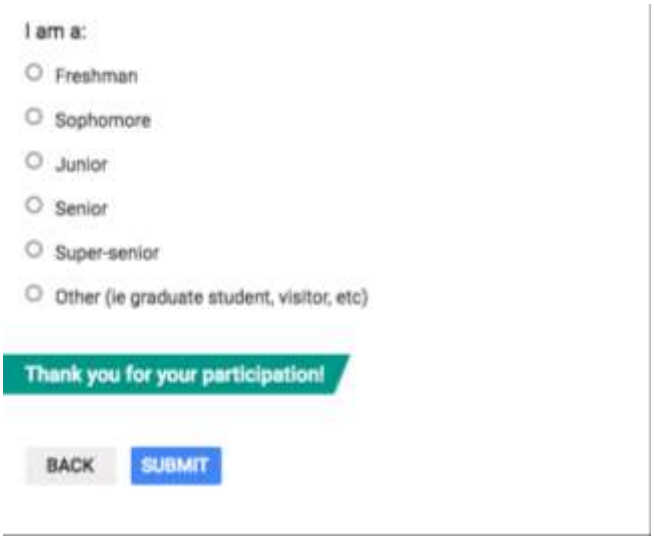
- ○ very dirty
- ○ dirty
- ○ relatively clean
- ○ clean
- ○ N/A

I live:

- ○ On campus
- ○ Off campus
- ○ Commute from home
- ○ Prefer not to say

Gender

- ○ Male
- ○ Female
- ○ Other/Prefer not to say


I am a:
Freshman
Sophomore
Junior
Senior
Super-senior
Other (ie graduate student, visitor, etc)
Thank you for your participation!
BACK
SUBMIT