The Design Process of the Ball State Center for the Environment

An Honors Thesis (ARCH 401)

By

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Abstract:

Like all projects, an effective and successful building takes time to develop and detail so it may benefit the client and the public. A building should also add to the context that surrounds it and improve the quality of life of those who come in contact with it. To accomplish this, architects work through multiple stages of the design process. These stages include programming, schematic design, design development, and construction drawings. Each stage builds from the previous and as a student, we focus on the early stages of a design.

The design process is the culmination of ideas, philosophies, and practices that are studied, changed, and altered in each stage of development. As a student, we work to improve our design throughout the course of study, but we must also make compromises with our peers and instructors to produce a better design. In order to further explain this, I give an explanation of the competition project and the stages of design that I followed to reach the final product of my design. Each stage is explained in relation to the studio section I was a part of and to the competition. These include programming, schematic design, and design development. The phase of construction drawings is not discussed because the competition did not require that amount of detail and finalization in the design. The research conducted and the changes made in the design are also included to further understand what informs an architecture student’s design.
Acknowledgements:

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-I would also like to thank Ann Ross, Emily Weiler, and Ben Herring. They were my partners in the early phases of research for this project and their part helped me to better my design through our shared effort and work.

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In order to create a successful design in architecture, the design process must be well thought out from start to finish. The design process, in a classroom setting, involves the interaction between students and the professor. This communication is important for the student, who needs their expertise to detail and better articulate his or her design. While this advice does create a better finalized product, it does begin to express the ideas and views of the professor to some degree. While collaborating with the student, the instructor’s own design philosophies influence the students work over the course of the project. This does not mean that the student’s work is uninspired, for every student creates a unique design. A studio professor only influences the student and their ideas are predictably expressed at some point in the design process. However, this also benefits the students because the ideas and philosophies of many professors or architects become important to the development of the student. If successfully instructed, the student will carry their ideas with them throughout the rest of their life as a tool in design.

_Ball State University Center for the Environment_

The design process of this project pertained to the CRIPE competition; a design of the Ball State University Center for the Environment. The center was located between the Arts and Journalism Building and the Teacher’s College. The design requirements of the building included four classrooms, four labs, an auditorium, and a solar aquatic machine. The center also included spaces such as a library, computer lab, and offices. As an environmental center, the building was meant to inform the user of technology or sustainable practices, and allow those sustainable ideas to be explored while inside the building. As a building along McKinley
Avenue located closer to the center of campus, the center was designed to be a focal point that drew users towards it while staying in the context of the campus.

Since the center was proposed between the Arts and Journalism building and Teacher’s College, it completed the internal street that runs from the Atrium through the Ball Telecommunications Building, the Letterman Building, and Robert Bell. This connection is important to the integration of the Teacher’s College and must provide sufficient circulation for the user inside the building but also for the pedestrian outside. Currently, the proposed site is the sidewalk connection of the two boundary buildings and a section of the parking lot, also located in between. This site is currently an important outdoor connection space that allows travel in all directions. The environmental center had the possibility of being a boundary to this circulation so planning for flexibility and the pedestrian was a high priority.

Since the proposed environmental center was supposed to be new construction on Ball State’s campus, the building must achieve a Silver LEED (Leadership in Energy and Environmental Design) rating. This is the minimum for any new building on campus, but there are also other forms of accreditation with renovations. A LEED rating involves various aspects of design including public transportation, material usage, water collection, energy usage and collection, etc. Several of these requirements are already present on Ball State’s campus like the shuttle bus stops and ease of bicycle use on campus. Some of these require integration into the site while others are already provided in the program like the solar aquatic machine. Due to the importance of this to the project, several sustainable ideas were researched and studied but the LEED accreditation process is long and time consuming. To fully understand the LEED rating system, a formal education is required to be certified in the accreditation process. As students, we used it as a guideline and didn’t faithfully follow every suggestion and requirement of LEED.
As a tool, it influenced our design but not as fully as if we had completed our education and were at a professional firm.

Research:

The design process of an architect is a long one where ideas are constantly changing. This process begins with research, for knowledge about the building must be reflected and inform your design. The design of the Ball State University Center for the Environment, with the competition requirements, began with the research of programming for the center. However like all designs, there needs to be a precedent to better inform your design.

The first phase of research began with the assignment of a precedent to study and discuss. This first phase involved a partner to help with the study. We chose the Microelectronic Center in Duisburg, Germany (Figures 1-8). The architect is Sir Norman Foster and his approach to architecture was centered around the use of high technology to better the quality of life through sustainable principles. Norman Foster looked at architecture as a tool to better one’s life, and used sustainable concepts to drive the design of his buildings. These concepts are well articulated in the architecture of his buildings. Another philosophy of Norman Foster was to create a maximum transparency in a building with minimum structure. Many of these views are expressed in the Microelectronic Center, a complex that redefined the city’s industry.

The precedent involved the study of the plans, sections, elevations, and various other images of the building. We interpreted these drawings and created a series of diagrams that helped us further explain the building. We looked at the circulation, serviceable spaces, and service spaces of the building while also looking at the structure and apertures for daylighting. The center provided a core for vertical circulation while the spine of the building is an offset from the center of the building. This area is dedicated to a large atrium space that provides
lighting to all the surrounding offices that look out onto it. The curvilinear shape of the building allowed optimal daylighting as it is oriented northeast. This orientation allowed ambient light from the north to be used the best, while the southern edges of the building had smaller apertures, which are easier to shade and control. The shading devices, integrated with the structure of the building, were also studied and noted in the diagrams produced. The main atria spaces of the complex also served to naturally ventilate the building with the help of a building management system, both in the winter and summer seasons. Finally, we explored the transformation of the building's form. The curvilinear shape cut its way through the traditional rectilinear form. This then cut into a triangular geometry and was fitted together accordingly. The alternating triangular geometry also varied between solid and void, providing the spaces for the atria that act as the focus of the center.

The study of the Microelectronics Center provided valuable information about the green solutions that were possible in the built environment. With tools like natural ventilation and daylighting, the building was a great success and helped improve not only the user experience but also help change the view of industry in the city. All of this was done with architecture and if this building could benefit and change the view of people in Germany, we can accomplish the same thing with students, faculty, and users at Ball State University.

The next study involved a new team of partners for researching labs at Ball State. We were each assigned a lab at the Cooper Science Building and met with a faculty member to discuss the needs of the specific lab; our team focused on a biology lab and the equipment needed (Figure 9-11). The research conducted in a biology lab included isolating proteins and characterizing cells, conducting enzyme assays, DNA and RNA isolation, cloning of DNA into bacterial vectors, and sequencing DNA. After meeting with those in charge of the labs at
Cooper, we found that the ideal lab would be what was located at Ball State. The labs there were designed well and not many configurations could improve the workspace. The ideal room would have a size of 1200 square feet with 16 to 20 students. The classroom was sealed from natural daylight and ventilation because the lab was situated in the middle of the building for easy access to the central mechanical core. However, a lab could have daylighting and natural ventilation as long as it was easy to control and manipulate. Our group also studied and measured the various furnishings of the lab and measured the equipment needed in the lab. This equipment included a ventilation hood, centrifuge, incubator, and cell culture incubator. Other considerations also included emergency showers, eye wash stations, and a gas shut off control panel. This research was compared to other groups researching labs focused on chemistry and microbiology. All of this information was available to the studio section during the design development stage of the environmental center.

At the same time, we also researched the solar aquatic machine that was integral to our design. A solar aquatic machine, more commonly known as a living machine, manages the waste produced by the building. Most notably, it treats black water waste from toilets and sinks in bathrooms and kitchens. Currently, most waste water travels straight into the sewage system to be mechanically filtered and separated. The common process for filtering sewage takes the black water offsite which wastes electrical energy to mechanically filter and treat. A living machine recreates the same process, but naturally. As seen in our visit to the solar aquatic machine at P.A.W.S. Inc., the process begins with an anaerobic tank which separates the liquid waste from the solid waste. Once this occurs, the liquid is sent to open tanks where bacteria and plants filter the larger particles. Next, the water is filtered through a traditional system before moving to a larger tank which holds various species of plant life. Here, ammonia and other
components are removed as the water flows through the tank and plants. Once finished, the water is sent to another anaerobic tank with plant root systems filtering the rest of the water. At this point, the water is either treated chemically or with ultraviolet light to kill any pathogens. The previous black water is now potable and can be reused on the same site. Any excess water can also be put back into the city and local system.

The living machine does have limitations for it must be meticulously cared for. It must be contained within a green house structure and there must be a variety of plant life, for the winter months are the hardest. With fewer plants, the filtering process takes longer and may not be complete by the end of the journey. The living machine must also be well designed, for the square footage of each tank depends on the amount of people the machine is serving. This must be carefully planned for the machine can either be designed with electrical pumping or it can be gravity fed. Gravity fed machines allow the water to flow naturally from tank to tank and require no extra energy, providing the most sustainable solution.

While the living machine serves the purpose of cleaning black water, there is also gray water to consider. This water, collected from site runoff and rain water falling on the roof, is not as contaminated as the black water but is still non-potable. The water must still be purified and filtered to some degree but is much easier to do. All that is needed is a traditional filter, usually located at the source of the water collection. However, depending on the size of the living machine, gray water can be cleansed of contaminates inside the machine. This does present a problem at peak times and during a heavy downfall or snow thaw where this overflow must be accommodated.

Another aspect of the living machine is the amount of direct daylight. Since the system must be contained in a green house, the majority of the green house must have access to the
south, east, and west. This must be year round because during the winter months, the density of
the plant surface is low; another reason for a variety of species. The maximum southern
exposure is needed for the living machine to operate throughout the year.

The living machine, the most sustainable feature of the center, can also be the most
visible. It is an open system that can be a learning tool in the center. The material needed for the
living machine, double layer insulated glass, allows the living machine to be transparent to the
user. This gives the user the chance to see how the machine works and how
it operates on a day to day basis. With this said, the solar aquatic machine should be the focal point of the
environmental center.

Programming:

At the same time of this research, the design moved into the development stage. Here we
began to look at programming, each space was defined by the competition with a specific square
footage (Figure 12). While this proved to be a hindrance, it created many opportunities for
different designs. The site was officially 85 feet by 220 feet. This gave the 27000 square foot
building little room and required the building to be two stories. Right away, I looked at using
this building as a connector between Teacher’s College (TC) and the Arts and Journalism
Building (AJ). This path was clearly defined from the south entrance of AJ to the north side of
TC. This became the internal corridor that all classrooms and spaces would spill into. At this
time, the spaces were organized to step down from the height of the corridor which ran from
north to south, allowing maximum daylighting to reach every space. The living machine was
nestled close to the interior corridor, with another circulation path perpendicular to it. This path
leads from the McKinley side of the building (east) to the cowpath side (west). This circulation
space was included because the site was already a point where students intersect in all directions, moving to and from class. The site was also an access point for bicyclers moving east to west across campus. With the inclusion of this building, they are cut off from this type of access. The circulation corridor will have to be open enough to allow free access but still remain enclosed for protection from the elements. The use of materials is also important for this reason and will have to reflect the use of the space.

The organization of the building, at the earliest stage had offices staggered throughout the two stories of the building. The classrooms, labs, library and computer lab were all located on the first floor while the second floor contained two of the three offices. These staggered away from the main atria and continued with it until it intersected the other corridor. Just north of this corridor was the multi-use suite which housed the auditorium and supporting services. Above this space the mechanical rooms and other services were located, which allocated 5% to 7% of the gross square footage. This organization allowed the building to flow from north to south without any break to the outdoors.

At this stage, it was also decided that the floor to floor height would remain at twelve feet due to the restriction of Teacher’s College. Teacher’s College, a ten story structure with basement, maintained a uniform height throughout. Each floor, from the basement to the penthouse service room, maintained a floor to floor height of twelve feet. Since it was decided the environmental center would remain at two stories, that determined their floor heights. The Arts and Journalism Building did not determine this because its first floor had a height of sixteen feet while the second had a height of fifteen. This was considered, but was resolved further in the design process.
Schematic Design:

At this point in the design process, we gathered all of the previous research and used it as a tool for our design. After a review of the initial concept, we decided to look at the layout of the building again. Three concepts were required and for each, I maintained the internal corridor that would connect TC to AJ. The path of the corridor changed between each concept and the spaces that were connected to each would be massed accordingly.

The first concept (Figure 13) was previously discussed and remained unchanged for the layout and organization of the adjacent spaces of the interior corridor remained promising.

The second concept (Figure 13) tried to recreate what was successful about the first but formed a rectilinear organization. The main spaces were on their respective floors but some moved across the circulation corridor, like the library, from the west edge to the east edge. A large change was moving the living machine from the center of the building to the north western edge where it was believed to have the most direct daylight throughout the day. What influenced this were the shadow studies of TC and AJ. The problem discovered was the height of Teacher’s College ended up casting a large shadow that reached over halfway across the site. This was a problem for daylighting in the serviceable spaces and the living machine because it would block direct daylight. Either the location, orientation, or the height of the living machine would have to change. With the change in location, the corridor moved along with it so that there would be maximum transparency for the public to view and learn from its day to day operation. The building became more staggered horizontally but still retained its presence vertically.

The third concept (Figure 13) was almost a combination of both designs previously discussed. However, the serviceable spaces were reorganized more on the west side of the building allowing the east side to be more transparent. These spaces were also pushed to the
south, allowing only the living machine and the multi-use suite to remain on the north half of the circulation corridor. The mass of the building was now pushed to the southwest corner of the site which allowed the east side of the building to have transparent edges, creating large atria that would span the internal corridor and link both circulation spaces. Again, at the intersection of these spaces, would be the living machine, being open to the public to view once inside the building. However, the living machine was still located on the western side of the building, blocking views from McKinley Avenue.

After these initial concept stages, it was decided over the following weeks to use the strengths of each design. This involved reorganizing the program and the location of the living machine along with developing the exterior of the building envelope (Figure 14-15). Again these were developed over a few weeks and the ideas like the living machine were tried in various forms. The organization of the building was also manipulated, mostly due to an elevation change between AJ and TC. This change in height, previously discussed, caused a five foot difference in the second floor elevation. There was also an elevation change on the first floor because TC’s ground floor rested at 938 feet above sea level while AJ rested 939 feet above sea level. This change would mean the use of ramps inside the building and instead of having this change occur near classrooms and offices, the northern part of the corridor would instead be devoted to these ramps. This effectively broke the building in two with an atrium connecting the halves in the center.

The location of the living machine was also reevaluated for its previous location on the site hid it from the public. While it could be viewed once inside, it needed to be viewed on the exterior for those who were passing by. This would be better suited on the edge of McKinley where there is constant pedestrian and vehicle traffic. The living machine would be at the east
edge of the building and would create the north boundary of the entry plaza. This way, the living machine would bring people into the building yet draw enough attention for those who are outside of it. The living machine would also be transparent from top to bottom so that everyone can see the system at work.

The solar aquatic machine has also changed in its configuration. It was originally a greenhouse like structure and was turned into a tower that acts as a beacon for the environmental center. The tower consisted of a concrete core that housed a service elevator and systems. This core uses cantilevered platforms that step down from the top like a winding staircase. Each platform holds a tank for the first stages of the purifying process and each tank flows into the next. This makes the living machine a gravity fed system, except for the initial grind pump that takes the liquid waste from the anaerobic tank to the top of the core. Once the waste is filtered in the tanks, it travels through a larger holding tank with various species of plants. This filters the water further until it travels to another section which is the anaerobic tank that uses plant roots for filtration. Here the water is decontaminated and either used or sent back into the outlying network.

The rest of the building resembled the third concept but used the others as guidance. The south end of the building was where many of the programs are located. Labs remained on the first floor along with the library, computer lab, and digital fabrication suite. Above were the offices and classrooms on the second and third floor. The third floor was added so that more room could be used for the corridor space in between both halves and was connected only to TC. This section of the building was now a mirror image with the interior corridor acting as the axis. As the building changed levels, balconies were pulled back into the second and third floor so that users could see the entire height of the atrium. This created a large, open space that had a
separate roof structure covering the opening a full story higher. Along its edge were clear story
windows that ran the length of the roof, providing substantial lighting to the interior. Along the
interior corridor, stretching across the space were also walkways that connected at various
angles. This allowed interaction between levels of the building and gave easier access from both
east and west.

This section of the building created a street front façade and must be transparent to this
edge. This allowed the pedestrian to further view the structure of the building and the
sustainable ideas that were present in its design. On the east side, the façade of this half was
completely transparent with clear story windows. This needed shading because this side faces
the east which proves to be a harder orientation to control for shading. On the west, the same
holds true, so the same façade will be used as well. This however remained temporary, because
the context of the west side of the center is much different than that of the east. However,
similar shading devices can and should be used.

On the north half of the building, along with the living machine, was the multi-use suite.
This space was mostly on the ground floor with only an audio/visual booth on the second. The
space was formed around the ramps that allowed the elevation changes between AJ and TC.
These ramps were separated from the space and any entrance into the adjoining rooms had a
landing to accommodate access. This space was not developed at this stage of the project, but
will be developed further in the final phase.
Design Development-Final Design (Figures 16-25):

Throughout the following weeks, changes occurred to the design by developing the structure more thoroughly. While previously considering a steel frame, the best solution seemed to be a concrete slab. More specifically, a two way slab was used so that there is no exposed beam work and the slab created a clean form between each level. The concrete structure is actually exposed to the exterior while the windows and panels were infill. This created depth in the façade and the contrast between brick and concrete created a visually captivating building. With the structure exposed, the building again became a learning tool, instead of being a hidden feature that did nothing to inform the user. The concrete structure flowed throughout the building, but became more complicated towards the center. The south and even the north ends of the building were organized as a grid, creating the spaces needed for the various activities and circulation while the center was designed around the ramp structures. Now a part of the building structure, the ramps integrated with the adjoining rooms and forms their edges as it cuts through. The continuous ramp created easier wayfinding through the building with the north and south ends remained a part of the main axis of TC and AJ. The bend towards the center created a point of interest and the intersection that occurred allows movement in all directions.

The only structure that was separate in design was the living machine. With the spiral-like design of the tank platforms, the enclosure was formed around it. The now curved façade was pushed out closer to McKinley, drawing attention to the form even while traveling south along the road. The curvilinear form continued from the foundation to the very top, which consisted of five levels of platforms. This structure towered above everything else and was capped with a pitched roof structure that remained the same in glazing and structural design. The double insulated glazing allowed maximum transparency while providing minimal structure
so that the user may see the natural processes at work. The core that was previously mentioned
acted as an anchor for the entire beacon, with the north wall being structured like the rest of the
center. The north wall used concrete masonry infill, all to provide thermal massing so that the
structure itself may gather heat to store and use in the night and winter.

The same holds true for the rest of the building because the concrete structure behaves
the same way. This however proves to be problematic, because in the summer months thermal
storage proves to be unusable. There are ways to store this heat but shading is provided instead.
Horizontal, external louvers provided shading on both sides while the overhang of the exposed
structure does the same. The east side did not encounter as much direct light in the early
morning hours for Emens Auditorium blocks much of this light. On the west side, the windows
were changed to start at a height of two and half feet above the floor and then continued on to the
ceiling. This left brick infill underneath providing some shading from the structure storing any
thermal energy. With the previous shadow studies, it was decided that Teacher’s College
provided much of the shading for the structure, allowing much of the daylight to be more
ambient than direct closer to the midday.

Another system that was studied was water collection. In the previous phase of the
design, all of the roofs remained flat. This however changed with the roof structure that covered
the interior corridor on the southern part of the building. To better showcase water collection, a
butterfly design was incorporated which would drain into cisterns on the roof level below. On
each side of the butterfly roof were large flat roofs which held plantings to create a green roof.
This not only blocked a large amount of heat absorb into the roof structure but this also allowed
the water to be used in keeping the green roof flourishing. The water cisterns were located on
the east roof and were stainless steel. This showcased the water collection from a far, with a
pedestrian noticing the gleaming containers set against the concrete frame and brick, glass façade. On the northern side of the center were also flat roof structures that had the ability to become green roofs or be fitted for a photovoltaic array, depending on what the center decides. The green roof solved water collection issues by allowing the plant life to use the water falling on the roof while the photovoltaic panels can provide some of the energy needed for the building. This will not provide the entire building with power but may be enough for the energy needed to run the instrumentation in the living machine.

Just below was the auditorium which was reorganized to accommodate everyone and allow flexibility in the space. This included a raised stage which was reoriented along the south wall. Opposite was the audio visual room on the second level. Also, on the second level was a viewing area for a passerby to watch a lecture or performance. Seating is incorporated into this space which allowed for it to possibly become another presentation space or an area for independent study. This is incorporated into the circulation space where views allowed the user to see the surrounding campus buildings. On the south side, the balconies provided views of both below and above. On the first floor, a few trees created human scale to the space while above, the user looks above the canopy. The first two levels connected TC and AJ, while the first level used the perpendicular connection to access the outside. These spaces connected to their corresponding routes, with the east side to McKinley and the west to the parking lot. The east side provided a raised patio for interaction between the pedestrian and user along with extended seating for the bus stop. The west side provided permanent structure for a drop-off point. The Center for the Environment was thus connected to Ball State inside and out.

The design process is a long and ever changing process. It involves research, programming, design development, and finalization. Each phase of design must include
implementation of the previous phase for a successful product. The building must improve the user's knowledge while improve the quality of life.

My design of the Ball State Center for the Environment showcases sustainable design so that the user may appreciate the built environment. By using the living machine as a beacon, the user is immediately aware this building is integrated with sustainable concepts and technologies. The rest of the ideas are shown and represented, but not as powerfully as the living machine. This building brings sustainable and green design to the forefront at Ball State and is a leader of environmental consciousness.

While the building does accomplish many of its goals, it does have room for improvement. As this is a large project, details are never fully realized and there is always room for development. Any shortcomings in design are not due to lack of knowledge but in amount of time. As a student, this building’s process has ended at the finalization of design process. There are still more phases to this work including construction documents, bidding, and construction. These require a much higher level of detail but the design development stage was as developed as it could be. It has expanded my knowledge of the built environment along with integration of systems and structure, and provided a window into the design process that, has hopefully, been a beneficial one.
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Micro Electronics Park Duisburg, Germany
Norman Foster 1988-1996

“Our work in Duisburg is not about a single emblematic building. It has more to do with the collective power of diverse interventions.”
- Norman Foster

Foster designed an alternating series of pavilions and atria beneath a continuous curved roof. He wanted his work to demonstrate that technology could be used to achieve green ends. The tapered plans of the pavilions and the curved profile of the section use a habitable environmental buffer (reliance upon naturally induced air circulation) until extreme weather occurs when secondary mechanical units take over.

“...the modernist idea of a fully glazed building with the goal of energy efficiency.”

Figure 1 Precedent Study
Figure 2 Precedent Study

Google Earth Image

Proposed Site Plan

Ground Floor Plan

Site, Primary Floor Plan and Section; Photographs
Micro Electronics Park Duisburg, Germany

Section
Connective Tissue
- Rear Spine and Atria

Served Spaces
- Offices, Conference Rooms, And Laboratories

Service Spaces
- Mechanical and Utility

Morphological / Volumetric Organization
Micro Electronics Park  Duisburg, Germany

Figure 3 Precedent Study
Dimensional Order, Symmetry, Triangular Geometry, Spherical Geometry.

Geometric and Dimensional Orders
Micro Electronics Park, Duisburg, Germany

Figure 4 Precedent Study
The primary structure consists of columns on the North East side and load-bearing concrete walls on the South West side. The concrete serves as a thermal mass.
Figure 6 Precedent Study
This building relies on naturally induced air circulation. Air comes into the building through the atria and also from an air intake in the park. When extreme conditions occur, the mechanical units take over.

Foster designed the building to use cross and stack ventilation to move air across the space.
Extruded Section

Repetition of Units

Ideal Conception and its Transformation
Micro Electronics Park Duisburg, Germany

Figure 8 Precedent Study
Biology Lab: Classroom and Research

1228 sq. ft.
Average Classroom size is 16 to 20 students; 32 students
No daylighting or natural ventilation

Furniture Dimensions
Counterheight: 36"
Desk height: 30"
Counter to cabinet: 24"
Cabinet height: 30"
Cabinet Depth: 12"

Floor Plan: 1 Square=2’x2’
Section: 1 Square=2’x2’

Systems
LAN Internet
Electrical
Vacuum
Compressed air
Water
Natural gas

Special Considerations
Safety measures such as an emergency shower and eye wash, fire extinguishers, and gas shut off control panel.
Research projects include:
- Isolating proteins and characterizing cells which involves the collection of said cells by pippetting and the use of a centrifuge.
- Conducting enzyme assays which is looking for any activity in said enzymes.
- DNA and RNA isolation.
- Cloning of DNA into bacterial vectors which involves one bacteria carrying a different DNA into another; a vessel.
- Sequencing DNA

Different design configurations:
The most efficient design is one with counter space and group workstations located on the perimeter of the room. Students desks and workstations in the interior.

Figure 10 Lab Study
Special Equipment

Hood: 31" x 90" x 48"

Centrifuge: 28" x 37" x 33"

Cell Culture Incubator:
Single Unit: 28" x 38" x 32"
Double Unit: 28" x 72" x 32"

Heater/Incubator: 28" x 68" x 25"

Figure 11 Lab Study
Circulation: Intersecting atria corridors, stairwell

Ceiling heights are at 12'.
Available daylighting is from direct light on the east and west and ambient light from the north. Southern light is limited due to Teacher College's height

Functional Zones:
- Multi-use Suite
- Exhibit Suite
- Library
- Classrooms
- Laboratories
- Model Fabrication Suite
- Computer Lab
- Director's Office Suite
- General Office Suite
- Visiting Scholars Office Suite
- Lounge
- Living Machine Suite
- Toilets
- Janitor's Closet
- General Storage Area
- Circulation
- Mechanical Room

Functional Zones: McKinley, view of classrooms, model fabrication suite, multi use suite, etc.

Functional Zones: McKinley, view of laboratories, library, living machine, etc.

Figure 12 Programming
Figure 13 Design Concepts
Water/Roof Detail

Sustainable Water Diagram

Wall Detail and Elevation

Figure 16 Final Design
View of the main Atrium

View of the second floor circulation corridor

Exterior view of the entry plaza

Figure 18 Final Design
Figure 19 Final Design
Figure 24 Final Design

Final Model-View north along McKinley

Final Model-View south along McKinley