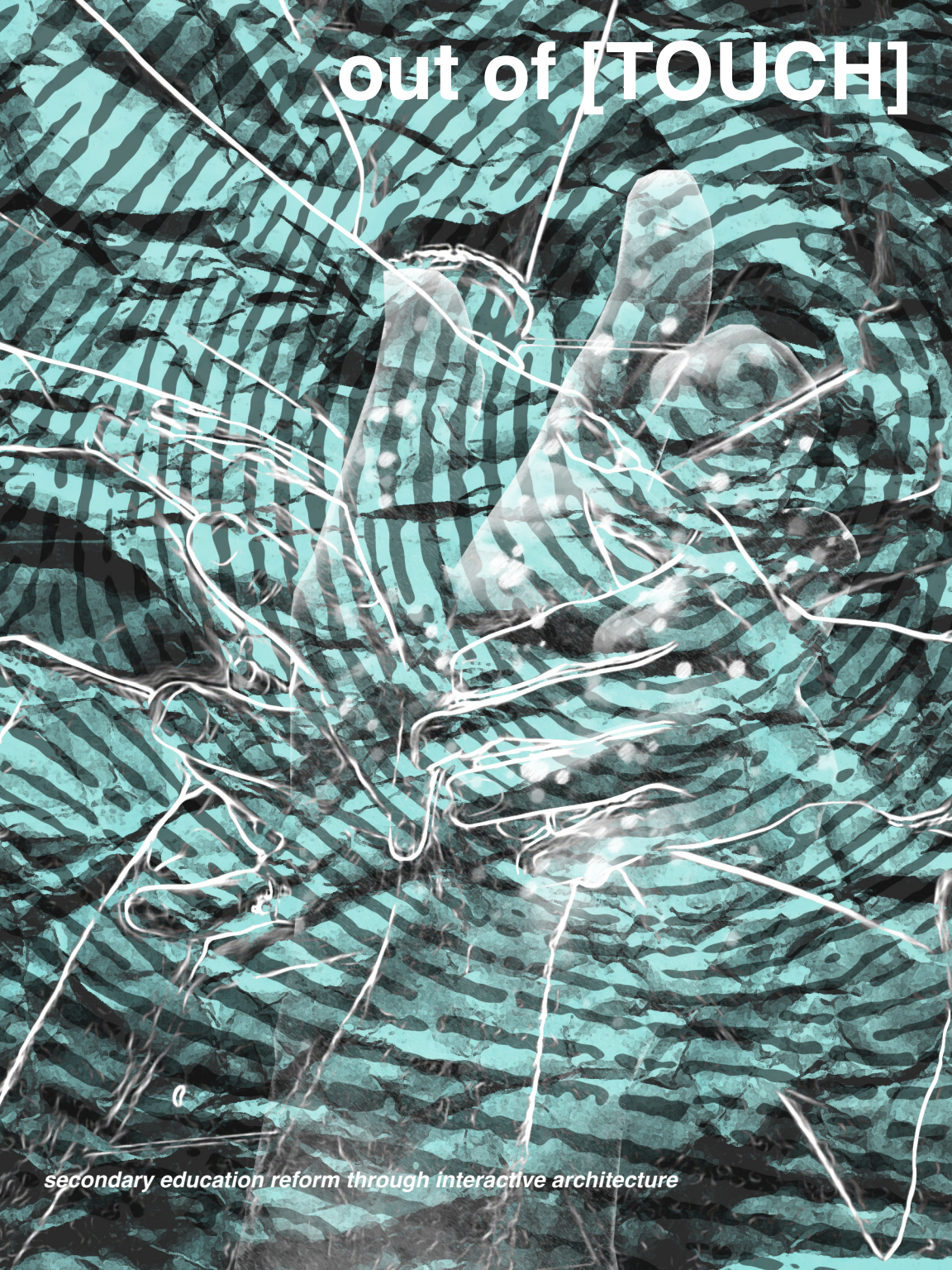


out of [TOUCH]



secondary education reform through interactive architecture

OUT OF [TOUCH]:

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1

INTRODUCTION

“In a culture that is preoccupied by the looks of things, we have lost touch with the feel of things.”

Anonymous

“The senses are specializations of skin tissue, and all sensory experiences are modes of touching and thus related to tactility.”

Juhani Pallasmaa

“If education is always to be conceived along the same antiquated lines of a mere transmission of knowledge, there is little to be hoped from it in the bettering of man’s future. For what is the use of transmitting knowledge if the individual’s total development lags behind?”

Maria Montessori

thesis abstract

The curiosity of children has always been a personal point of interest. There is something so pure in the way they interact with their environment. Nothing is ever certain or predetermined. A couch is not something to sit on, it is a jungle gym, trampoline, the framework for a fort or anything else a child's brain can imagine. This ingenuity and experiential learning is slowly lost as people grow up. Books, technology, and others' opinions interfere with the simplicity of the interactions between human and environment. As people age, they tend to distance themselves from the carpets they crawled on and the small spaces they fit themselves into, and instead submerge themselves in the artificial reality of technology. This thesis will challenge the digression of experience-based exploration and investigate the ways in which people interact with spacial conditions. It will study how human senses and movement affect their perceptions of space. The root of all experience and learning is found in the basic senses. As a person moves through a space, it is through sight, sound, touch, and smell one learns. One can figure out more about his or her environment from senses than he or she could ever absorb through any tangible thing. The intangibles created through sensory experience are the things that universalize human understanding, yet simultaneously are the exact things that make all human experience unique. Through the investigation and discovery of the understanding of the interactions of people and space, a language

of architecture can be developed with the only means of un-coding being through the human body.

This thesis aims to understand the affect the built environment can have on person in the context of the high school. It examines how methods of teaching and methods of learning can be applied to the design of the physical environment.

thesis paper

Throughout the past century, there has been a rapid increase of technologies in all areas of production and communication. It is difficult to keep up with the pace of information in this ever-evolving technological time. These technological changes have generated a shift in the way in which people interact with their environment and how they interact with others. Objects that were once futuristic luxuries are now considered everyday necessities. People have become preoccupied with the visual realm and lost touch with their other senses. This phenomenon also happens at a much smaller level, that of the individual person. Children have a very pure, exploratory and reactionary way of interacting with their environments. These interactions provide the groundwork for learning as children transition into the school atmosphere. The existing educational system slowly integrates technical information through books, technology and discussion as they move through the system, replacing play-type learning with lecture-type learning. Playtime is reduced to scheduled recess, and eventually recess is eliminated completely. This follows the pre-school to primary school to secondary school linear model of education.

Students at the secondary school level are transitioning from dependent children to independent adults. They take on more societal responsibilities and are capable of making decisions regarding living situations, driving, work and education.

The current Michigan graduation requirements for high school students are completely standardized across all public schools in the state through the Michigan Merit Curriculum developed by the Michigan Department of Education. This system requires four credits of math, four credits of English language arts, three credits of science, three credits of social studies, two credits of a foreign language, one credit of physical education and health, one credit of visual, performing and applied arts and an online learning experience in order to graduate. Despite this standardization, there is a drastic difference in graduation rates across the state. After analyzing the State of Michigan 2010 Cohort 4-year Graduation and Dropout Rate Report, a trending of graduation rates based on location typology emerged. These typologies include rural, suburban and urban areas. High Schools in rural areas had an average graduation rate ranging in the mid 80%; suburban areas trended averages in the 90% range; urban areas had a significant drop, averaging between 60% graduation rate. This stark difference in the success of urban high schools creates many questions about the situation. Is this simply proportional to the differences of socioeconomic issues amongst the typologies? Possibly. Can it be contributed to the dedication of the students, parents or teachers to achieve success? Definitely. Does the learning environment created by the school design have a significant contribution? Maybe? This thesis aims to investigate how the design of a school can influence the

success rates of its students in a standardized educational system and develop a new way of designing for education with a haptic methodological focus, while being responsive to the ways technology is evolving.

Within the public school system, there are two alternatives that exist beyond the standardized program. They are magnet schools and charter schools. These schools primarily exist within the urban fabric and were created to offer students a different learning experience while still being tuition free.

Magnet schools are schools of choice within the public school system, but typically have an admissions policy based on selection criteria. They were founded on the premise to desegregate public schools, attracting students from outside the traditional school zoning boundaries. However, magnet schools are now more focused on providing highly motivated students with the opportunity to take advantage of a specialized educational program. They offer a distinctive curriculum with an alternative/compelling instructional approach.

Charter schools are also schools of choice within the public school system, but follow a lottery admission system. They were founded on the idea that teachers would be given contracts, “charters,” by local school boards to explore new educational approaches. They have the freedom to tailor programs respecting the community needs and encourage innovative teaching practices. Teachers and administrators have more authority in decision-making

but are accountable to academic results and upholding their charter.

These alternative schools naturally have higher graduation rates than their traditional public school counterparts due to their smaller size and higher academic standards. Magnet and charter schools typically target students that are more motivated academically than their peers and remove them from the standard public school education. This does not address the problem of the failing public school system in urban areas; it just offers a way out of it.

Instead of creating alternative schools with innovative and compelling teaching practices, we should look to see how we could implement innovative and compelling design practices. Developing schools so they are more responsive to student needs and environmental demands can reform the way students perceive their high school experience, potentially leading to higher graduation rates.

There are also countless numbers of educational methods that could be implemented to attempt to fix the graduation issues facing urban high schools. Despite proven success rates of alternative teaching methods, simply using them to replace the current public school system does not address the problem of why the standardized system can work in one living typology, but fails in another. However, these alternative models are useful tools in analyzing how to better understand design implications of educational theory.

The Montessori method is an educational approach developed in the late 1800s and early 1900s by the Italian physician and educator Maria Montessori. This system is primarily designed for children of pre-school and elementary age, but the basis of its foundation are quite relevant to designing for high school students. There is a great focus on environmental interactions. It is also responsive to human tendencies and the driving behavior(s) in each stage of development.

The reciprocal relationship between person and environment is of growing importance in today's society. There is a push toward environmentally sustainable design. Solar panels and other green systems, like rooftop gardens, are a few of the elements of sustainable design solutions that could involve students. With guidance from teachers, students could be responsible for installing/planting and maintaining these systems. The design of shading devices could also be interactive elements of the design. Such processes can serve to engage the students in hands-on learning of sustainable methods, while simultaneously giving them a greater understanding of their environmental impact.

The responsiveness to human tendencies and driving behavior(s) of students is an integral part in design analysis. Gaining understanding of the ways high school students react to situations and why can influence the way in which the building is organized and how circulation spaces should work. Having

this insight will lead to the development of more productive and interactive learning environments, resulting in students being more involved in the learning processes.

The Socratic method also offers some possible insight to classroom design. It is a method of inquiry and debate developed by the Greek philosopher Socrates that has been applied to learning theory. The intentions of the Socratic method are to foster critical thinking and provide character education through a series of questioning. It prompts student participation and dynamic classroom discussions to teach students about the power of choice and to understand personal responsibility.

This method has a very circular pattern and engages all members of the classroom with one another. Developing ways to design for the types of non-authoritarian discussions that the Socratic method suggests is one approach that can be taken in the rethinking of the typical classroom. Also, creating spaces that the students would have a degree of design control over can contribute to reaching the goals that the Socratic method strives for in a more social than formal way.

Beyond various teaching methods, there are also different ways of learning. Three of the primary modes of learning include auditory, visual and kinesthetic. Auditory learners gain the greatest understanding of material through what they hear. Visual learners gather the most information through seeing, whether through demonstration or reading. Kinesthetic learners require a more hands-on approach. It is difficult to design a school

to accommodate every type of learning because every student learns in a different way. However, it is possible to design specific areas or classrooms to accommodate students that learn through these different means. Different acoustical qualities can be applied to specific places to create certain auditory environments. The same can be done with materiality and color to generate specific environmental qualities and transitions throughout the school.

The design principals from these various types of methodologies, combined with a thorough analysis of different school building typologies, will provide the foundation for the development of a new method of educational facility design. This new design system will be responsive to the social and educational needs of high school students while being environmentally sustainable and adaptable to the context of the times and the site of the school.

Situation/Context

The Detroit Public School system used to be one of the most highly regarded public school districts in the state of Michigan. Its current ranking, however, is one of the worst districts in the state, posting an average graduation rate of just over 50% in the 2010 report. Urban flight and economic recessions have plagued the area for decades. In recent years, the Detroit Public School system has been suffering from budgeting issues, resulting in the layoffs of hundreds of teachers, cancelling of extra curricular programming and a general lacking of funding. Dozens of inner city schools have been closed due to the

combination of these budget cuts and rapidly decreasing population.

Many of the schools that remain are in need of major maintenance and are outdated, but the money is not available to renovate and update their facilities. The students are the ones who suffer the most in these instances. Unfit facilities and under supplied schools are allowing these inner city kids to be left behind in a society that is exponentially moving forward.

2 EDUCATIONAL THEORIES

“Education is a natural process carried out by the child and is not acquired by listening to words but by experiences in the environment.”

Maria Montessori

“If a child is not learning the way you are teaching, then you must teach in the way the child learns.”

Rita Dunn

“If you’re not prepared to be wrong, you’ll never come up with anything original.”

Sir Ken Robinson

the montessori method

1. *The Human Tendencies and Montessori Education*

2. *Maria Montessori: Her Life and Work*

The Montessori method is an educational approach that was developed by the Italian physician and educator Maria Montessori in the late 1800s and early 1900s. She constructed her theory through her observations of children.

It is an educational approach that is based on a model of human development and focuses on environmental interactions. The Montessori method is responsive to 12 human tendencies/driving behaviors in each of her four defined planes of development. The human tendencies she explores are: self-preservation, orientation to the environment, order, exploration, communication, work/purposeful activity, manipulation of the environment, exactness, repetition, abstraction, self-perfection, and the mathematical mind.¹

Dr. Montessori also outlines environmental characteristics that should be found in her schools. These are: construction in proportion to the child and his/her needs; beauty and harmony, cleanliness of environment; order; an arrangement that facilitates movement and activity; and limitations of materials, so that only material that supports the child's development is included.²



Left Dr. Montessori working with students using her specialized learning tools.

learning styles

There are three main ways that people learn: haptic, visual and auditory. Haptic learners learn through doing things, moving around and by hands-on activities. Visual learners learn by seeing things, such as through photos and images. Auditory learners learn through hearing sounds and words.

Teachers are able to adapt their teaching methods to each student, but architecture can also have an affect. An architect can create spaces for learning that are adaptive to each learning type.

Haptic learners must have plenty of space to move around and have environments with materials and furniture that can be easily manipulated. Visual learners prefer atmospheres that have rich colors and imagery, but are quiet and passive. Auditory learners need environments that have good acoustics and provide spaces for them to read aloud and isolate sounds.

Not all spaces in a school are required to meet the needs of each learner because most students learn with a mixture of the three styles. However, there should be spaces within a school that meet the needs of students that learn in these three different ways, for one style is usually dominant over the others in each student.

multiple intelligences

3. <http://www.multipleintelligencetheory.co.uk/>

According to Harvard researcher Howard Gardner, each person has seven distinct intelligences. His theory says that through language, logical-mathematical analysis, spatial representation, musical thinking, the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves, people are able to know the world.³

Through an understanding of each of these intelligences and how they are related to learning, it is shown that using a multimedia approach to teaching is necessary to accommodate for them. This multimedia approach can also be applied to the architectural design of schools. Gardner identifies 12 categories of media to be considered against the research of each learning style, six of which can be applied to school design: visuals, printed words, sound, motion, color, and realia (real objects).

Through the application of these six categories, schools can be transformed from places where learning takes place to places designed for learning.

sir ken robinson

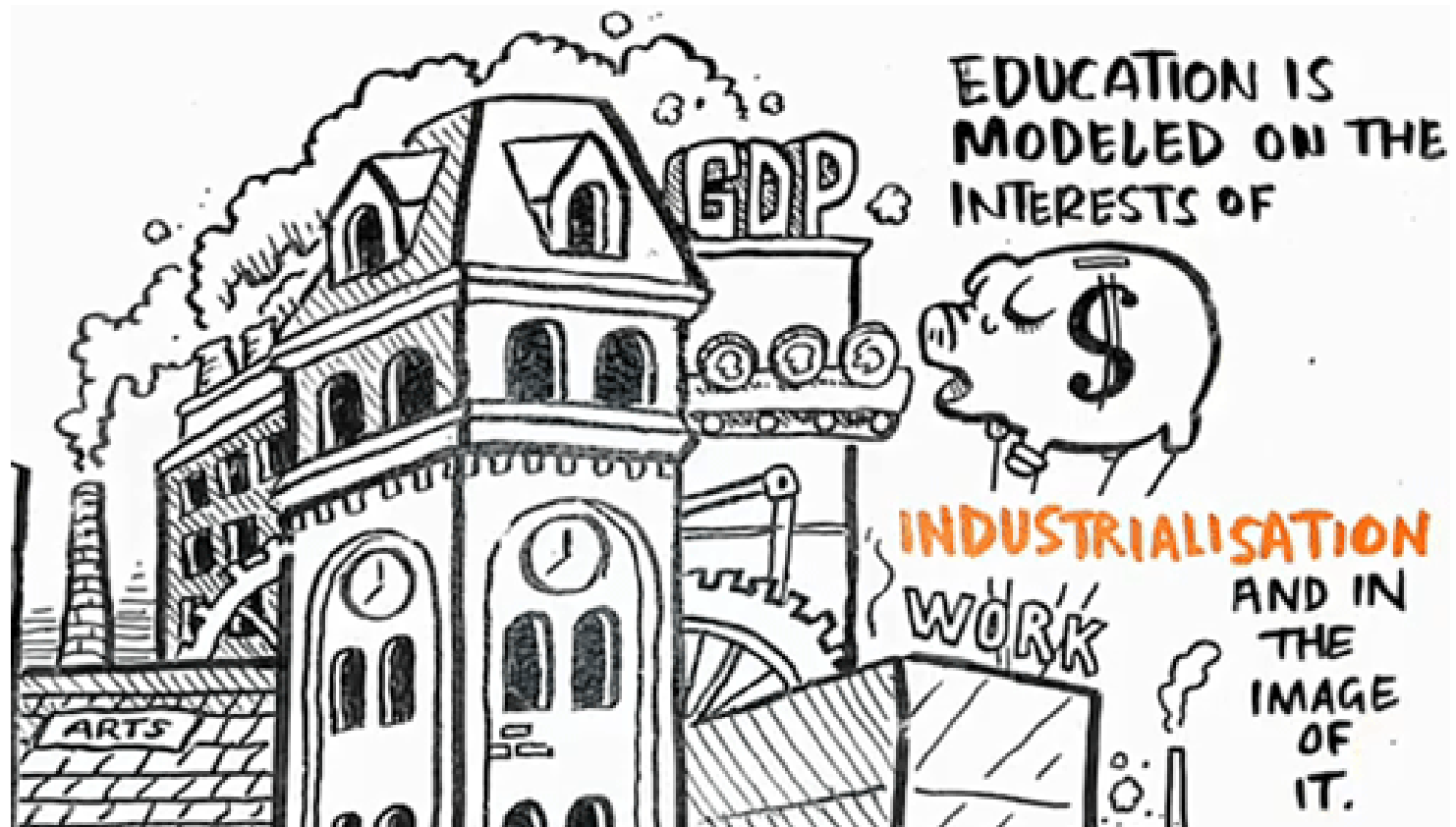
4. <http://www.cnn.com/2009/OPINION/11/03/robinson.schools.stifle.creativity/index.html>

Sir Ken Robinson, PhD is recognized internationally for his development of education, creativity and innovation, and he is one of the world's leading speakers on the topics.

He is very critical of the current system of public education, especially in Europe, Asia and the United States of America. He comments most often about the immense waste of talent that the assembly line method of education has produced. This waste is not deliberate, but is an unavoidable product of the current system. It affects all those in contact with the school system, not just the students. Sir Ken Robinson provokes ideas of how this waste can be eliminated through a more personalized and creatively stimulating educational system and environment.

He argues that the problem not only exists in the systems of education, but also in the culture of education. Education is about developing human beings, and human development is not mechanical or linear. It is organic and dynamic.⁴ The age of industrialism is now the age of digital technology; creativity now takes precedent over standardization and the methods of education must adapt to this global change in the economy.

Below A screenshot of an animate adapted from an RSA lecture given by Sir Ken Robinson. He discusses in his lecture how the public school system needs to change paradigms. He claims that the education system is still based in the industrial revolution way of thinking and needs to be re-evaluated to adapt to the age of modern technology, arguing that goals of education are opposite from the market demands on new employees. Currently, conformity is ranked higher than creativity within the public education system.



3 CASE STUDIES

*“Life can only be understood backward, but
it must be lived forward.”*

Soren Kierkegaard

*“You can teach a student a lesson for a day;
but if you can teach him to learn by creating
curiosity, he will continue the learning
process as long as he lives.”*

Clay P. Bedford

crow island school

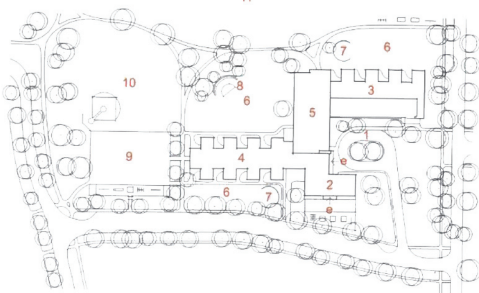
5. Peter Brown Architects

6. www.winnetka36.org

7. *Evidence-based Design of Elementary and Secondary Schools*

The Crow Island School in Winnetka, IL was designed in 1939 by Eliel Saarinen with Perkins, Wheeler and Will. It is known for being “the first modern school.”⁶ It is responsive to the progressive education approach, using the needs of the children as the primary design determinants. The classroom size, layout and furniture were all determined based on the children’s size and space requirements. Also, each classroom is self-contained with a lavatory, flexible classroom space and access to an outdoor courtyard.⁷

The school is organized with 3 wings (later a 4th) around a central core of spaces. The wings are separated by age level, that are composed of series of L-shaped classrooms. There is daylighting provided by large, low windows in every classroom. The classroom doors are colored differently for identification purposes.⁸

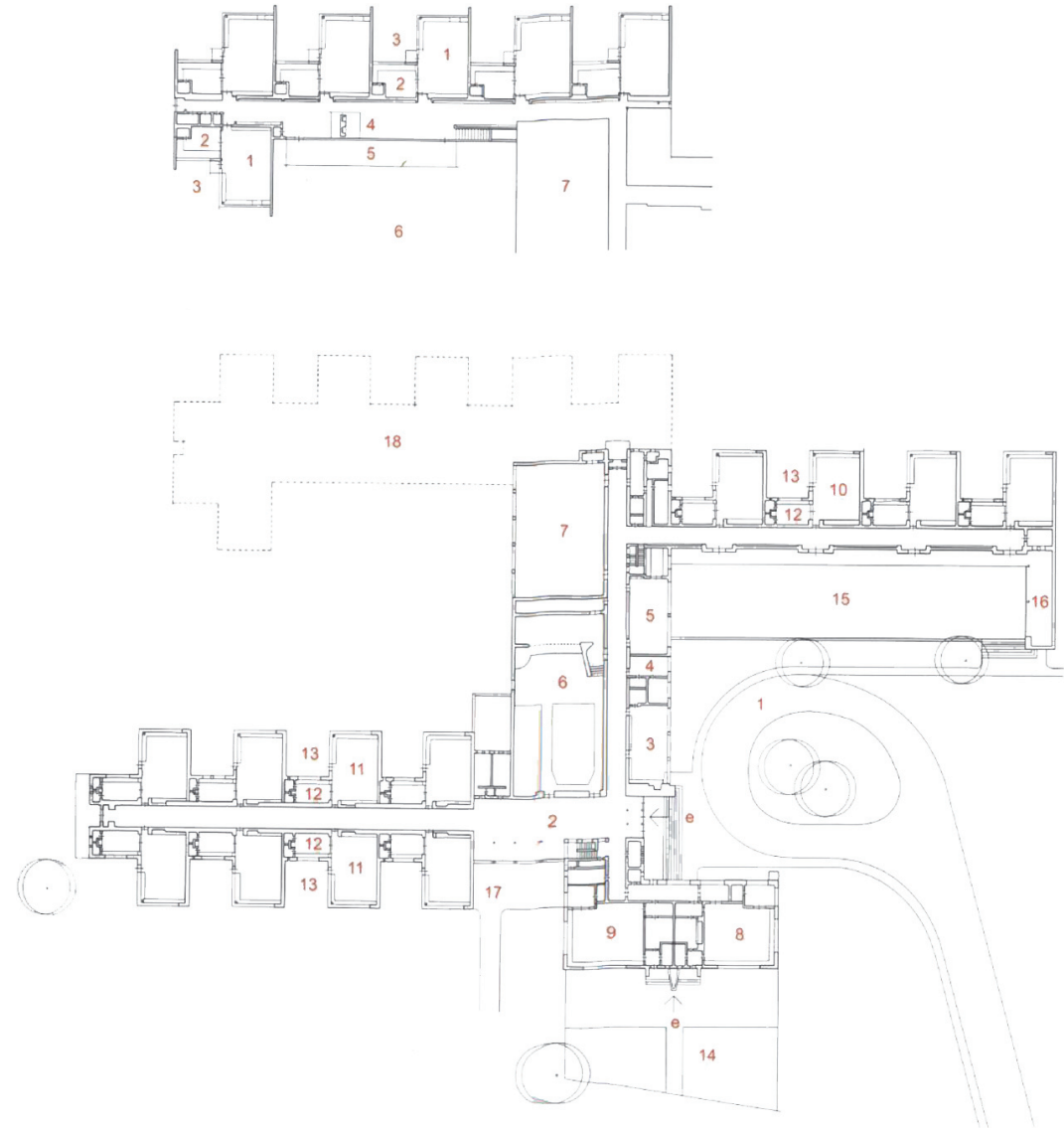


Left Site plan of Crow Island School

Top Right Floor plan of classroom addition to Crow Island School

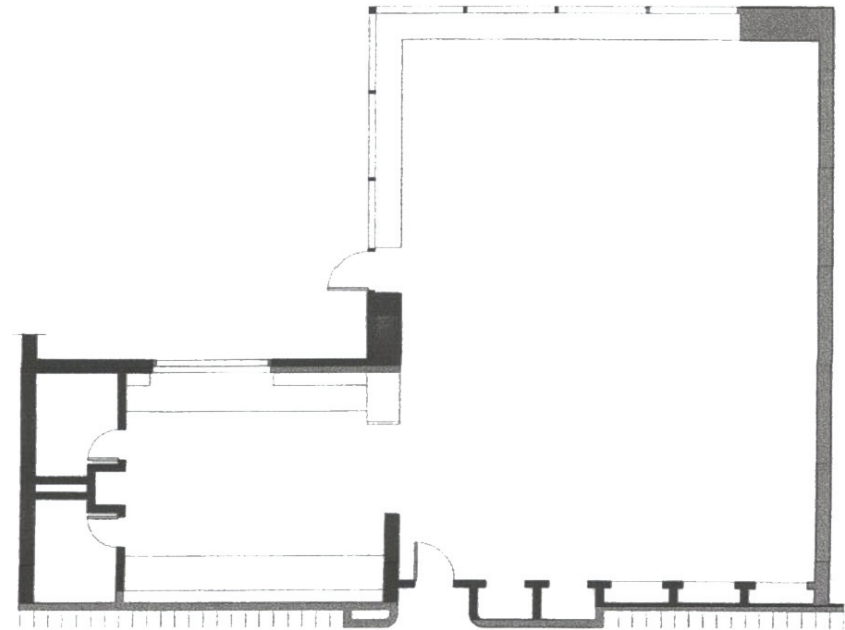
Right Floor plan of Crow Island School

*images from *Modern Schools*



Right Interior of classroom inside Crow Island School. photo from Peter Bron Architects blog.

Below Floor plan of single L-shaped classroom in Crow Island School. photo from *Evidence-based Design*



sidwell friends

8. www.usgbc.org

9. www.sidwell.edu, also source for floor plans.

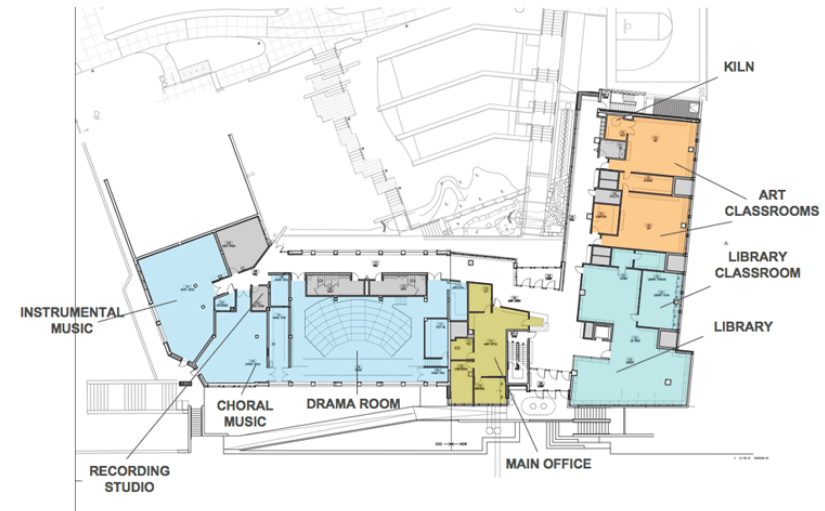
Sidwell Friends Middle School in Washington, D.C. was designed by Kieran Timberlake Associates. It was LEED certified in 2007 with a platinum certification. It was given 57 out of 69 points distributed in the categories of: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design.⁹

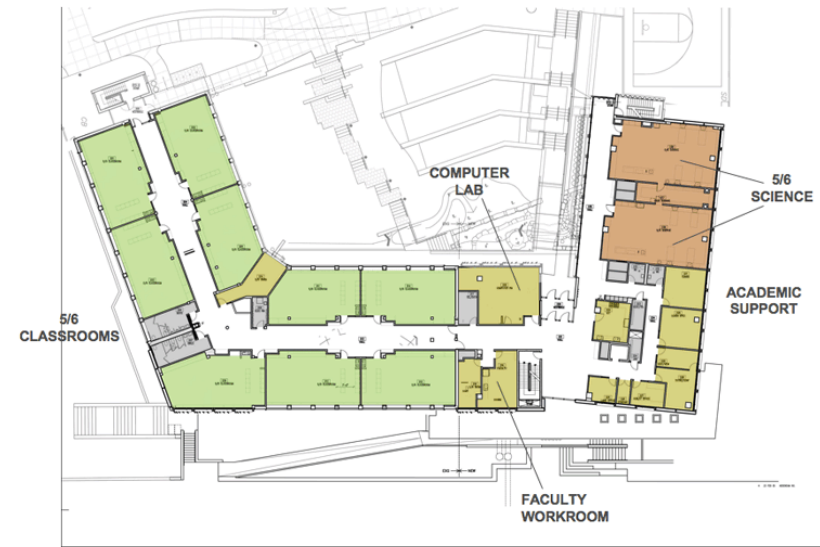
It is a three level private school that houses approximately 350 students. Through its use of materials, sustainable design and daylighting, it aims to increase the health and productivity of its students. The school is currently participating in a study to help prove this correlation.¹⁰

Not only is the design of the school beneficial to the students, but to the environment as well. Its energy savings is over 50% because of the passive solar design and natural ventilation; and water savings around 90% due to its water-efficient landscaping and constructed wetland.

Right Front of Sidwell Friends School. photo courtesy of Beverly Schaefer; <http://www.sidwell.edu/middle-school/ms-green-building/index.aspx>

Below First floor plan.





Left Second floor plan

Bottom Left Third floor plan



4 CIRCUMSTANCE

“Experience is a hard teacher because she gives the test first, the lesson afterward.”

Vernon Law

“The bottom line is this: We cannot in good conscience operate the same school system in the same way when only 5 percent of our students are proficient in reading, as measured against students nationally. We would be failing our kids.”

Robert Bobb, Emergency Manager, Detroit Public Schools

“The ground is shifted beneath us... and we will transform our schools and colleges and universities to meet the demands of a new age.”

President Barack Obama

michigan public schools

The Michigan education system strives to provide its students with a curriculum to prepare them for post-secondary studies and offers programs to promote the complete health and safety of all those who attend their schools.

The Michigan Educational Assessment Program (MEAP) and Michigan Merit Exam (MME) are the primary tests administered at strategic grade levels to test the competency of students statewide in the core subjects as laid out in the Michigan curriculum requirements for primary and secondary schools. There are also measures in place to hold teachers and schools as a whole accountable for student success, such as Michigan's Educator Evaluations and Adequate Yearly Progress (AYP). These evaluations are analyzed on a yearly basis, and actions are taken to ensure the progress and success of all Michigan public schools.

Despite the standardized curriculum and testing across the state, there are significant differences in success rates between the three different geographic community types. There are many factors that could contribute to this trend; however, the effects of the responsiveness of school design to its students and community have been under investigated.



RURAL



SUBURBAN



URBAN

Above State of Michigan 2010 Cohort Graduation Rates by Community Type

MICHIGAN MERIT CURRICULUM HS GRADUATION REQUIREMENTS

*From Michigan Department of Education

MATHEMATICS - 4 Credits

Algebra I
Algebra II
Geometry
One math course in final year of high school

ENGLISH LANGUAGE ARTS - 4 Credits

English Language Arts 9
English Language Arts 10
English Language Arts 11
English Language Arts 12

SCIENCE - 3 Credits

Biology
Physics or Chemistry
One additional science credit

SOCIAL STUDIES

.5 credit in Civics
.5 credit in Economics
U.S. History and Geography
World History and Geography

ARTS - 1 Credit

Visual, performing and applied

ONLINE LEARNING EXPERIENCE

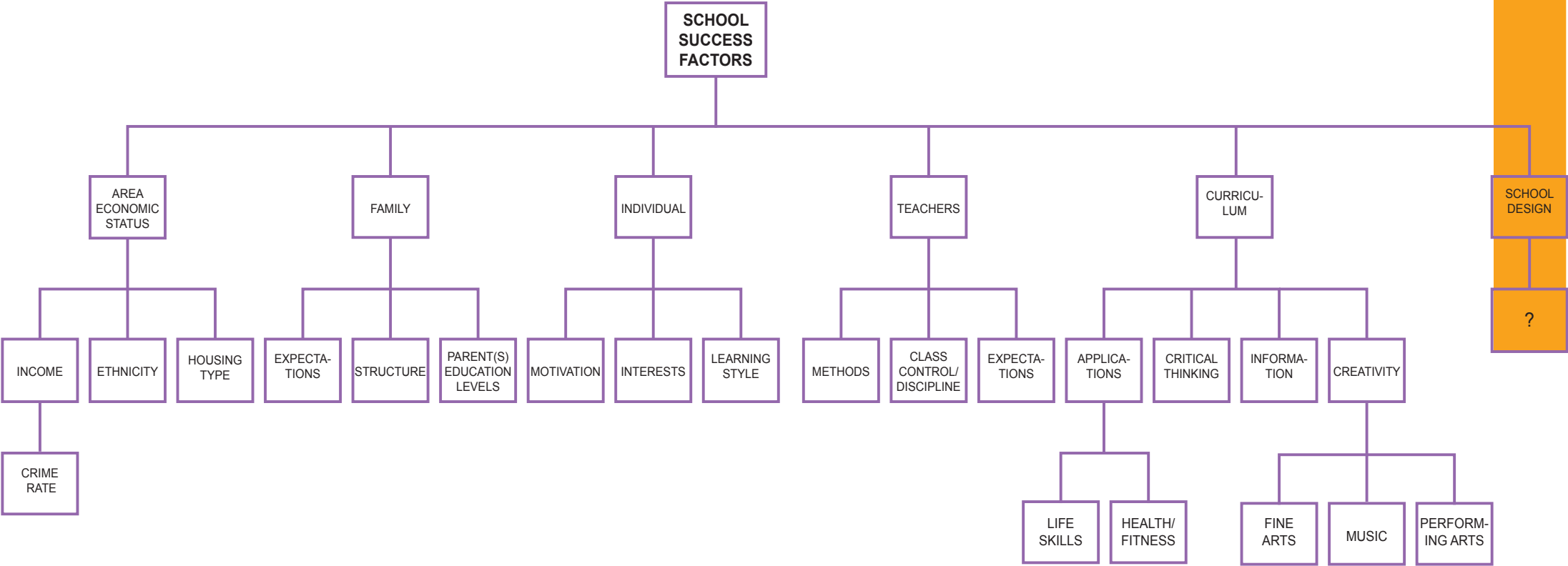
Course, Learning or Integrated Learning Experience

FOREIGN LANGUAGE - 2 Credits

In grades 9-12 OR an equivalent learning experience in grades K-12

PHYSICAL EDUCATION/HEALTH - 1 Credit

Below A graphic breakdown of different factors that affect the successfulness of schools to analyze why certain schooling areas are more successful than others in the Michigan standardized public school system.



detroit public schools

Since the start of urban flight, the Detroit Public Schools district has steadily been declining. Student enrollment is decreasing and academic progress is significantly below the state averages. The district has failed to make Adequate Yearly Progress (AYP), as set by the Michigan Department of Education under the federal No Child Left Behind Act, for three consecutive years.

Below A graph of the target versus actual graduation rates of primary and secondary students in the Detroit Public School system. There is approximately a 10% difference at the primary level. This separation grows to over 20% at the secondary level.



The reasons for the Detroit Public Schools district not making AYP are as follows:

- non-satisfactory attendance and graduation rates
- non-satisfactory proficiency in English Language Arts and Math
- non-satisfactory MEAP, MME and ACT scores

The district is currently in Phase II of AYP, which makes it necessary for the Michigan Department of Education to take at least one of the following actions:

- Withhold program funds or reduce administrative funds.
- Implement a new research-based curriculum and provide appropriate professional development for all relevant staff.
- Replace the district staff who are relevant to the failure to make AYP.
- Remove particular schools from the district's jurisdiction and make other arrangements to govern and supervise these schools.
- Appoint a receiver or trustee to administer the district in place of the superintendent and school board.
- Abolish or restructure the district.
- Authorize students in district to transfer to a higher-performing school in another district and provide or pay for transportation with Title 1 funds from the district subject to corrective action. If the Department chooses this action, it must also take at least one of the other six actions.

There is a demand for immediate change within DPS. Although there are efforts in place to change the structures of the schooling by making some schools charters, there are alternatives that can be implemented to take advantage of the public school system that has been proven successful in other areas in the state.

One of the efforts in place to improve the school environments is the DPS School Construction Project. They have been building and renovating Detroit schools following the passing of the Proposal S Bond Referendum in November 2009, which gave DPS access to \$500.5 million in stimulus dollars under President Barack Obama. "It's all part of the plan to create excellent schools in Detroit."



Left A rendering of the east entrance for the new Mumford High School in Detroit. It is one of the new construction projects included in the DPS School Construction Project.

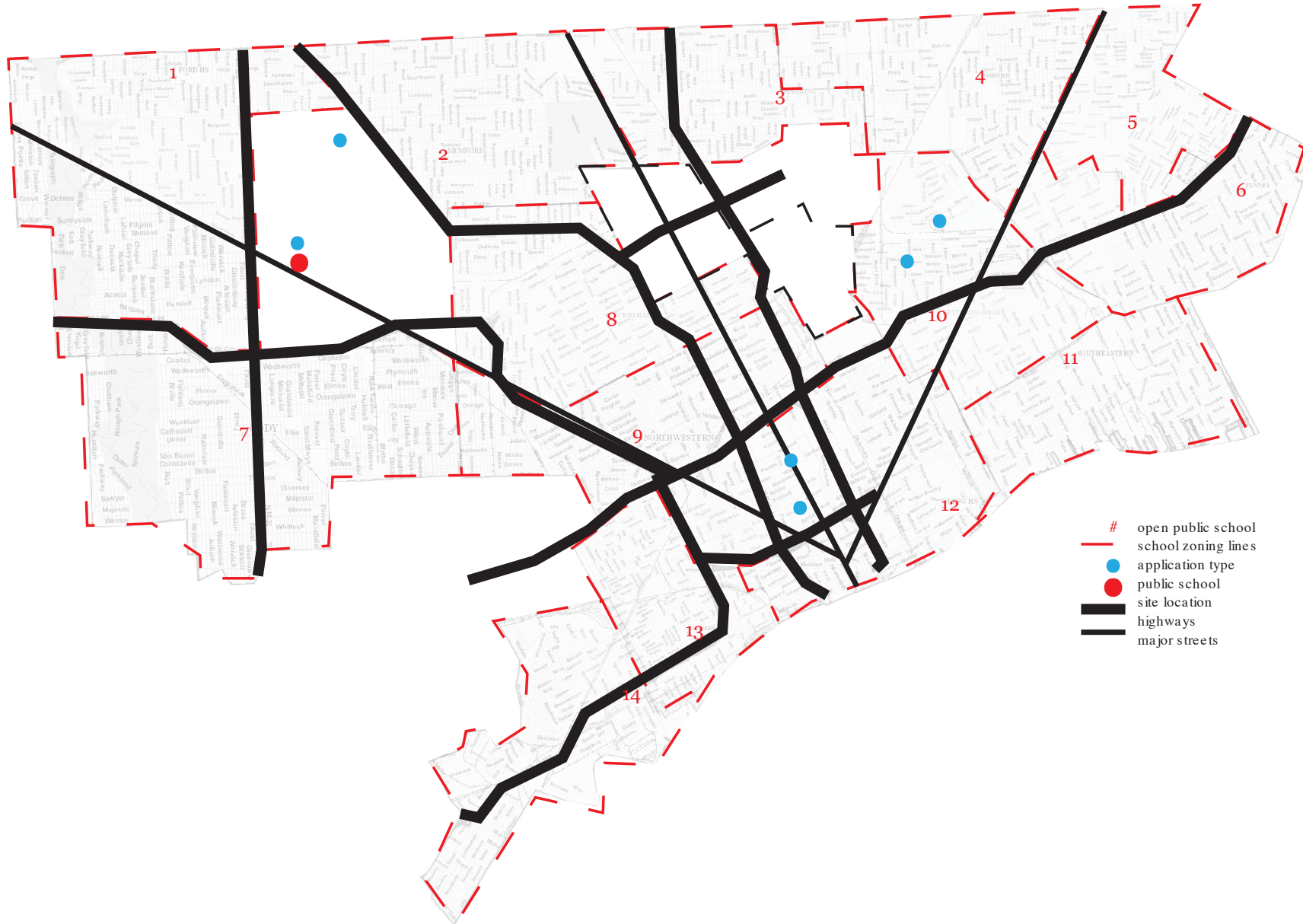
site context

Prior to the closing of Cooley High School, it was Detroit's third-largest high school. The closing of the school left a large gap in the zoning of the high schools on the northwest side of Detroit. The students were dispursed into Ford, Mumford, or Central public high schools, or transferred to one of the charter schools in the area.

The site is in a predominantly residential area, but is located off of a commercial corridor. There are many small shops, party stores and small churches on the Northern edge of the site.

This area is highly suitable for the development of a high school using the design methods I am proposing. Although the site is still home to the building of Cooley High School, for the purposes of the exercise to develop my approach, it will be considered as not existing.

1. Ford HS
1450 students
2. Mumford HS
1330 students
3. Pershing HS
1045 students
4. Osborn HS
1100 students
5. Denby HS
1330 students
6. Finney HS
620 students
7. Cody HS
1860 students
8. Central HS
1165 students
9. Northwestern HS
800 students
10. Kettering HS
850 students
11. Southeastern HS
1300 students
12. King HS
1520 students
13. Western Intl. HS
1425 students
14. Southwestern HS
875 students



- # open public school
- school zoning lines
- application type
- public school
- site location
- highways
- major streets

5 DESIGN

“Tell me and I’ll forget; show me and I may remember; involve me and I’ll understand.”

Chinese proverb

“The answer is not to standardize education, but to personalize and customize it to the needs of each child and community. There is no alternative. There never was.”

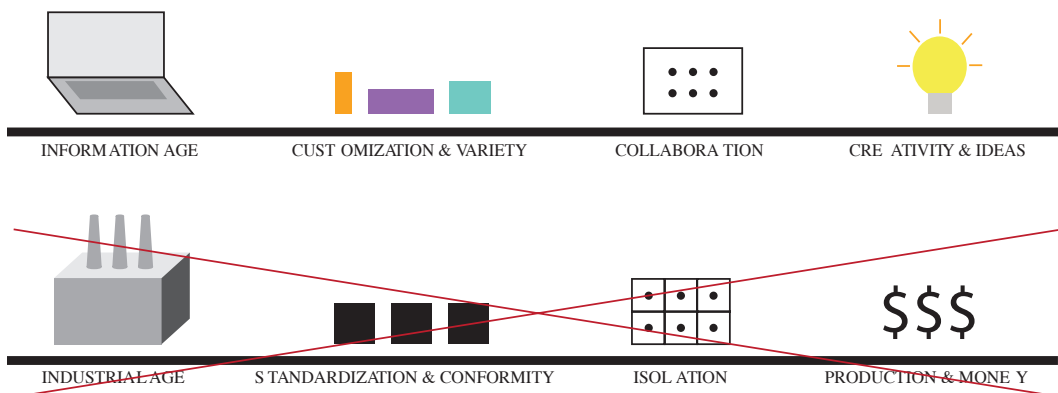
Sir Ken Robinson

considerations

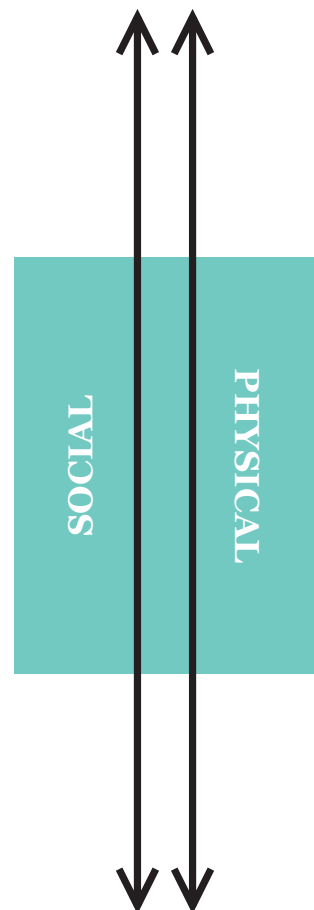
As society has moved from the industrial age into the information age, such move should be carried over to the design of schools.

The industrial age designed around the assembly line process, where students go into the school system and are churned out as intellectuals. However, the information age focuses more on how to use knowledge gained rather than the more simple knowing of information.

The educational system has started to adapt to these changes in pedagogy, but the designing of schools to really embrace them is lagging. A shift in design focus must occur so schools can support the changes brought about with the information age.



STUDENT



ENVIRONMENT

Learning in a place and a place for learning are two distinct ideas. The first refers to the old way of designing a school, in which the school building was viewed as a place that students came to learn. It was more of a simple shelter for learning. The second notion, contrastly, is a place that is designed for learning. The school building is used as a tool in the learning process. The information age requires this definition of a school for success.

In the context of the school building, there exists the user (primarily the student and teacher) and the environment. There are varying levels of interaction between the two; however, in order for a student to learn from their environment, there needs to be levels of integration between the physical and social environment of the school and have points of interaction between the student and elements of the school. Although these concepts are not pertinent to all subject matter within a school, there must be some level of embracing these elements within the school for the student to remain engaged.

Above A diagram of where learning takes place between the interactions of the student and his/her environment.

Lighting

- natural
 - building orientation
 - clerestories
 - daylighting shelves
 - skylights/light wells
 - interior windows
 - courtyards
- artificial
 - curved ceilings
 - indirect

Sustainable Design

- green roof
- solar panels
- solar shading
- grey water systems
- geothermal technology
- passive solar design

Materiality

- local
 - contextual
 - economical
 - ecological
- modern or traditional
- texture
 - rough
 - smooth
 - intermediate
- color use
 - neutral
 - cool
 - warm
 - bright

Site Selection

- location
- land area
- context

Users

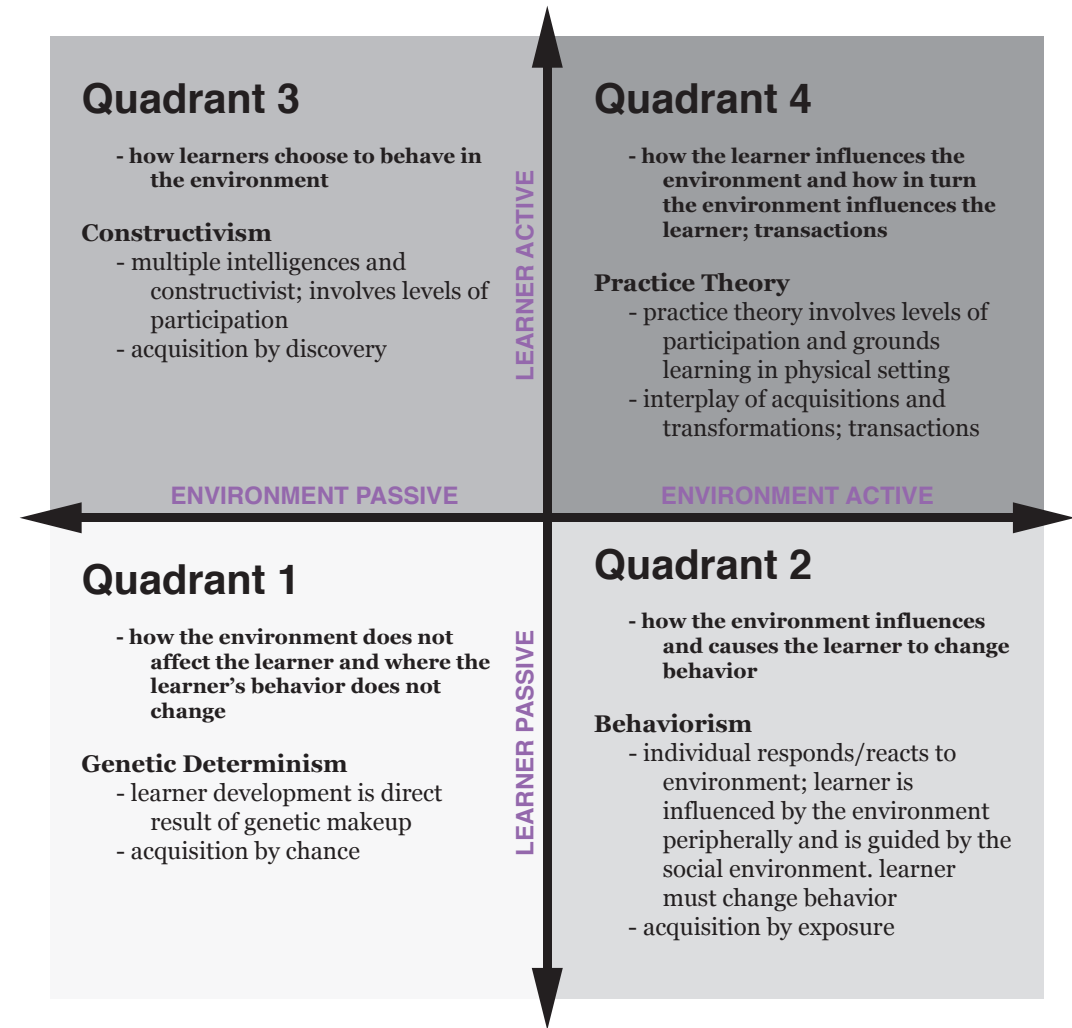
- students
- teachers
- community
- visitors

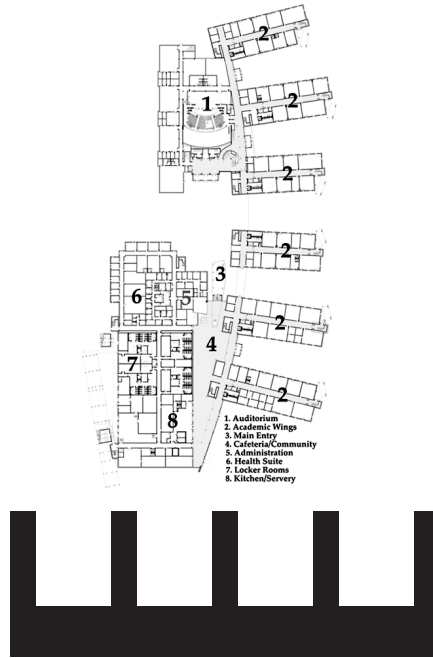
Organization

- grade
- subject
- learning style

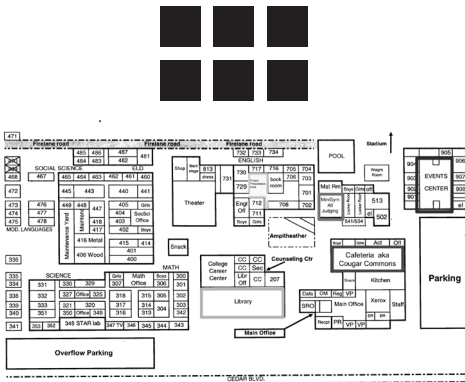
Interior

- compact
- open
- integrated
 - shared spaces
 - levels
 - interactions
 - intermediate
- circulation
 - differentiation
 - clarity
 - primary
 - secondary
 - tertiary





One of the most important decisions that must be made in designing a school is its organizational structure. The diagrams on this page include three common organizational layouts used in high school design and a fourth that proposes a new layout in which multi-use spaces are integrated into the plan.

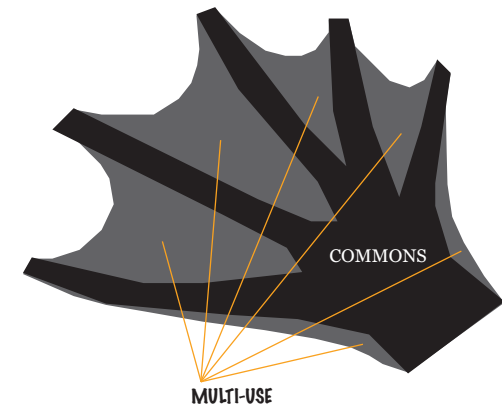
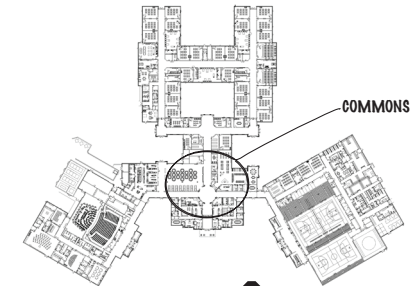


Top Left Single corridor plan

Bottom Left Campus plan

Top Right Hand and finger plan

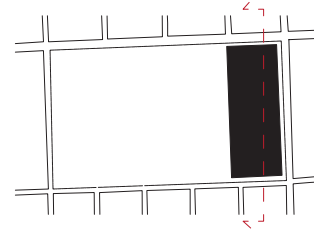
Bottom Right Web plan. This plan makes use of the spaces in-between main educational wings/corridors by integrated shared learning spaces and/or social spaces.



site analysis

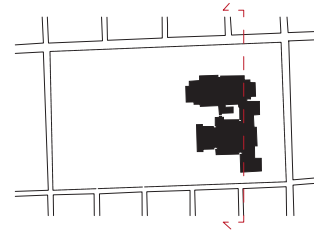
Understanding the site on which you are planning to develop is of utmost importance. A school serves as an anchor point in a community and must respond to its context accordingly.

The first step is identifying which siting option is most suitable and responsive to the community type and land availability. To aid in this, a photo analysis and site mapping should be conducted to gain more of an understanding of the surrounding area.



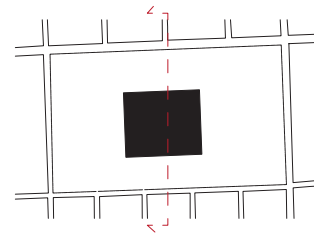
Street Edge

- best implemented in dense urban setting
- integrates school with surroundings
- multi-story height (typically 5+)
- expands up instead of out (condensed/efficient land use)



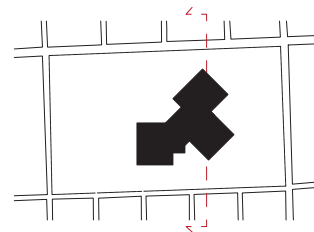
Iconic/Monolithic

- seen in suburban and urban areas (typically older buildings)
- set back from street edge
- creates spectacle of school among its surroundings (semi-isolation)
- mostly three - four stories
- can expand up and/or out



Centralized

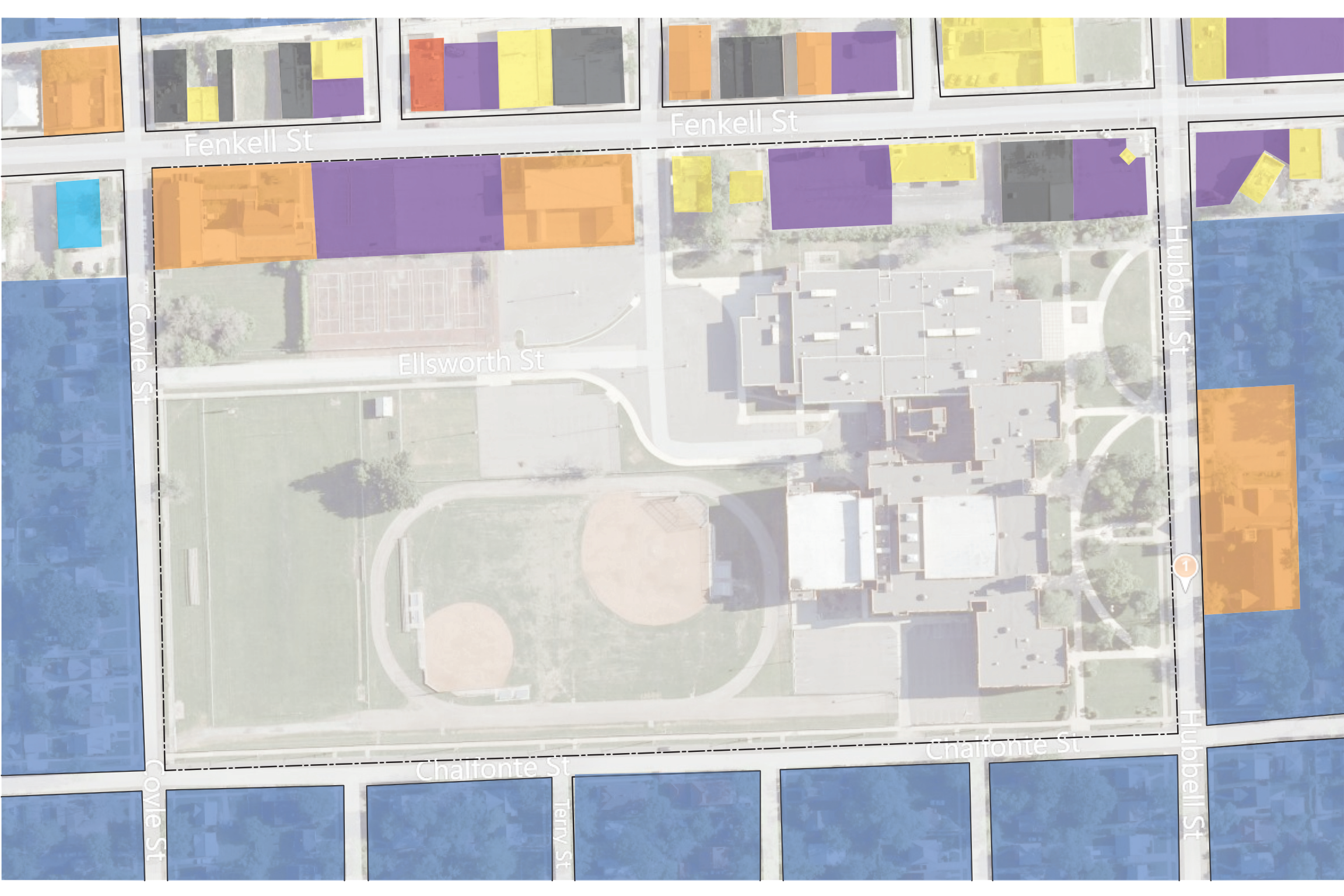
- commonly used in rural and suburban areas
- isolates school from surroundings
- mostly one or two stories in height
- expands out instead of up (large land use)



Integrative

- potential to be used in semi-urban, suburban and rural contexts
- connects school with its surroundings using site/sight lines
- height dependent on scale of surroundings
- expands according to site constraints
- no defined shape or site location





Fenkell St

Fenkell St

Ellsworth St

Hubbell St

1

Challronte St

Challronte St

Hubbell St

Covle St

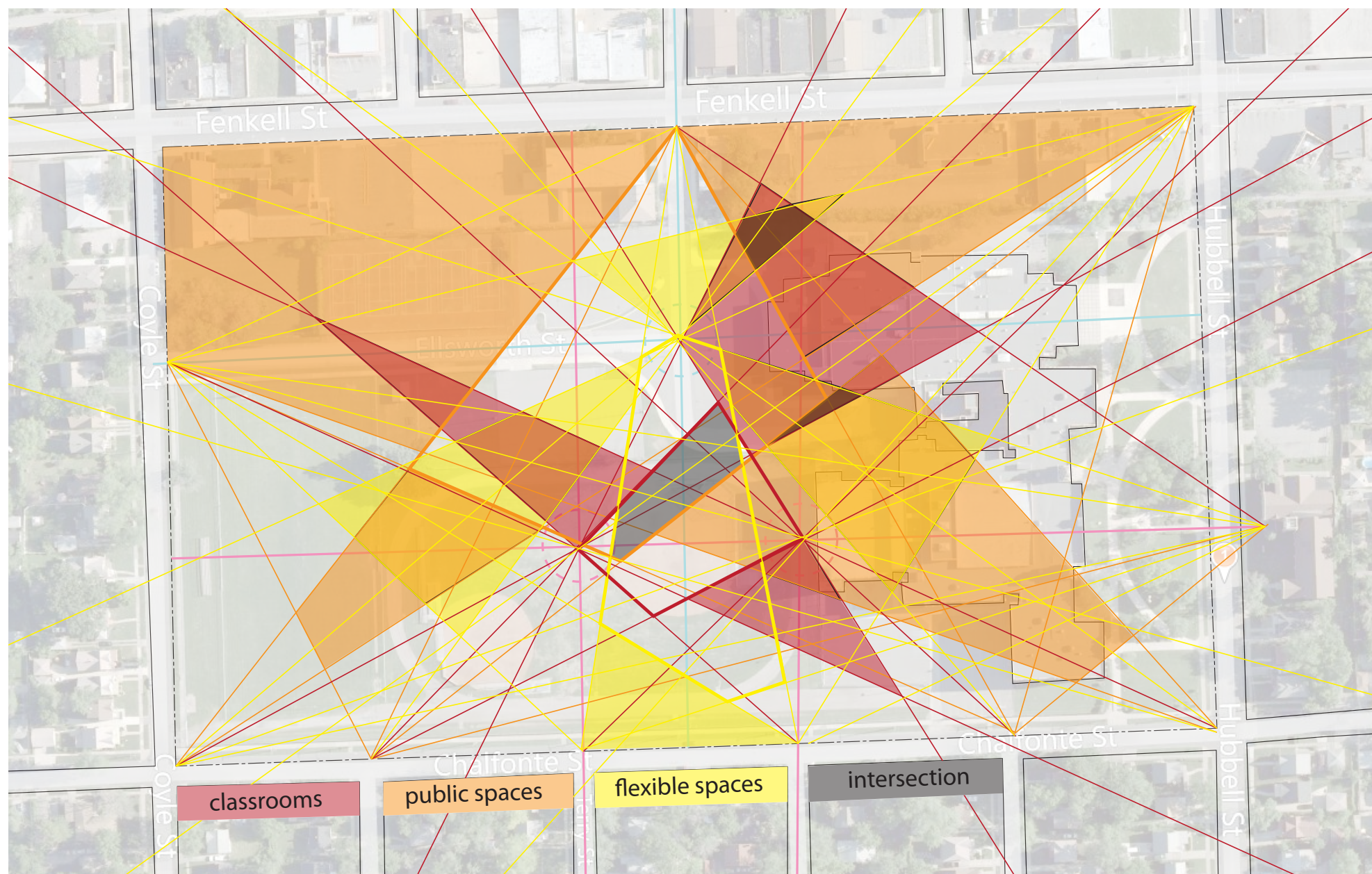
Covle St

Terry St

One method of site analysis is pathway line sketches. The lines develop to create visual and physical areas of interest that can be adapted into building forms, circulation pathways, organizational distinctions and/or materiality changes.

These lines are not definite or unchangeable when being integrated into the building design, but should serve as bases and provide a more rigorous understanding of the site, leading to a more informed design.





circulation

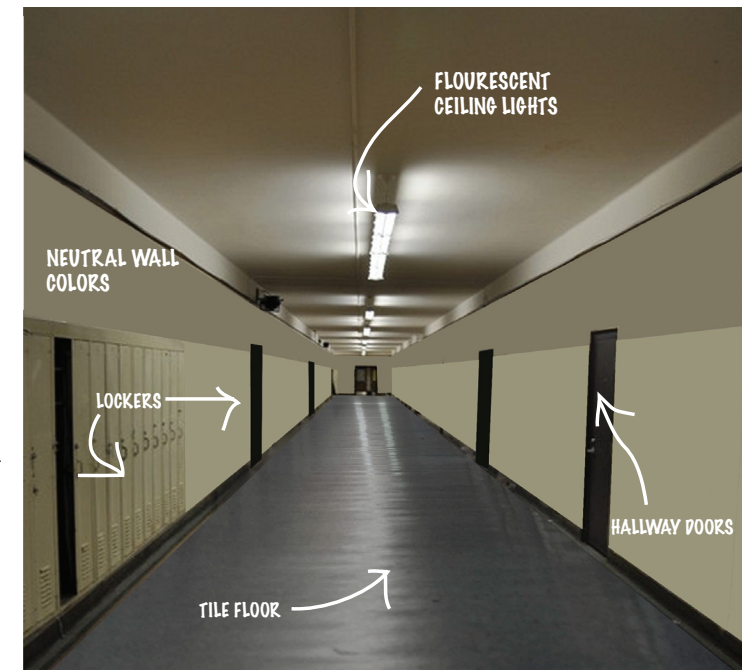
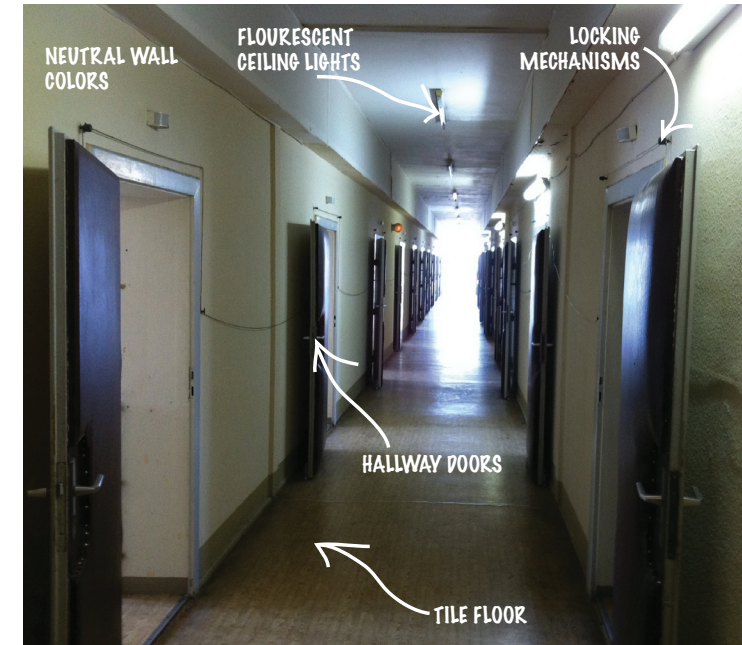
The design of circulation areas must be taken into consideration. Not only are they the means of navigation, but also serve important social functions in the high school setting. The hallways and stairwells are the places where students can socialize between classes. These areas need to provide adequate space for both primary circulation and static socialization to take place simultaneously.

Historically, circulation spaces are enclosed by classroom walls and fluorescent lights. This “land lock” effect gives them a very dismal atmosphere, much resembling that of a prison. Most corridors have little to no daylight, accentuating the gloomy atmosphere.

Something must be done to remedy this circumstance. Considering that during the school day, the hallways are where students spend most of their time when not in class, these areas must be designed with the students in mind, not just function. Providing daylighting and planned social spaces within the circulation system can help eliminate the prison-like atmosphere that school hallways traditionally create.

Top Left A diagrammatic analysis of a prison corridor labeled with primary elements.

Bottom Left A diagrammatic analysis of a hallway in Cooley High School, Detroit labeled with primary elements.



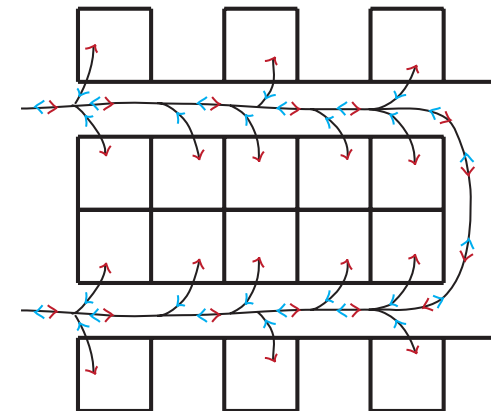
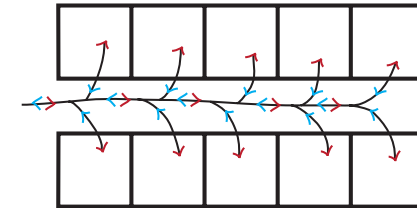
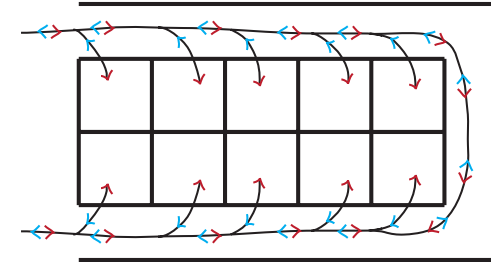
Left The analysis of circulation in three hallway loading arrangements.

Top Single loaded corridor

Middle Double loaded corridor

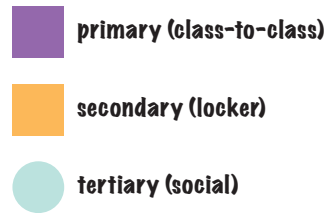
Bottom Hybrid loaded corridor

circulation **IN** **OUT**

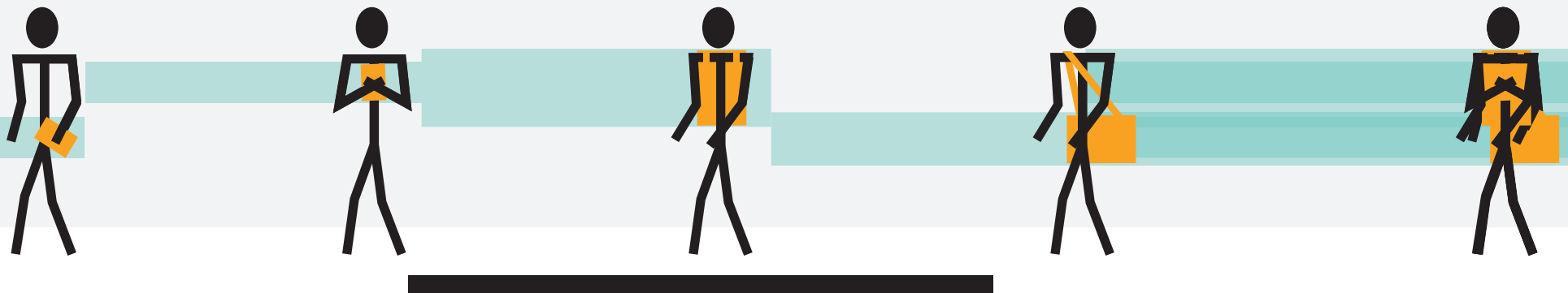


Bottom Plan diagram of hallway usage breakdown (see key to right).

Far Right Section of corridor showing use patterns.

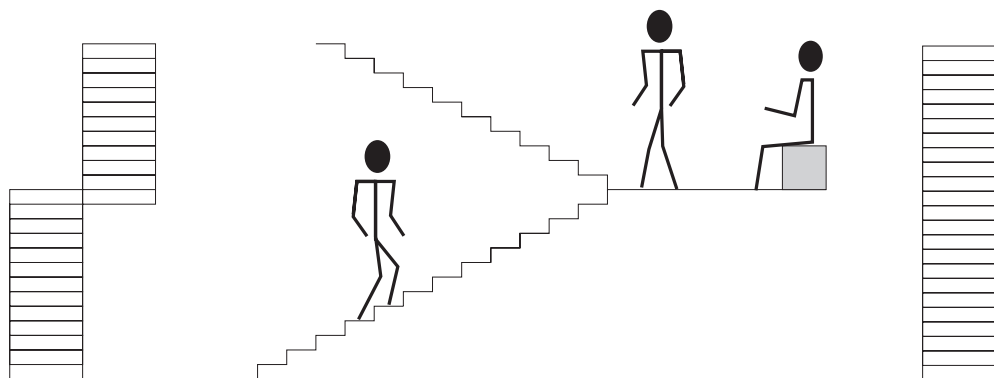
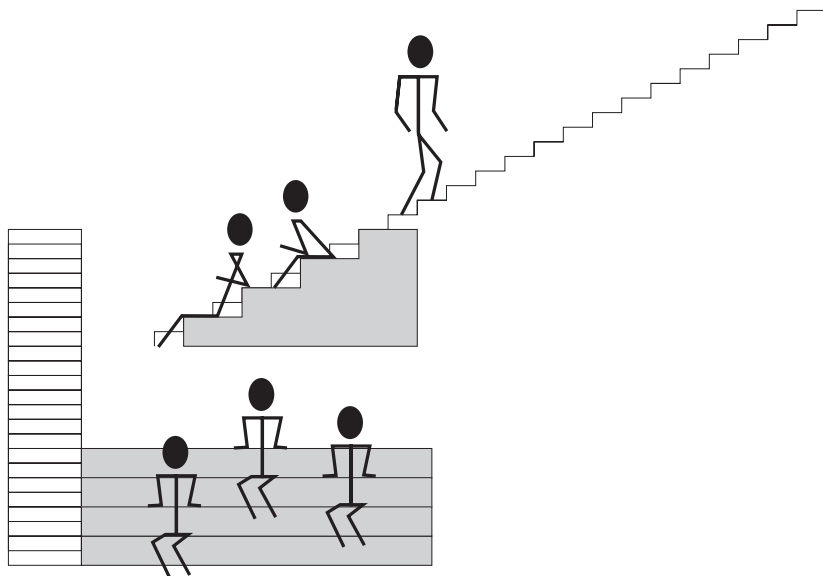


Below A graphic representation of different wear patterns created by student traffic in a high school hallway. The patterns could be used as navigation tools and colorized in relation to the primary subject the corridor services.



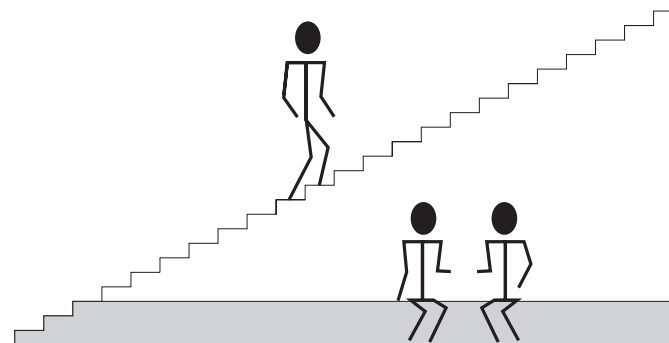
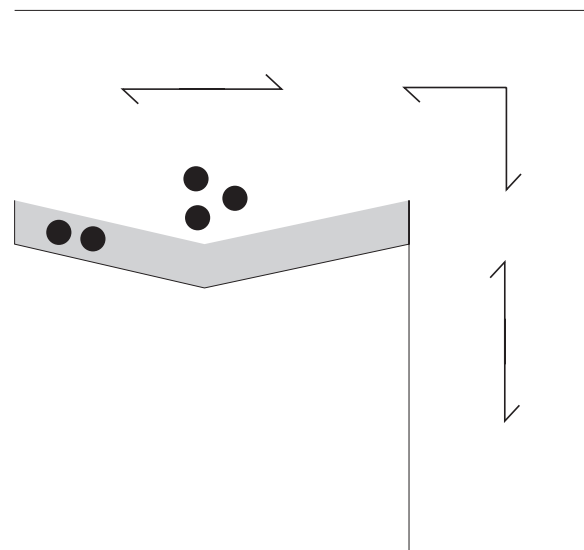
Top Extended stairs. This provides extra for seating and socializing without disturbing primary circulation flow.

Bottom Extended landing. This provides an area for seating or socializing in the stairwells while avoiding congestion with stair traffic. It can also serve as an outlook point when coupled with windows.



Top Active corridor. This serves to provide social areas within the main corridors that do not interfere with the primary circulation.

Bottom Under staircase. This provides seating areas in spaces that are typically un-utilized, adding active spaces without increasing floor area.



daylighting

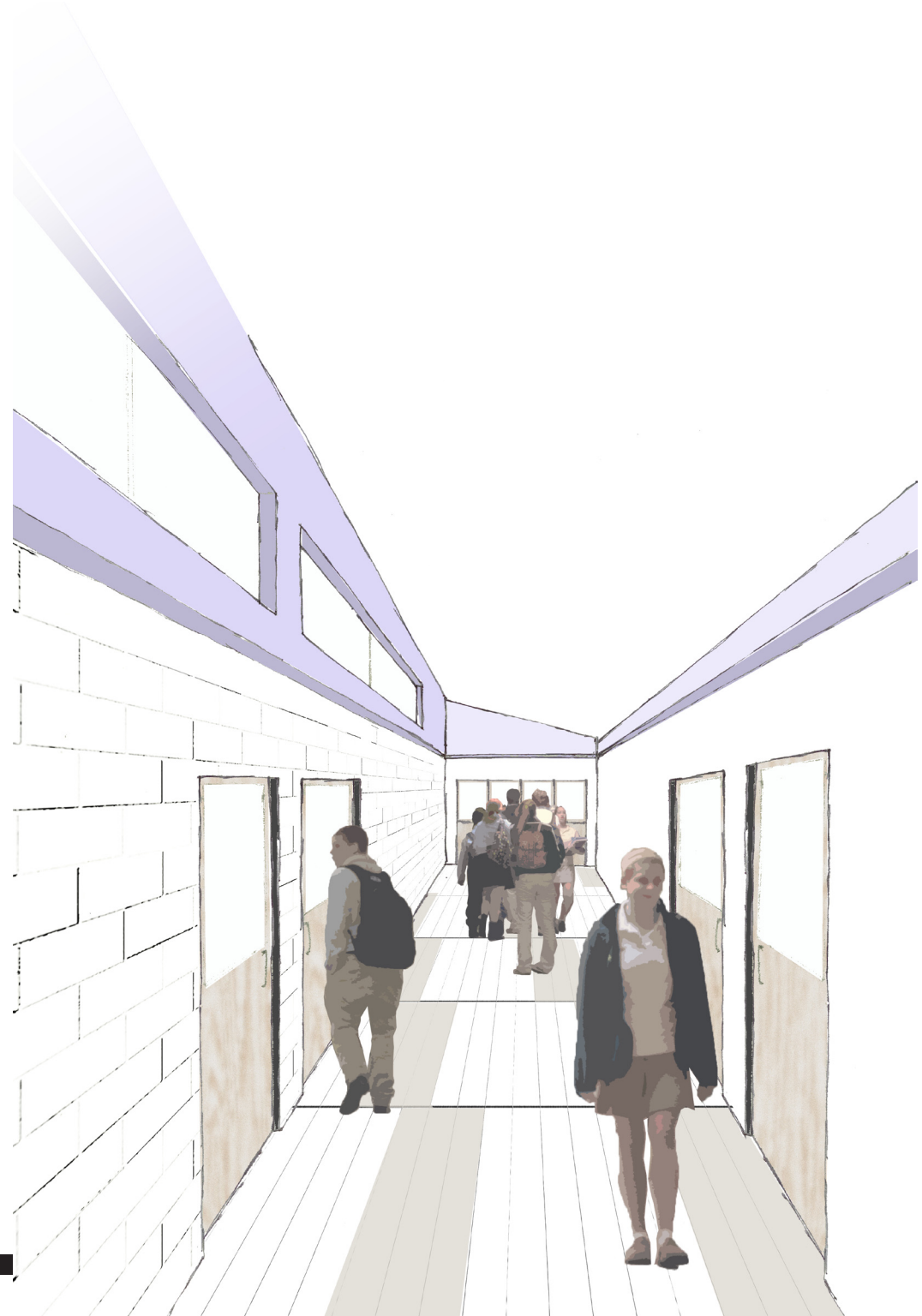
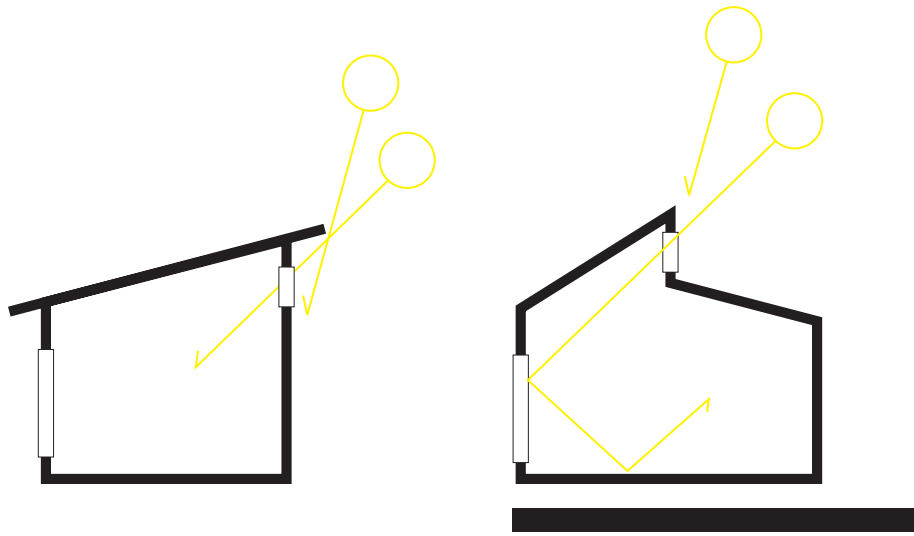
Daylighting provides both physical and psychological benefits. In numerous studies, there has been shown a strong positive correlation between the amount of daylighting and student test scores, behavior and health.

There are also benefits for teachers. Daylighting has proven to increase worker happiness and productivity. When teachers have an enjoyable environment to work in, there is a positive effect on their attitudes.

The students, then, also benefit from this. Students are more likely to want to go to school if they know their teachers want to be there, too.

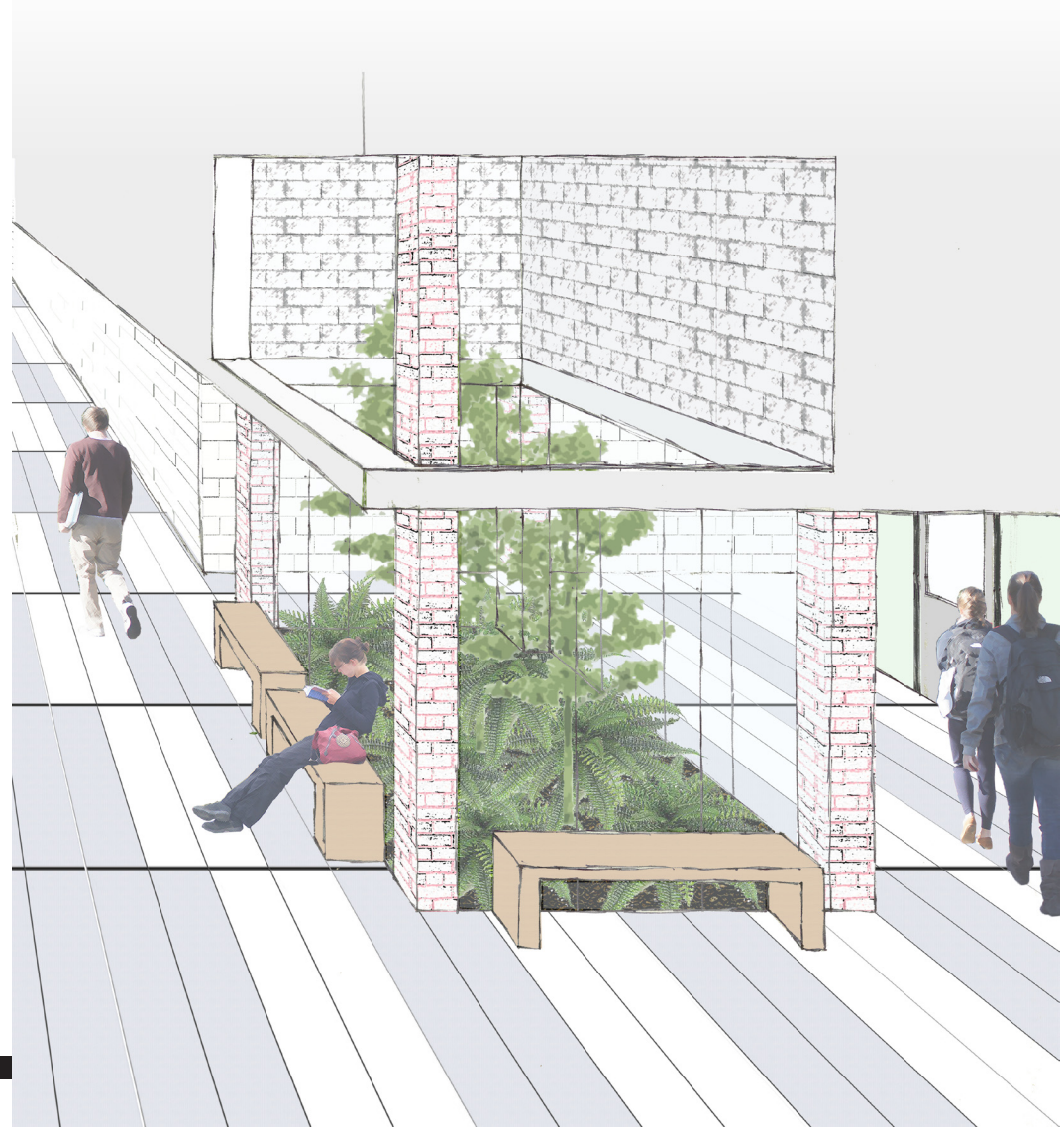
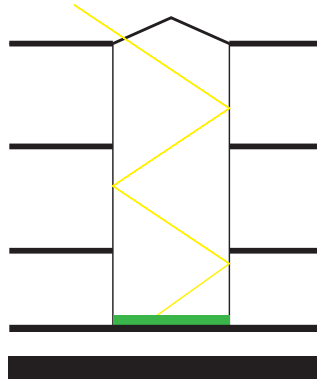
Clerestories

- provide natural lighting in hallways and commons
- allows for uninterrupted wall space below
- used to join two different roof sections
- diffused light can enter deep into interior of the space
- reduces need for artificial light during daytime
- passive solar heat during winter



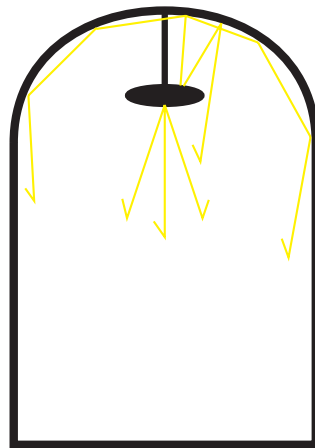
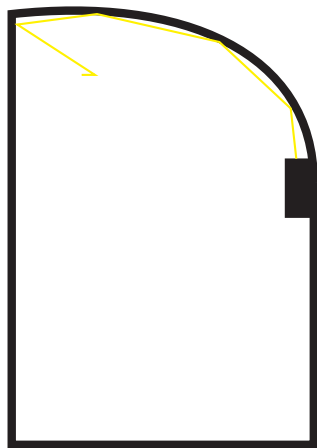
Interior Courtyards

- provide natural lighting in enclosed areas
- create a center for social interaction
- brings greenery into interior spaces
- diffused light can enter into interior of the space
- reduces need for artificial light during daytime
- serves as visual marker in navigation of interior



Curved Ceilings

- allow for uninterrupted wall space below
- heightens ceiling, giving a more open feel to corridors
- provides extra aesthetic to ceiling plane
- diffuses natural and artificial light; indirect lighting
- creates a warmer interior environment
- when combined w/ clerestory, reduces lighting load during daytime



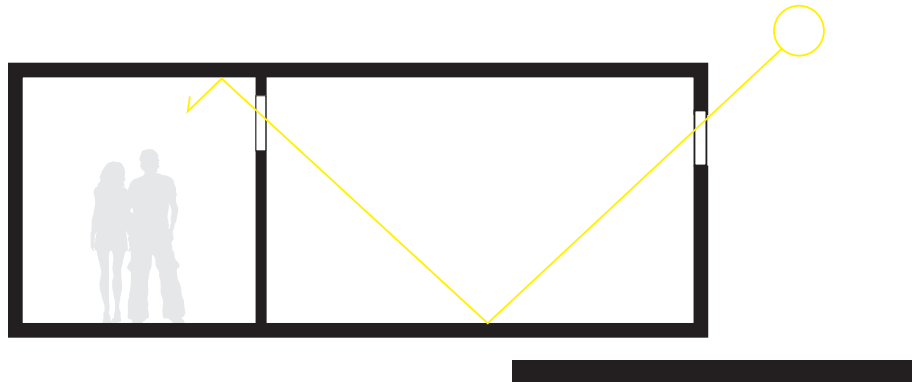
Daylighting Shelves

- provide natural lighting to rooms
- maximizes daylighting while minimizing glare
- minimize solar heat gain
- diffused light can enter deep into interior
- reduces lighting load during daytime
- shades lower portion of window from summer sun



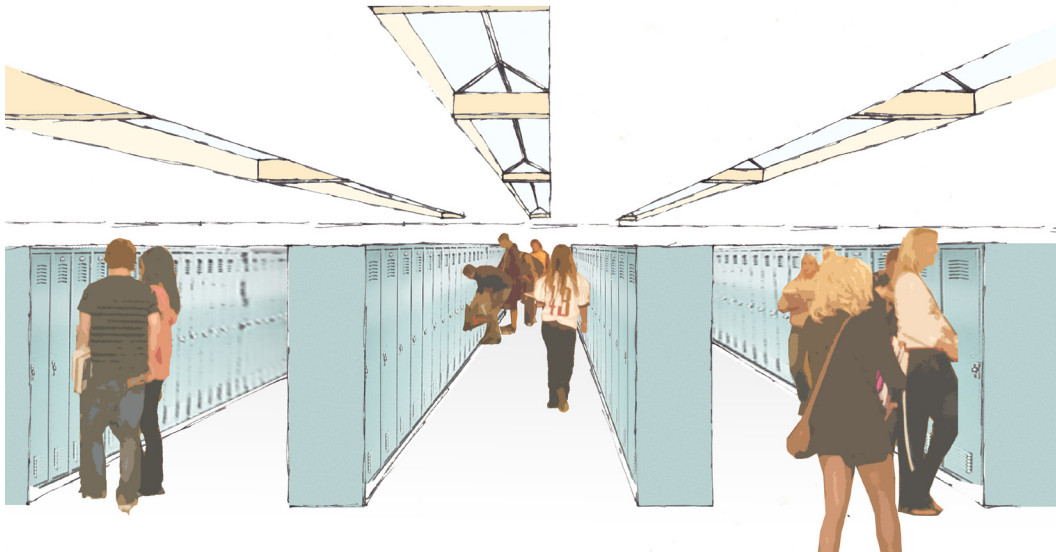
Interior Windows

- provide natural lighting in hallways
- allow for uninterrupted wall space below
- allows light from classrooms to enter into hallway
- diffused light can enter deep into interior
- reduces lighting load during daytime
- visual connection between classroom and hallway
- breaks up height of wall to alleviate prison-like look
- creates a warm corridor environment



Skylights/Lightwells

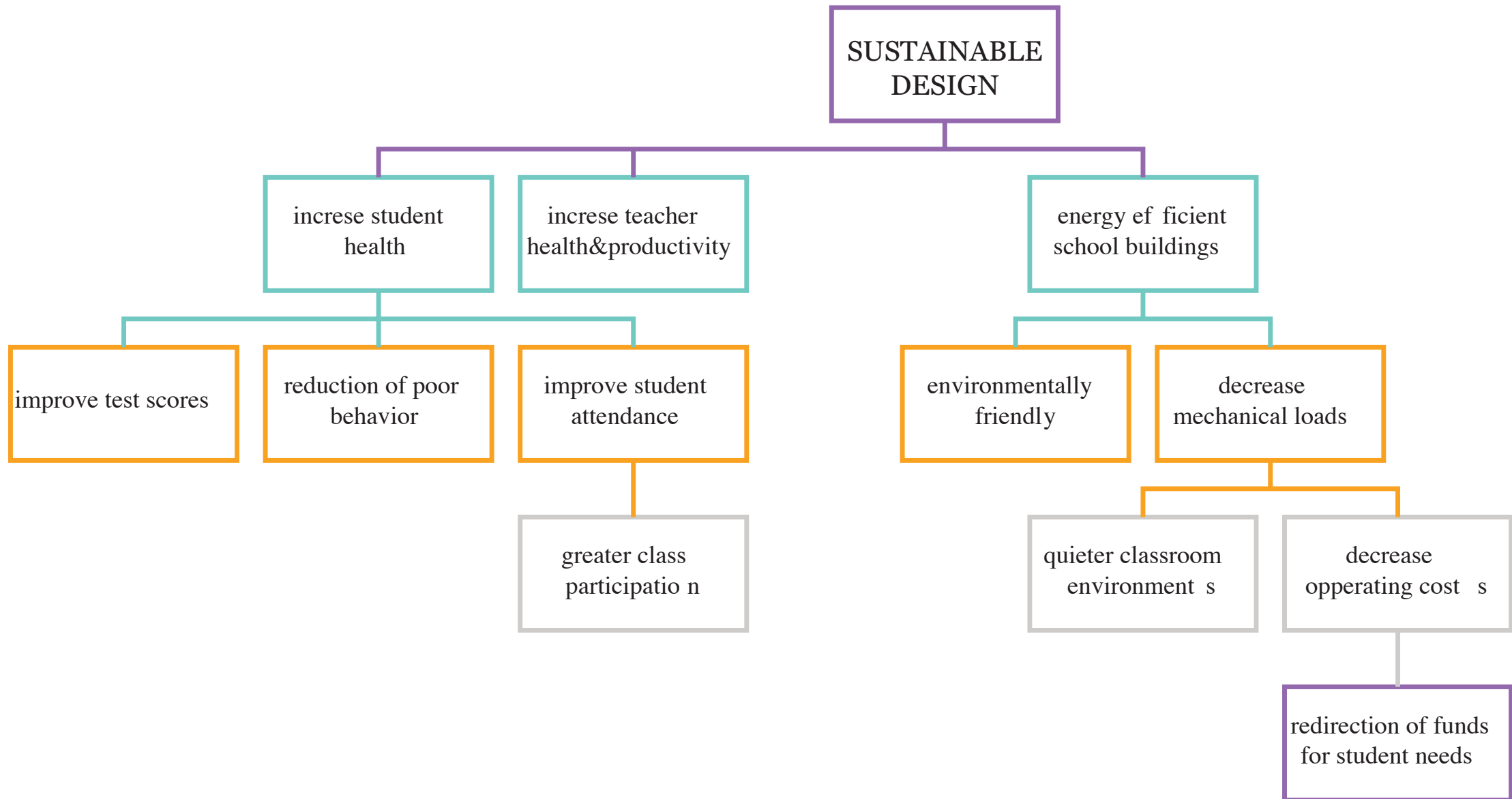
- provide natural lighting to interior
- allow for uninterrupted wall space below
- diffused light can enter deep into interior
- can be implemented in gathering space, classrooms, hallways, etc.
- reduces lighting load during daytime
- visual connection between deep interior and exterior environments
- provides extra aesthetic to ceiling plane
- creates a warm interior environment



sustainable design

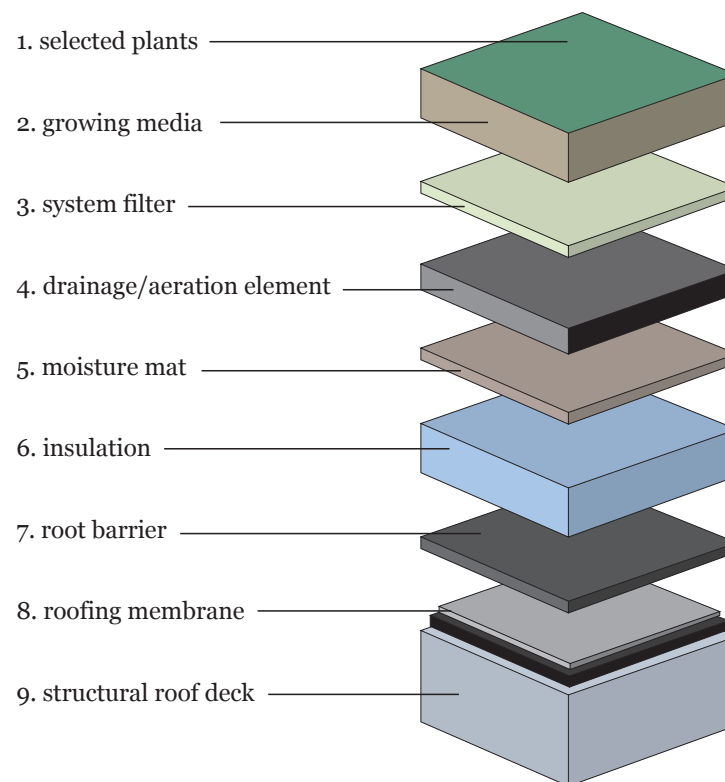
Instituting sustainable design practices has many benefits with very few drawbacks. It is environmentally friendly and can significantly reduce operating costs in all seasons. Although the up-front cost for these systems is greater than standard systems, the operating cost savings far outweigh them.

Sustainable systems can also be used as tools for the teachers. It allows students to see first hand how green roofs, solar panels, shading devices, etc. work , and with teacher guidance and supervision, can contribute to the maintenance of certain aspects of the systems.



Green Roof

- reduce mechanical loads in summer and winter
- provide secure learning spaces and opportunities
- are a learning tool for biology, ecology and agriculture
- create outdoor spaces when limited by land availability
- opportunity to engage the community
- engages students in sustainability/ environmental design
- involves students in the maintenance of their school

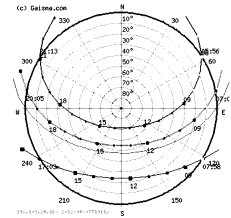


Above A diagram of the basic components in green roof construction



Solar Shading

- reduce solar heat gain
- reduce mechanical load
- allow for larger use of glass for natural sunlight
- reduce glare from sunlight
- can be operable to adjust to sun conditions
- opportunity to involve students in operation
- incorporates sun patterns and building orientation
- opportunity to engage students with daylight strategies



vertical shading device
East & West orientation



horizontal shading device
South orientation

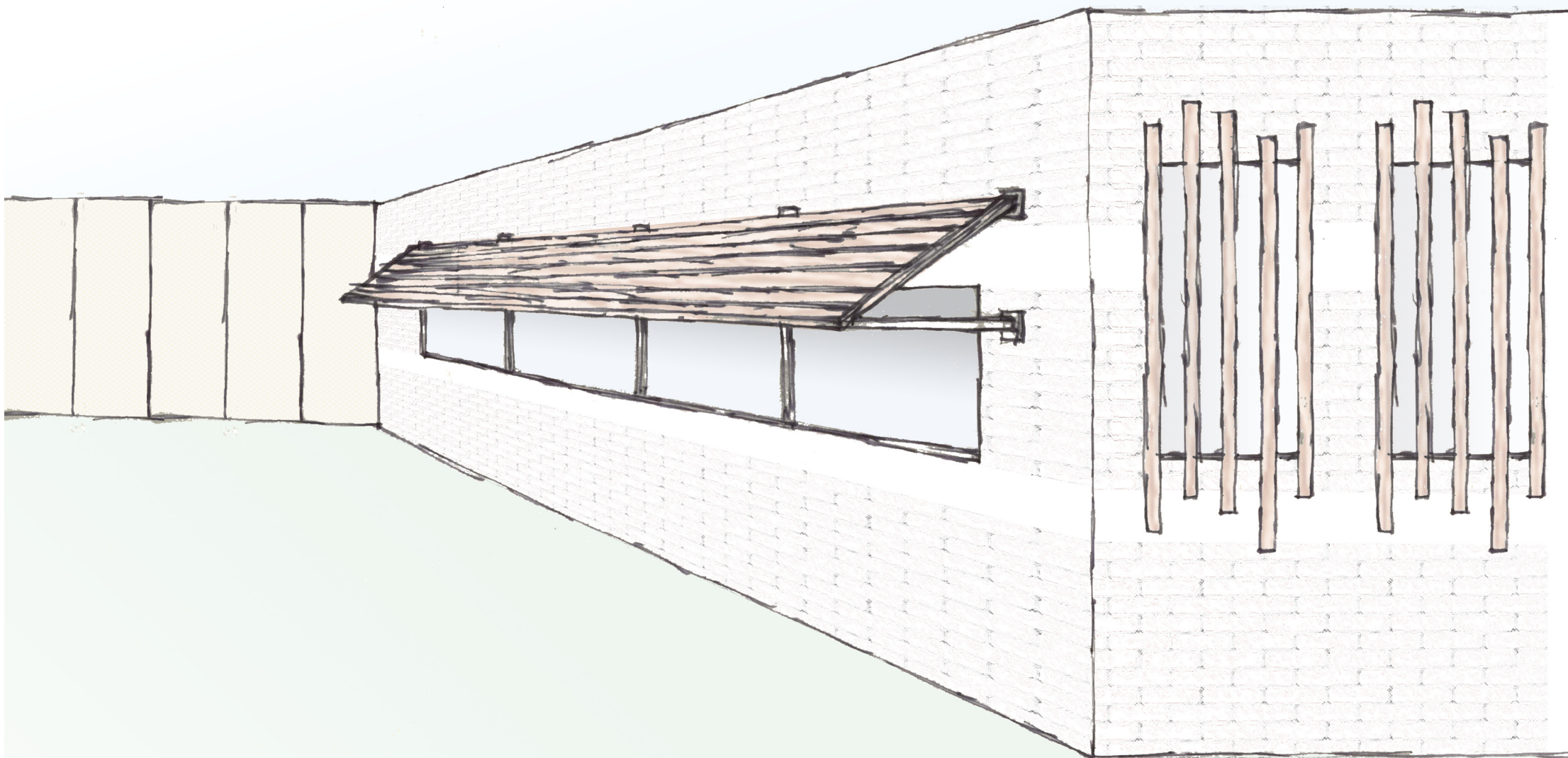


in-window shading device
any orientation



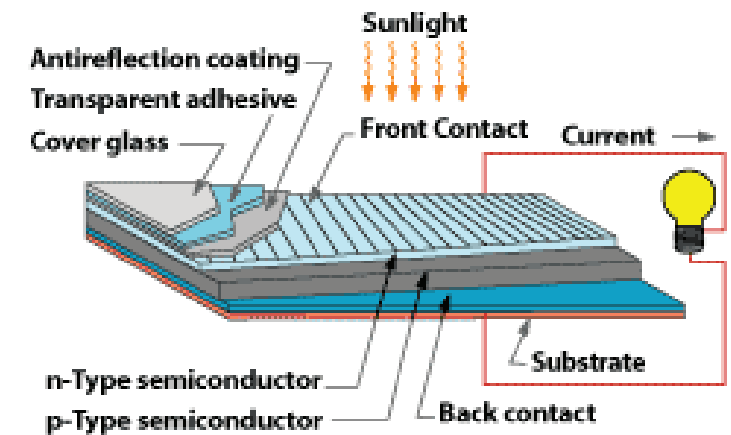
Top Right Sun chart for Detroit, MI

Lower Right (3) Diagrams of three different types and orientations of shading devices.



Solar Panels

- convert solar energy into usable energy
- reduce electrical loads
- can be doubled as shading devices on southern exposures
- are a learning tool for sciences
- engages students in sustainability/ environmental design
- involves students in the maintenance of their school



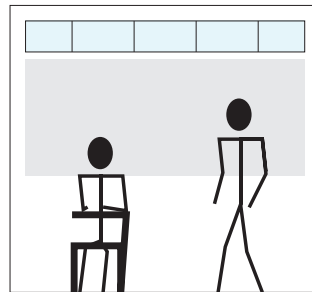
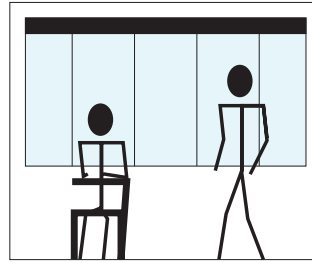
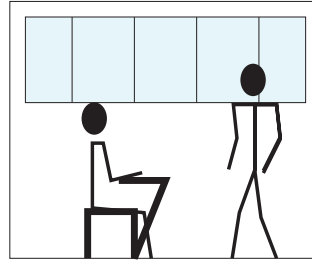
Right A diagram of how a solar panel works. photo from: <http://www.solar-powerbeginner.com/solar-panel-diagram.html>



classrooms

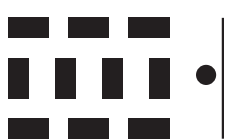
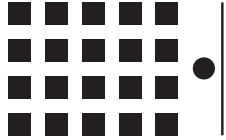
Classroom design is another important design consideration, as it is the place where students spent most of their time when in school. Careful thought must be put into the lighting and space planning of classrooms. There must be a mixture of natural and artificial lighting that produces maximum lighting quality with minimal glare. The furniture needs to be size-appropriate and flexible, in that it can be rearranged easily to accommodate for different teaching styles and subject needs.

Each subject should have its own classroom typology based on the needs and teaching methods associated with them.



Left Diagrams of how classroom orientation should be paired with window height and size to minimize eye strain, but maximize daylighting.

Right Diagrams of different classroom layouts. (from top to bottom: lecture type a, lecture type b, conference, independent, lab a, studio, lab b) These are a starting point of basic layouts, but are not limiting.



Sciences

Design Requirements

- need to withstand water and chemical spills
 - must be easily cleanable
 - epoxy, tile, engineered plastic composites
- needs access to exterior green spaces for observations and experiments
 - green roof, courtyard or fields
- must have adjustable lighting
 - includes daylighting with shading devices
 - high luminosity but minimal glare

Classes

- physics
- chemistry
- biology
- natural sciences
- other sciences

Classroom Types

- lecture
- lab
- storage
- digital lab
- experiment bay/ demonstration room

Materials

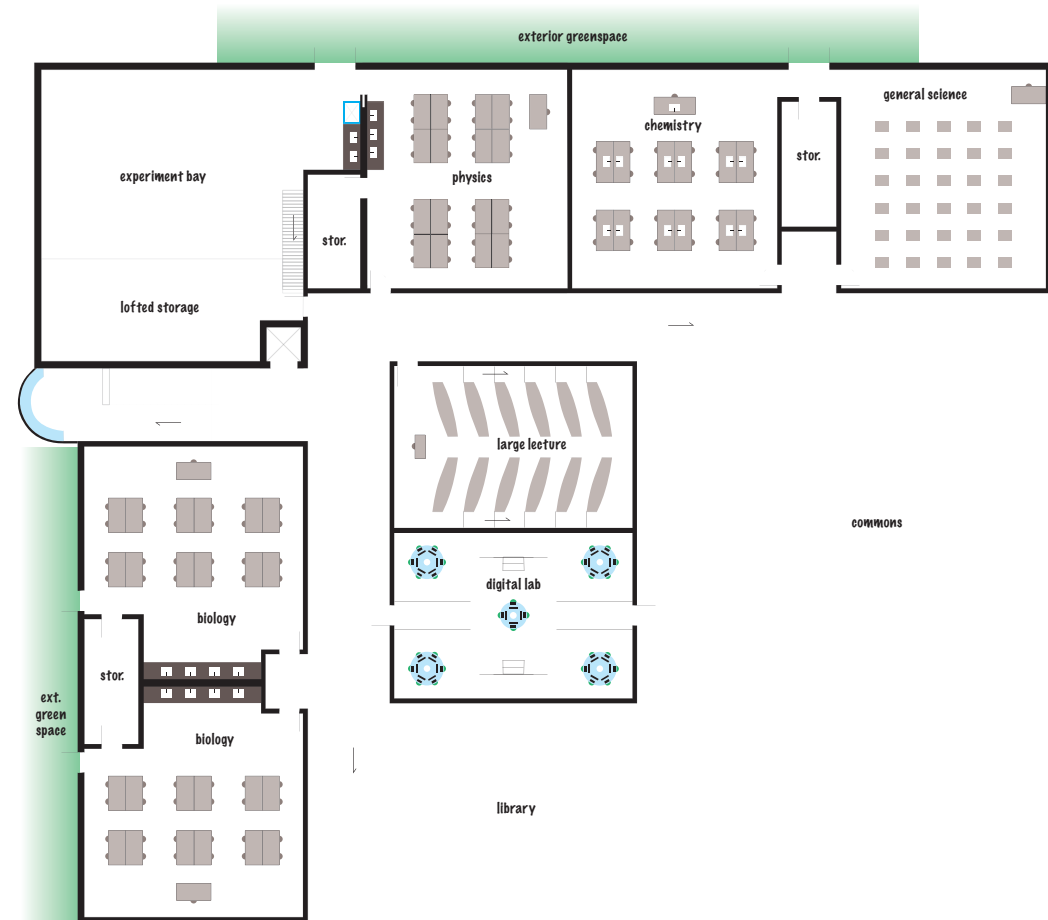
- smooth, non porous surfaces
- spill and chemical resistant floors and tables (labs)
- stainless steel fixtures (labs)
- cinder block (walls)

Colors

- cool palette
- earth tones

Far Left Sample gradients of suggested color palette

Below A graphic representation of spacial arrangements and adjacencies ideal for a science wing of a high school. Each classroom should have appropriate furniture and space based on the needs of the subject matter. It should be adjacent to the library and the commons area, along with access to outdoor green spaces.



Mathematics

Design Requirements

- needs adjacency to library
- should be adjacent to commons or primary circulation
- needs in-class storage space for materials
- computer lab to be centralized for ease of access by all classrooms

Classes

- calculus
- algebra
- trigonometry
- geometry
- other math

Classroom Types

- lectures
- computer lab

Materials

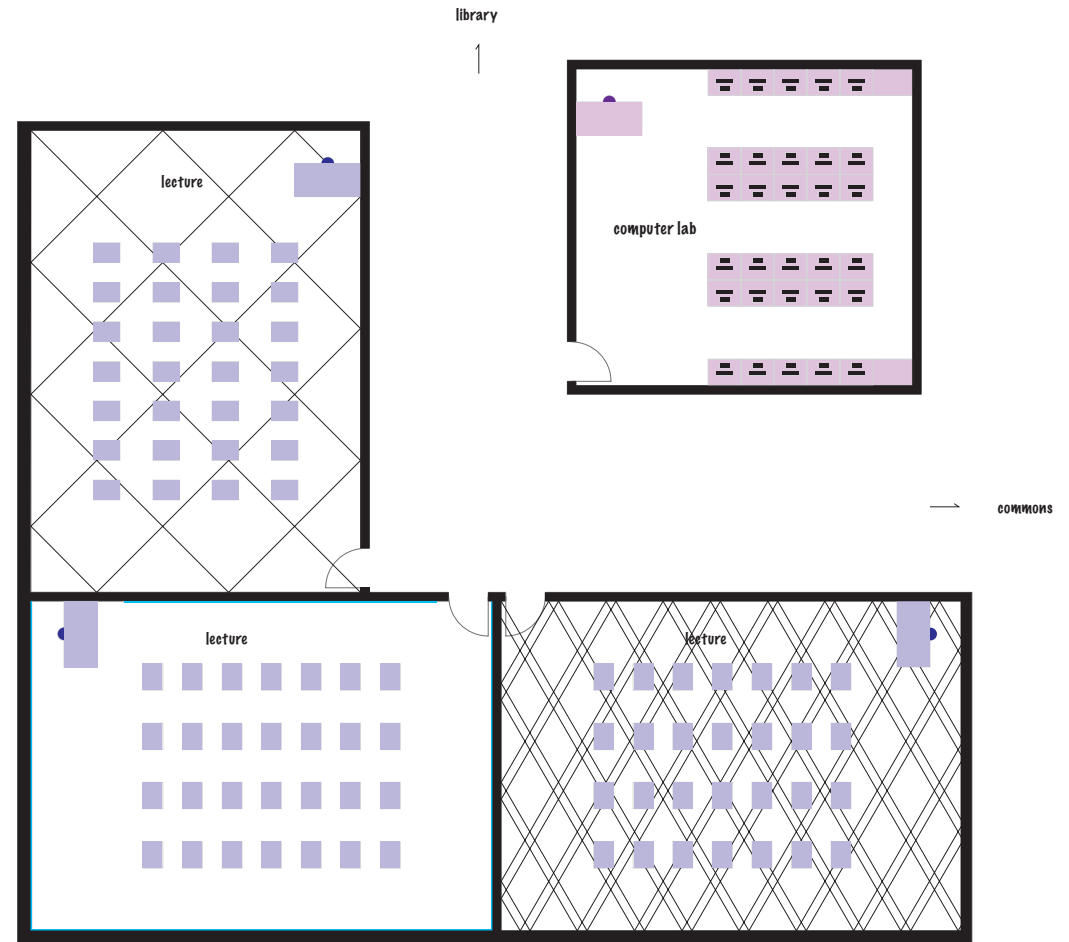
- angular floor patterns
- full wall white boards

Colors

- cool palette
- sky colors

Far Left Sample gradients of suggested color palette

Below A graphic representation of spacial arrangements and adjacencies ideal for a math wing of a high school. Furniture should be easily moveable to accommodate for teacher's needs in instruction. It should have adjacency to the library and commons.



Liberal Arts

Design Requirements

- furniture to be rearrangeable to accommodate multiple subjects and teaching strategies
- single desks or small tables
- must be adjacent to library
- ease of research access
- need adequate space for book storage

Classes

- english
- social studies
- history
- psychology
- sociology
- foreign language

Classroom Types

- lectures
- language lab
- conference
- reading room

Materials

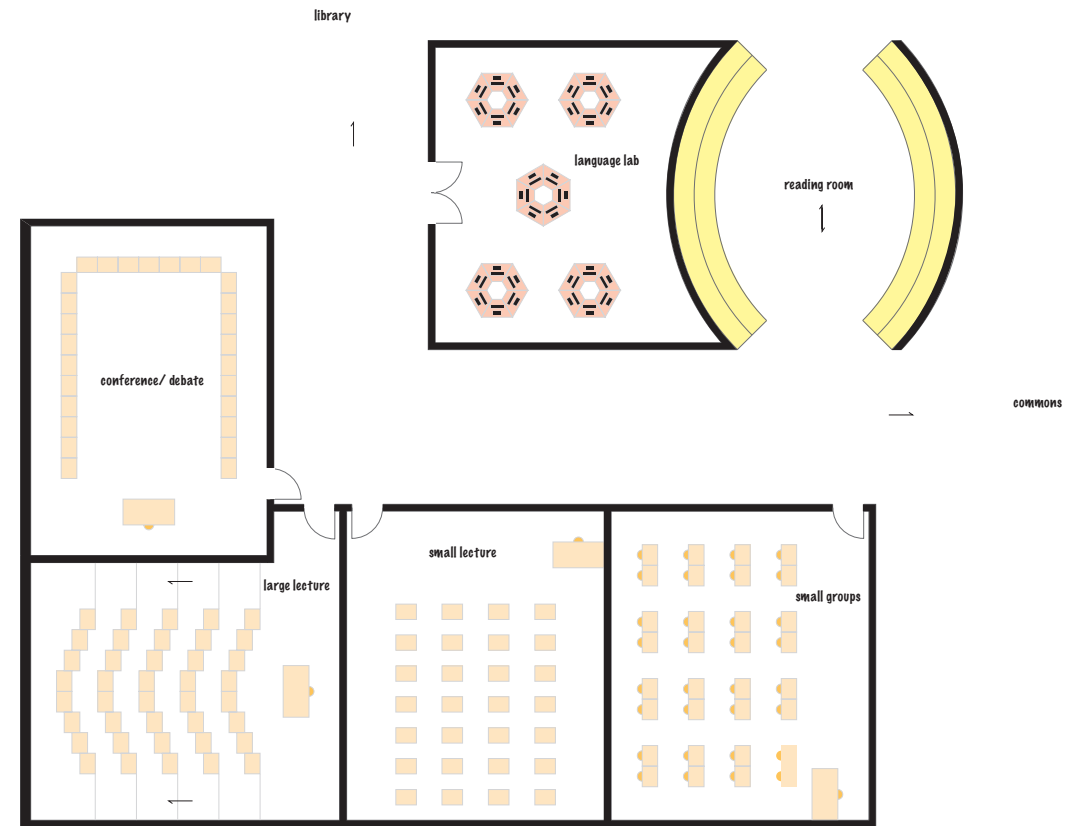
- softer materials
- provide good acoustics
- textiles, carpet (classrooms)

Colors

- warm palette
- sun colors

Far Left sample gradients of suggested color palette

Below A graphic representation of spacial arrangements and adjacencies ideal for a liberal arts wing of a high school. The classroom furniture should be flexible to adapt to the needs of the subject matter. Adjacency to the library is essential, along with having a connection to the commons. There should also be intermediate spaces (like the reading room shown in the plan) that provide for classes to be held outside of the classroom and can serve as social spaces in-between and after classes.



Fine Arts

Design Requirements

- needs to withstand water and material spills
- must be easily cleanable
- epoxy, tile, engineered plastic composites
- must have adjustable lighting
 - includes daylighting with shading devices
 - high luminosity but minimal glare

- needs adequate storage space for materials and projects

Classes

- art
 - drawing
 - painting
 - sculpting
- digital media

Classroom Types

- art studio
- storage
- kiln
- digital labs
- lecture
- gallery

Materials

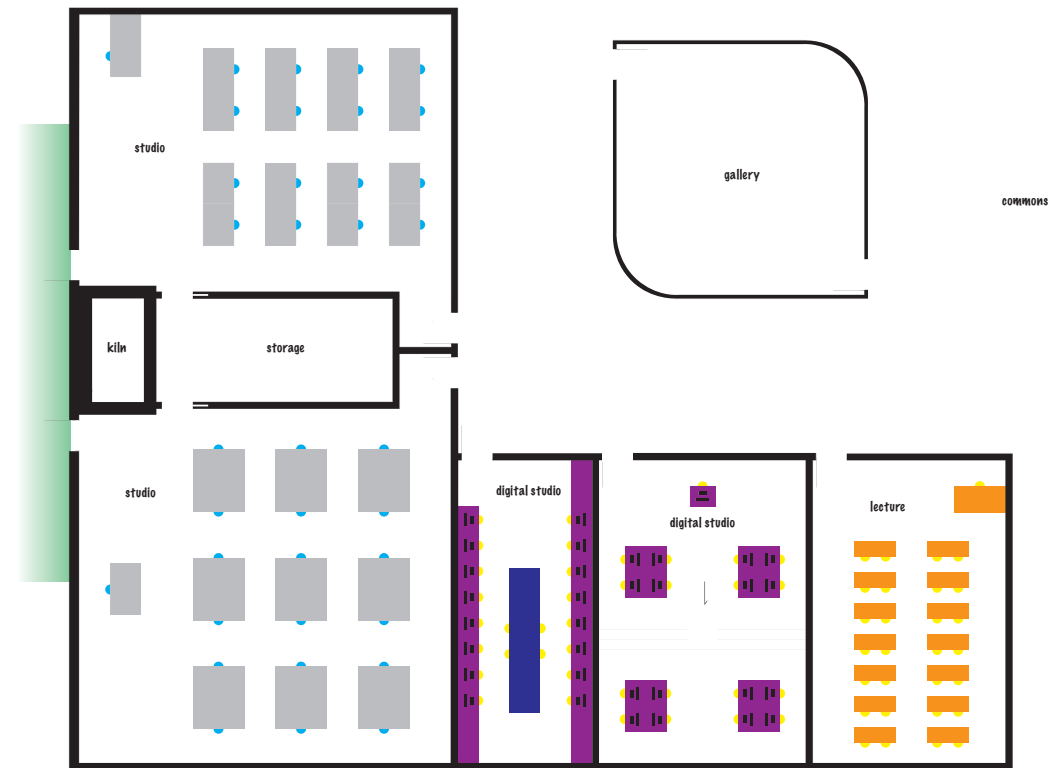
- smooth, non porous surfaces
- water/spill resistant floors and tables (studios)
- scratch resistant surfaces

Colors

- bold palette
- vibrant colors

Far Left sample gradients of suggested color palette

Below A graphic representation of spacial arrangements and adjacencies ideal for a fine arts wing of a high school. Studios must have a lot of space for movement and student-teacher interaction. A central gallery space should also be included to showcase student (and potentially community) works. Adjacency of the gallery to the commons is ideal. There must also be access to outdoor green spaces from the studios for ventilation and inspirational needs.



Performing Arts

Design Requirements

- must have proper acoustics for all areas
 - performances require high acoustic quality
- needs adjustable lighting
- need adequate storage space for props, instruments, etc.
- adjacency to main entrance/exit for ease of visitor access to auditorium
- adjacency to shop for set design construction and transportation

Classes

- drama/theatre
- dance
- vocal/choir
- music/band

Classroom Types

- dance studio
- choral room
- band room
- storage
- auditorium
- lecture
- shop

Materials

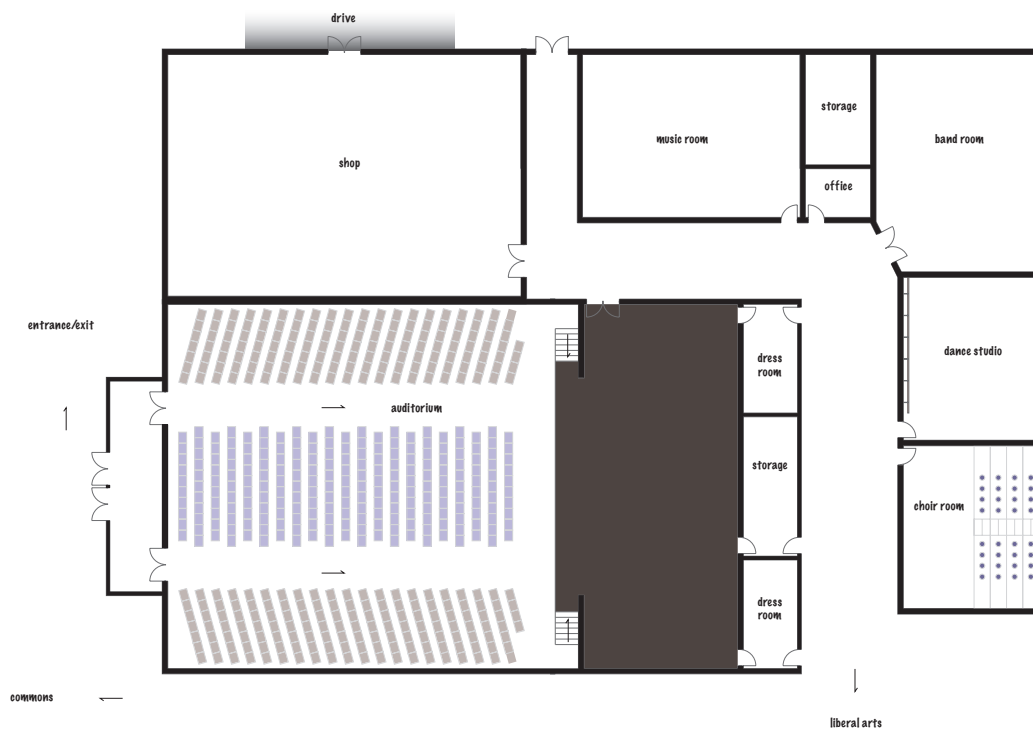
- mixture of soft and hard
 - best acoustics per space
 - textiles, tiles, and hardwood
- flat and seamless

Colors

- neutral palette
- rich colors

Far Left sample gradients of suggested color palette

Below A graphic representation of spacial arrangements and adjacencies ideal for a performing arts wing of a high school. This wing must be located to a main entrance/exit of the school for ease of circulation during events. It must also connect to the commons area, which can serve as a large lobby space before and after an event. This wing should have adjacency to the liberal arts wing of the school due to their interrelatedness.



Physical Education/Health

Design Requirements

- needs large amounts of lighting with minimal glare
 - use of high, diffused natural lighting in gym area
 - larger glass systems in other areas, especially pool
- materials must withstand consistent wear
 - high foot traffic and use of weight equipment
- must provide for mass seating areas in gym and pool
 - large assembly space and event center
- can be isolated from other school functions, but should link to commons

Classes

- physical education
- swimming
- health
- life skills

Classroom Types

- gymnasium
- pool
- locker rooms
- offices
- fitness room
- weight room
- lecture
- storage
- sports medicine
- running track

Materials

- sealed hardwood (gym floor)
- tiles (pool and lockers)
- cinder block (walls)
- steel (supports)

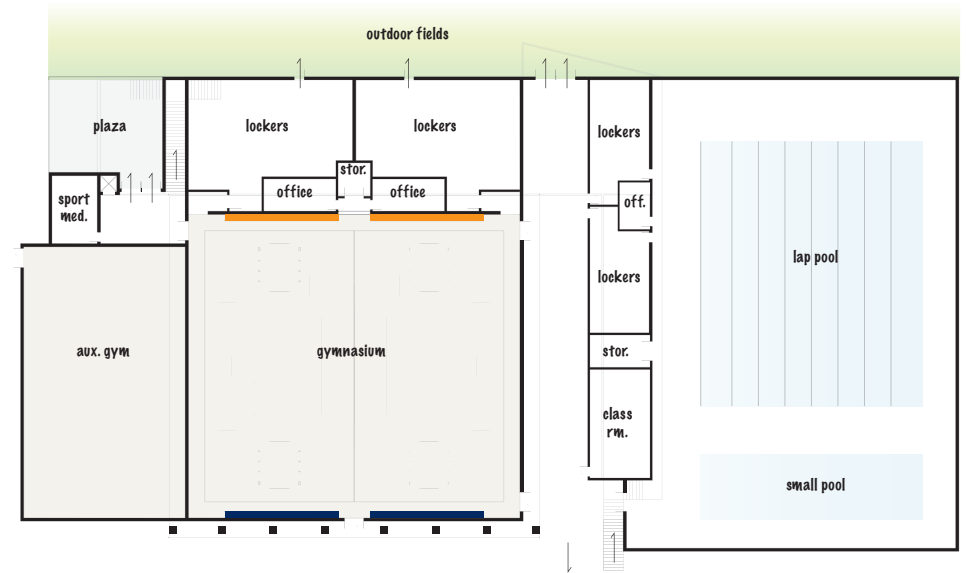
Colors

- varsity palette
- school colors

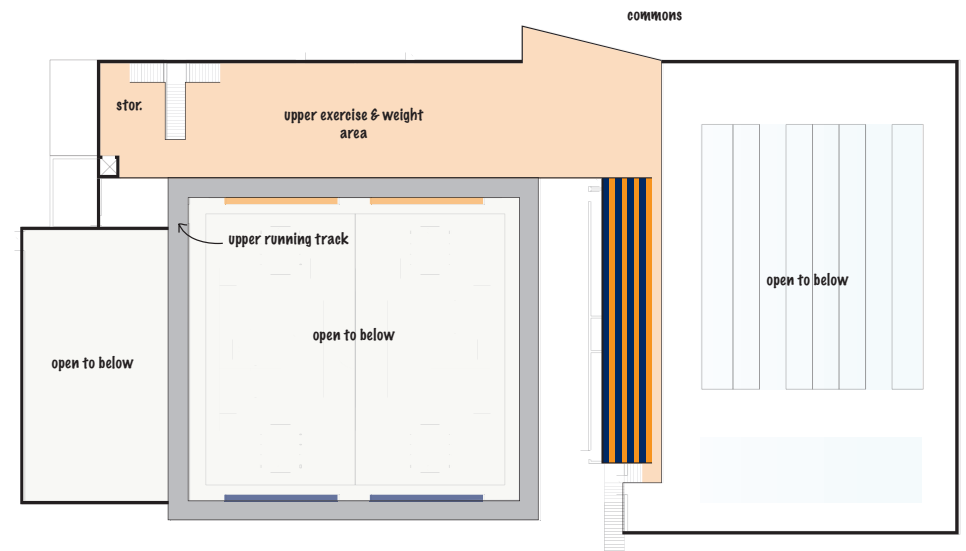
Left sample gradients of suggested color palette

Far Right A graphic representation of spacial arrangements and adjacencies ideal for a physical education/health wing of a high school. Must have its own main entrance/exit to support visitor traffic during events. Adjacency to commons for ease of student access during large in-school functions/assemblies.

- 1st floor



- 2nd floor



6 CONCLUSION

“It doesn’t matter which side of the fence you get off on sometimes. What matters most is getting off. You cannot make progress without making decisions.”

Jim Rohn

“You are always a student, never a master. You have to keep moving forward.”

Conrad Hall

“This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.”

Winston Churchill

conclusion

The way a school is designed can affect student behavior; but to what extent is unclear. When designed with the aforementioned strategies and considerations, schools can become hubs for learning and community interaction. They can shift from gloomy industrial education factories to bright and positive centers for information sharing and collaboration.

When the work/school environment is adequately day lit, sustainable and engaging, it has a positive affect in teacher and student happiness. This has proven to lead to increased productivity and success. It is quite simple psychology: when a person enjoys being somewhere, they are more likely to enjoy what they do there, and in turn are more successful at what they are doing.

I believe I have established a solid kit of ideas and design considerations to be implemented when planning a high school. They are a starting block for design, made to be built upon and changed through time and circumstance. They are not a design, but a how to think toward a design. Although this thesis may have reached its end, it is not finished. The ideas expressed must be tested, and it is my intent to keep pursuing this subject and testing my hypotheses on the effects on school design on student behavior and academic success. This book may represent the close to my academic career, but it is only the beginning of a long intellectual career.

Special thanks to my thesis advisor John Mueller for his encouragement and push for quick decision making. The allowance of side-tracked investigations that stemmed from those decisions ironically made things clearer in the end and helped me produce a project that hold my interest for a lifetime.

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