A Science & Mathematics Magnet School at Maymont

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Virginia Commonwealth University

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I search for connections.
With and among objects and people.
Exploring similarities and adjacencies.
Determining differences and boundaries.
Considering how they shape and influence one another.
Deciphering the theory of grand unification.
How everything is interconnected.
This theory supports the means and identifies the reasons.
It gives a foundation; a starting point.
Discovering that is imperative in understanding and designing.

Sarah Nakfoor
May 2008
I am interested in the idea that schools should be designed to offer individualized learning. "A Science & Mathematics Magnet School at Maymont" explores a type of school that is becoming more familiar and accessible. By allowing students who have an interest in excelling in school and preparing for their future careers to come together and meet one another and experience an education that might not otherwise be available can be beneficial in many ways. In most cases, because of the funding required for such specialized schools, class sizes are reduced to meet budgets and the schools are opened to the community to gain funding. Smaller class sizes increase student interaction and aid in forming connections among students and between students and teachers. The use of the school as a venue for the community adds needed revenue. Both occurrences may be advantageous and positively effect community at the school and surrounding populous levels.
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Robin's Nature & Visitor Center

Location: Maymont Park, Richmond, Virginia

Building Type: Nature/Visitor Center

Year Built: 1999

Square Footage: 20,000 sq. ft.

Architect: Bond Comer Westmoreland & Hiner Architects

Construction: W.M. Jordan Company, Inc.

Post-Occupancy: Maymont Foundation – Robin's Visitor & Nature Center

About:

Now home to the Maymont Foundation, Maymont Park encompasses the full 100-acres of a grand Victorian country estate once belonging to James and Sallie Dooley. In 1886, the Dooleys first viewed and purchased the rough pasture and field that would become Maymont Park. Sallie Dooley led the effort to transform the landscape into a showplace that would rival the lavish estates that were springing up throughout the country. Major Dooley died in 1922, and upon Mrs. Dooley's death in 1925, Maymont was bequeathed to the City of Richmond. There were no heirs to remodel the residence and its interiors. There were no subsequent generations to parcel the land or to sell off the Dooleys’ distinctly personal collection of decorative arts. In fact, only six months after Mrs. Dooley’s death, Maymont opened as a public park and museum, and has survived intact. Today it is an unusually complete example of a Gilded Age estate. The estate, now known as Maymont Park, including the residence, gardens, grounds and original architectural complex, remains very much as it was during the Dooleys’ time. Surrounding the Robin's Nature & Visitor Center, Maymont Park is host to walking trails which lead to the Maymont estate, an Italian garden, a Japanese garden, various wildlife habitat enclosures, and the children’s farm.

The Robin's Nature & Visitor Center, located on a sloping elevation in the field setting of Maymont Park, serves as a site for introducing Maymont's history and natural surroundings. Visitors to the center enjoy self-guided tours through Maymont's nature exhibits and a variety of staff-led educational programs are offered throughout the year. The main exhibit hall features a 20 foot waterfall cascading into the first of 13 giant, linked aquariums that are home to playful river otters, turtles and fish of all shapes and sizes. Interactive galleries, including a replica of Richmond's floodwall, a weather station and a fish ladder, complete this memorable river experience. The Nature & Visitor Center displays murals and a large topographical map to help guests plan their day at Maymont Park. In addition to behind-the-scenes tours, night hikes and many other public programs, the Nature Center is visited annually by nearly 50,000 school children attending classes which reinforce Virginia's Standards of Learning. The Maymont Shop features everything from garden ornaments and jewelry to children's games and books. The Maymont Cafe offers light lunch options and indoor and outdoor seating with outstanding views of the grounds.

-Courtesy of maymont.org
A SCIENCE & MATHEMATICS MAGNET SCHOOL

Science Exploration Center (SEC) educational guidelines:

Numerous public high schools from different districts within the county, considered “home base schools,” participate with SEC by sending their students for accelerated learning in math and science. The “home base” schools are varied: both urban and suburban. Students attending SEC come from diverse backgrounds and cultures but share the common goal of excelling in school and preparing early for their future careers. Compared to most public schools, SEC offers more educational choices and smaller class sizes. Students leave with a better understanding of their interests and needs, and gain a stable foundation upon entering college.

SEC's students are high-achievers who are self-motivated and interested in exploring mathematics and science topics in order to experience hands-on learning with an investigative approach that isn't always available in typical public schools. Students attend classes only in the afternoon, for 2 - 55 min. sessions, after instruction in the morning at their “home base” school. Like most magnet schools, SEC is highly competitive; a limited number of students are accepted and the level of interest always outweighs the school's capacity. To ensure fairness, SEC's students are selected by a yearly lottery.

SEC provides numerous opportunities for students who have an interest in excelling in the math and science disciplines while taking advanced placement and college-prep courses. The school offers state-of-the-art technology and laboratory equipment which is available for use student use after regular school hours. SEC takes advantage of Maymont's natural setting; students often participate in fieldwork around the school, attend class in the outdoor educational space, and utilize the newly added greenhouse for projects.

SEC's pedagogy focuses on individual student needs while also encouraging student collaboration and involvement in the variety of disciplines studied at the school. The program enables students to interact with each other, to work together and to learn from one another. The library, student lounge (where students have lockable desks for personal items) and the research and instrumentation lab are areas where students who might not be in the same classes may meet one another, discuss their studies, develop projects together and ultimately, form friendships.

SEC acts to connect with the local populous by being a venue for the community. Examples of community uses include: after-hours classes, lectures and social events in the library which utilize the new pull-out stage, a proctored testing site, and a field trip destination for younger students. While also generating revenue for the school, SEC is a center for social and cultural activities.

"School is a part of its community. Not apart from it."
- C. William Brubaker, Planning and Designing Schools

"Schools are opening their doors for longer hours and welcoming segments of the population who typically did not venture into school buildings."
- Buchler & Johnson, Becoming a Learning Community

PROGRAM

Courses offered:

- Chemistry
- Biology
- Environmental Science
- Botany
- Mathematics

School Capacity: 80 students
Class Size: 16 students

"Schools are opening their doors for longer hours and welcoming segments of the population who typically did not venture into school buildings."
- Buchler & Johnson, Becoming a Learning Community
Main Concepts

A learning environment that fosters collaboration and community through students' discovery of similar interests and the application of a crossover of math and science disciplines.

SEC's classrooms and laboratories are combined to form "suites." Comprised of instructional and hands-on learning areas, the suites offer a functional and adaptable environment that maximizes the building's physical space and increases efficiency during the teaching and learning process.

Watercolor Studies

Watercolor studies displaying 3 main usage areas:

- Administration
- Teaching
- Community

Group spaces: highly saturated; individual spaces: less saturated
secondary colors display overlapping usage

Conclusion:

Group and community activities define the majority of SEC's program.
Quick Sketch: Maymont Nature Center’s South Entrance

Column Grid Study
Block Plan

Adjacency Matrix

ENTRY
SECRETARY
PRINCIPAL
TEACHERS LOUNGE
STUDENT RESTROOMS
ADULT RESTROOMS
STUDENT HOME BASE
AP CHEMISTRY LAB
AP BIOLOGY LAB
AP ENV. SCI. LAB
BOTANY LAB
GREENHOUSE
COMPUTER LAB
AP CHEMISTRY CLASS/LECTURE RM
AP BIOLOGY CLASS/LECTURE RM
AP ENV. SCI. CLASS/LECTURE RM
BOTANY CLASS/LECTURE RM
MATH CLASS/LECTURE RM
STUDENT LOCKER RM
LIBRARY
PRINTING/COPY CENTER
VENDING MACHINES
MECHANICAL
STORAGE

Direct/Primary Adjacency
Convenient/Secondary Adjacency
Adjustable Perimeter Benches

Used individually or in groups in Environmental Science and Botany Suites. Benches slide on rails to allow for larger groups of students and more work surface area.

Half Round Tables

Used individually or in pairs in Math Classroom. Table shape encourages student interaction.

Molecular Model

Inspiration for Chemistry Suite design. Portrayed in color palette, floor pattern and workstation shape and arrangement.

Bench & Media Desk Model

ADA Media Desk with small seating area provides a space for student interaction.
BOTANY SUITE
MATH CLASSROOM
LIBRARY, MEZZANINE & STUDENT LOUNGE
LIBRARY
MEZZANINE & STUDENT LOUNGE
MODEL

Scale: 3/32" = 1'-0"

Construction:
Basswood
Chipboard
Cardboard

Base Size: 2' x 2'
Maymont’s Square Footage: approx. 20,000 sq. ft.
SEC’s Building & Mezzanine Square Footage: approx. 23,000 sq. ft.
Building Use: Educational (E)
Fire Protection: Sprinkled
Elevators: 1
Ramps: 8 ADA (1:12 & 6’ wide)
Total Main Floor Exits: 12
Maximum Access Travel Distance: 250 ft.
Maximum Length of Common Path of Travel: 75 ft.
Exit Enclosures: 1 hour
Exit Corridors: 0 hour
Water Fountains: 8 total, 4 ADA
Restrooms: 4 total (2 M/F Adult, 2 M/F Student)
Toilets: 11 total, 4 ADA, 3 urinals

School Occupancy Requirement: ~ 170 sq. ft./student in a school
Based on Allowed Occupancy: ~ 110 students

SEC’s Total Proposed capacity: 92 people
• 80 students (16 in 5 classes)
  • 1 Principal
  • 1 Secretary
  • 6 Teachers
  • 1 Prep/Storage
  • 1 Media Desk
    • 1 IT
  • 1 Security
  • 1 Janitorial
## MATERIALS

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- *Main fabrics are used to distinguish each suite with a signature color palette. Coordinate fabrics accent the space and tie in the subject studied or inspiration.*
- *Coordinate fabrics are used to tie together all main fabrics from suites.*
- *Bright carpet tiles add vibrancy and color to the space and can easily be swapped out if damaged.*
- *Interface Modular Carpet Tile can be heat welded and coved for laboratory use.*
- *Forbo Sheet Vinyl can be heat welded and coved in modified sizes.*
- *Accent paints correspond to color palettes in suites. Painted with a metallic finish to add character.*
Site Case Study: Ben Franklin Elementary

Overview:

Architect: Mahlum Architects
Location: Kirkland, WA
Building Type: Elementary Education
Year Completed: 2005
Square Footage: 56,800 sq. ft.

About:

Ben Franklin Elementary School is a high-performance building that focuses on educational learning communities. The students are distributed within small learning communities, each including a cluster of four naturally ventilated and day-lit classrooms around a multipurpose activity area. Stacked within two-story wings that overlook the surrounding greenspace, these communities are integrally together with the outdoors.

By connecting the school's pedagogy to the outdoors, the students' learning is expanded to include an appreciation for nature and sustainability. Outdoor educational spaces, gardens, and rainwater collection are all ways that the school utilizes the surroundings to expand learning beyond the classroom.

Because daylight and indoor air quality profoundly impact student performance, the school was designed to maximize performance in these areas. The classroom areas of the school are entirely naturally ventilated and day-lit, decreasing the reliance.

-Information and photos courtesy of Building Green, Inc.

Focus for Case Study: School's pedagogy & building materials.
Site Case Study: Schlitz Audubon Nature Center

Overview:

Architects: The Kubala Washatko Architects, Inc.
Location: Milwaukee, Wisconsin
Building Type: Nature Center
Year Built: 2003
Square Footage: 35000 sq. ft.

About:

The mission of the Schlitz Audubon Nature Center is to promote an appreciation, understanding and stewardship of our natural heritage through environmental education and sanctuary preservation. It was only natural, then, for the Center to build its new Dorothy K. Vallier Environmental Learning Center with environmental sustainability in mind. With the assistance of Johnson Controls, Inc., the Center achieved a Gold rating under the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) program upon construction of the facility.

Founded in 1971 and named after the Joseph Schlitz Brewing Company, the Schlitz Audubon Center is located on 185 acres of natural beauty along the shores of Lake Michigan, north of Milwaukee, Wisconsin.

The land was first used to field the brewery’s draft horses, then later as a recreational area. Presently, the Center offers classes and programs for all ages and annually teaches thousands of young children about nature, using its land as an outdoor classroom. The 35,000-square-foot learning center— the first of its kind in Wisconsin, provides much needed space for classrooms, an enlarged auditorium, new exhibits, a nature preschool, a nature store and improved access for persons with disabilities.

-Information & photos courtesy of schlitzauduboncenter.com. Drawings courtesy of Joel Krueger at TKWA.

Case Study Focus: Similar program, terrain, building plan, height, great hall, & materials.
Site Case Study: Fallingwater

Overview:

Architect: Frank Lloyd Wright
Location: Mill Run, Pennsylvania
Building Type: Residential
Year Built: 1935
Square Footage: 5300 sq. ft.

About:

Fallingwater is recognized as one of Wright's most acclaimed works, and in a 1991 poll of members of the American Institute of Architects, it was voted “the best all-time work of American architecture.”

The building is a supreme example of Frank Lloyd Wright's concept of organic architecture, which promotes harmony between man and nature through design so well integrated with its site that buildings, furnishings, and surroundings become part of a unified, interrelated composition.


Case Study Focus: Building's connection to site & similar footprint
Process Case Study: Andy Goldsworthy

Profession: Sculptor, Photographer, Environmentalist

Born: July 26, 1956, England

About:

Few contemporary artists are as beloved as Andy Goldsworthy, an Englishman who specializes in constructing ephemeral works out of natural materials -- leaves, reeds, twigs, stones, ice, clay, petals, wind, water, gravity, darkness, light. Making them all the more special, many of his creations last only for hours or days, until wind, sun, or flowing water takes them away.

Goldsworthy creates what J. R. R. Tolkien called a “Secondary World,” made of the stuff of the Primary World of nature but reshaped by imagination. “The mind that thought of light, heavy, grey, yellow, still, swift, also conceived of magic that would make heavy things light and able to fly, turn grey lead into yellow gold, and the still rock into a swift water,” wrote Tolkien. The artist who would create such worlds, he observed, requires an “elvish craft.” Elvish craft is what Andy Goldsworthy possesses in abundance.

Goldsworthy’s art reminds us how precious is the Primary World we are using up, paving over, chopping down, draining dry. He has no quarrel with modern civilization. What he asks for is a new alliance with the Earth, informed by science and technology, yet transparent to mystery -- a re-enchantment in the Tolkien sense. It is impossible to look at a Goldsworthy work -- a river boulder, say, wrapped in red poppy petals -- without feeling that one has entered the world of fairies: nature transformed by impish imagination.

-Information courtesy Chet Raymo, sciencemusings.com

Case Study Focus: Design methods
Christopher Alexander is an architect noted for his theories about design, and for more than 200 building projects in California, Japan, Mexico and around the world. Reasoning that users know more about the buildings they need than any architect could, he produced and validated (in collaboration with Sarah Ishikawa and Murray Silverstein) a "pattern language" designed to empower any human being to design and build at any scale. Christopher Alexander is now a professor emeritus at the University of California, Berkeley.

A Pattern Language: Towns, Buildings, Construction describes a practical architectural system in a form that a theoretical mathematician or computer scientist might call a generative grammar. The work originated from an observation that mathematician or computer scientist might call a generative grammar. The work originated from an observation that

**Case Study Focus:** Analysis of Building & Site

**Case Study:** Christopher Alexander

**Profession:** Architect

**Born:** October 4, 1936, Austria
Process Case Study: Steven Holl

Profession: Architect

Born: December 9, 1947, U.S.

About:
The success of Steven Holl’s architecture derives from his sculptural shapes, his watercolor imagery, his interest in the poetics of space color, and material, as well as his fascination with scientific phenomena. His work refers to urban history and the potentials of modern science.

“It is precisely the realm of ideas - not of forms or styles - that presents the most promising legacy of twentieth-century architecture. The twenty-first century propels architecture into historical languages. Modern life brings with it the problem of the meaning of the larger whole. The increased size and programmatic complexity of buildings amplify the innate tendency of architecture toward abstraction. The tall office building, the urban apartment house, and the hybrid of commercial complex call for more open ideas more imaginative organization of a work of architecture. Organization of overall form depends on a central concept to which other elements remain subordinate.” – Steven Holl

-Information & photos courtesy of Holl, Written in Water

Case Study Focus: Watercolor Techniques
Program Case Study: Center for Advanced Studies and the Arts

Location: Oak Park, Michigan

Grades: 11-12

School Size: 40,000 sq. ft.

School Capacity: 400 students


CASA is a cross-district consortium program that includes partnerships with six different neighboring districts. High school students who participate in CASA study many unique classes not usually available in traditional schools, including dance, sculpture, Japanese, Russian, philosophy, or advanced placement statistics, world mythology, debate and forensics, global issues, and computer networking. CASA also offers eight Advanced Placement classes through which students can earn college credit. Students attend CASA in the afternoons after morning instruction at their home-base school and are able to receive outstanding instruction within CASA's diversified setting.

The CASA concept was born in the 1980's out of a desire to offer a larger variety of high level courses by high schools with limited funding. At the time, four classes were offered with an enrollment of 35 students. In 1986, Madison School District joined the consortium and in 1987, Clawson School District. By this time, 21 classes were offered and 280 students were registered. In 2001, The Lamphere Schools joined CASA, bringing the total to six participating school districts. Current enrollment runs between 370-400 students. Nineteen of the 41 courses offered at CASA are Advanced Placement, which enable students to earn college credit upon successful completion of the College Board Examination in May.

CASA is housed in the Jackson Center for Advanced Studies and the Arts, a centrally located facility in the City of Oak Park. Students may select to drive to CASA; however, bus transportation to and from CASA is available to those students wishing to use it. CASA moved to its new location in 2002. Still located in the City of Oak Park, the building belongs to the Ferndale School District. Seven rooms needed renovation; changing an elementary school to meet the demands of a high school program is not without its share of problems. Science rooms, computer rooms, art rooms, and another dance studio with a changing room were additions.

-Information & photos courtesy of casa-online.org & ferndale-mi.com

Case Study Focus: Program & Curriculum

Key:
A 102 - AP English Language & Philosophy
A 103 - AP European & U.S. History
A 104 - AP studio art & drawing
A 105 - Sculpture & AP 3-D Art Studio
B 102 - Dance studio
B 103 - Music Theory & Chamber music
B 104 - AP Geography
B 105 - Chinese
B 105 - Criminal Justice
C 102 - AP Psychology
C 103 - AP Comp. Government & Military
C 104 - Russian 1 & 2
C 105 - Japanese 1 & 2
D 102 - Forensics
D 103 - Comp. Religions & 60's Literature
D 104 - AP Statistics & AP Calculus
D 105 - World mythology
Media Center - AP Spanish & Intro to Ethics
E 102 - Genetics & Environmental Science
E 104 - AP Chemistry & AP Physics
Program Case Study: MAGGIE L. WALKER GOVERNOR’S SCHOOL

Location: Richmond, Virginia
Grades: 9-12
School Size: 150,000 sq. ft.
School Capacity: 1,200 students
School Started: 2001

About:

The Maggie L. Walker Governor’s School for Government and International Studies is a regional high school specifically for gifted students competitively selected from thirteen Richmond area school districts. The educational program is that of a comprehensive high school with a challenging curriculum focused on government and international studies. Drawing from an eleven-year history of innovative curriculum and teaching, the school embodies student-centered instruction: a true “Breaking Ranks” institution. It is a model for innovative teaching in the region, sharing successful methodology with the participating districts.

-Information & photos courtesy of designshare.com

Case Study Focus: Program & Curriculum
Program Case Study: NUS High School of Math & Science

Location: Singapore

Grades: 6-12

School Size: 444,00 sq. ft.

School Capacity: 1,200 students

School Started: 2005

About:

A first of its kind high school in Singapore to be developed and managed by a University, which aims to provide a stimulating environment for students with special aptitude in mathematics and science. This project marks a critical milestone in the development of schools in Singapore as it transcends beyond just the physical design of a school campus; it is about setting a new paradigm, an inspiration for a new era of learning.

Capitalizing on topography: A mid-level planning strategy: The design creatively takes advantage of the sloping terrain using a mid-level strategy. The main entrance is located on the third storey, thereby reducing the scale of the six-storey building, making it appear only four stories from the street. Large communal facilities such as the library and canteen are tucked under one end of the track and field, freeing up valuable ground space for other facilities within a very tight site. The Concourse is the main circulation thoroughfare and it is the organizing element from which three learning clusters branch out. In line with the mid-level strategy, all science laboratories are clustered and strung along the concourse on the third storey, same level as the entrance. This creates a datum within the campus and reinforces the importance of science within the curriculum.

Transmitting knowledge: School as a three-dimensional learning tool: The design philosophy envisions the building components of the school taking on the role of teaching tools. This concept explores the innovative use of elements abstracted from scientific and mathematical concepts, which are then integrated into the total built form. Many concepts were explored in the design of the school. Ideas include extracting the dynamic form of a double helix from the structure of DNA, and interpreting it into the form of an abstracted ‘nano tube stairway’ at the entry lobby. The main entrance ‘Periodic Facade’ was designed as an abstract version of the periodic table, with different parts of the elevation relating to different groups of elements. The “Pi Wall” defines the edge of the main concourse facing the track and field. It is derived from the mathematical concept of Pi, and consists of a mosaic of rectangular perforated aluminium panels that are translated into the decimal digits of Pi through a number-coded color system. The Eco-Learning Trail allows students to learn about natural habitats and natural processes. It meanders its way through the courtyards in-between teaching blocks, along the main concourse. The aquatic and eco systems, flora and fauna provide students with real life examples, enriching their total learning experience.

Fostering community: School as a social hub: The master plan aims to create a student-focused campus that is inter-connected and conducive for student interaction. Designed as an open campus, clear zoning between Academia, Living and Sports ensures proper passive security and safety. The school and hostel are distinct yet connected. The canteen and library are co-located to form a social arena. The landscaped courtyards of the eco-learning trail soften in-between spaces and encourage spillover activities.

Supporting learning: flexibility: Flexibility is integrated into the design of high school in order to support learning and accommodate changing pedagogies. The Concourse is designed as an open-concept, flexible space that can accommodate a variety of uses ranging from exhibition gallery, study corners, learning pods, science fairs and mathematics Olympiads. Classroom blocks are arranged in clusters to facilitate organization by grade levels, department or multi-disciplinary. Individual classrooms are also designed to allow different layout configurations to accommodate different modes of learning.

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Case Study Focus: Program, Concept & Curriculum


