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Open-Ended Learning

A survey of outstanding K–12 schools underscores the compelling ways that architects and designers respond to the changing nature of education today.

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The explosion in school construction in recent years to meet the demands of a post-9/11 baby boomlet has forced a fundamental shift in how we approach K–12 schools. For architects, this new thinking—with its call for project-based learning, an increased role for technology, and more sustainable and socially responsible institutions—has resulted in more flexible spatial configurations, integrated break-out and project rooms, and better connections between the indoors and out. For example, the Nueva School, in Hillsborough, California, designed by Leddy Maytum Stacy Architects, with some curriculum developed by IDEO and the Stanford d. School, has students growing food and learning from the building itself, extending the school's role into the wider community. We asked eight leading design firms to submit a recent K–12 school project that featured an innovative approach, application, or idea. Their responses—wind turbines, green roofs, using a building as a teaching tool, and something the architects call “ad hoc urbanism”—illustrate how changes in education are affecting the design of schools today, providing a new blueprint for the classroom of the 21st century.

Hillsborough, California / Leddy Maytum Stacy Architects

[THE NUEVA SCHOOL](#)

Innovation: Building as teaching tool

Students at the Nueva School grow vegetables, tend chickens, and build tree forts in the forest surrounding the campus. Those lessons carry into the classroom, where 392 gifted San Francisco Bay Area children—from pre-K through eighth grade—are taught how to be good stewards of the environment. When an institution like this one sets out to build an expansion, it's almost a foregone conclusion that the results will be sustainable. But as Leddy Maytum Stacy Architects went about constructing its LEED Gold design, something more interesting developed: the building became a part of the curriculum, with the teachers crafting learning exercises around the solar panels, living roofs, and water-conservation systems.

The new 27,000-square-foot complex—a classroom building, a library, and a student center—is tucked into a slope on the site. “We found opportunities to engage the hillside and to connect to the natural world as you move through the space,” says William Leddy, a partner in the San Francisco–based firm. The naturally ventilated interiors feature huge windows, ceiling fans, and radiant-floor heating, while a manmade creek bed in the plaza collects rainwater and runoff for irrigation. The most distinctive feature of the design, however, is the network of screens that forms canopies and a porous facade. “We were looking for a way to control daylight,” Leddy explains.

“We also wanted to find a use for the giant cypress trees on-site that were dear to the children.” In addition to the multifunctional screens, the kids now experience those trees as handrails and benches, a solution Leddy relates is now as popular as it is efficient. Still, he says, “There was a moment when I thought the students would chain themselves to the trees and mount a major protest.”—KC

New York / Rafael Viñoly Architects

[LEARNING LANDSCAPE](#)

Innovation: Green roof as living lab

Adlai E. Stevenson High School, in the Bronx, might be breathing a little bit easier in the coming years with the



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THE NEUVA SCHOOL

Using the natural slope between the new cafeteria (the semicircle in the aerial photo, next) and the classroom and library buildings (which form a V), the architects created a stepped plaza (above) that doubles as an amphitheater.

Timothy Griffith



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THE NEUVA SCHOOL
Steve Proehl/courtesy Leddy Maytum Stacy Architects



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THE NEUVA SCHOOL
In the Innovation Lab (above), students learn how to design products and create prototypes, with input from the staff at IDEO and Stanford University's engineering faculty.
Timothy Griffith

help of Rafael Viñoly Architects. The firm's concept to retrofit 20,000 square feet of the school's roof with a modular green roof would be an asset to the environment as well as a resource for students. The green roof sprouted from Ned Kaufman, the director of the firm's architectural-training and research programs, and Joseph Hagerman, its 2005–2006 research fellow and a Metropolis Next Generation winner. It blends technological innovations in everything from the roof membrane to the soil, and still remains light enough not to overburden the existing structure.

The new curriculum, created by the Salvadori Center, an organization that enhances the teaching of the arts and sciences with the built environment, would include outdoor experimentation on the roof. Equipment for recording temperatures and rainwater can teach students as well as provide valuable information to re-searchers and scientists. "The roof would serve the community and bring many different interests behind a common goal," Kaufman says.

Widespread implementation of this learning laboratory would have an especially significant environmental impact in the South Bronx, a community plagued by high asthma rates. Unfortunately, the project is currently on hold due to a lag in fund-raising. "This contains the perfect criteria of an economic-stimulus package," Kaufman says. "The project is shovel ready, it has a large reservoir of donated services, and should be a flagship project for Mayor Michael Bloomberg's PlaNYC." —RG

Doha, Qatar / RMJM

[THE AMERICAN SCHOOL OF DOHA](#)

Innovation: Solar shading

Siting the new American School of Doha was problematic at best. "Because of the available land and the need to put a 400-meter outdoor running track on the site, the leftover rectangle faced pretty much due west, which is the wrong way to face when you're in that part of the world," says Nicholas Garrison, of RMJM's Global Education Studio.

The architects used two strategies to counteract the desert climate. First, they designed and positioned the school so that large portions of it were mostly unaffected by the intense afternoon sun. Second, they devised dramatic, tentlike shading devices on the facade that reference the nomadic history of the Bedouin culture. "Sunscreens panels were put in either vertically or horizontally, depending on the solar condition," Garrison says. "Those are all over the building. Sometimes you see them as vertical screens with a kind of Islamic pattern; sometimes you see them as horizontal fins. The form giver for the school was the path of the sun throughout the day."

The building serves middle and high school students and does not feel like a traditional educational environment. Most of the large, flexible classrooms are L-shaped, not rectangular. "Some of them have tapered corners," Garrison says. "Some of them have little nooks and crannies within the rooms themselves." The public spaces look a bit like hotel lobbies. "The director's mantra was, 'I don't want bells and cells.' His way of saying, 'No long hallways or boxy classrooms.'" —MP

Dallas / Perkins + Will

[HECTOR GARCIA MIDDLE SCHOOL](#)

Innovation: Elevated public spaces

For the Hector Garcia Middle School, in Dallas, the architects at Perkins + Will were given a tight 13.4-acre site on which to include not just a building large enough for 1,200 students but also space for numerous outdoor tracks, courts, and fields. After accommodating these extracurricular areas, "The footprint of the building got much smaller," says Patrick Glenn, a senior designer at the firm. "It was the outdoor planning that definitely shaped the way we arranged and zoned the school."

The 175,000-square-foot, LEED-certified public school, located near the business district, is a three-story glass, steel, and brick structure that eschews the standard educational practice of locating communal spaces—library,

gymnasium—on the first floor. Instead, the architects placed them on the second floor to create a more unified building. The special-education program is also located on the second floor, giving its students better opportunities to socialize with the rest of the student body in the central hub. With the added benefit of public access to these spaces for night courses, the school has quickly become a beacon of activity in this reenergized urban community. —RG

Los Angeles / Daly Genik

[CAMINO NUEVO CHARTER ACADEMY](#)

Innovation: Ad hoc urbanism

In 1998, when Kevin Daly was tasked with designing a school in one of Los Angeles's densest neighborhoods, the architect repurposed a failed mini-mall, transforming it into a bright 12-classroom elementary school focused around a courtyard. The building was extended to widen upstairs passageways (allowing natural light into the classrooms), a parking lot was converted into a playground, and a latticed structure was added to shade the school.

The success of the project led the Pueblo Nuevo Development, a nonprofit grassroots effort founded by Philip Lance, to collaborate with Daly on two more educational buildings on the same block. A middle school was cobbled together from a converted warehouse and an abandoned office building, and a shared preschool and nonprofit dance studio were created out of another warehouse. (The firm also completed a nearby 500-student high school made from a converted industrial building.) "From an economic and sustainable standpoint, letting those supernormative building types continue to exist means you're not really changing the crappy backgrounds that basically make up most of Los Angeles," Daly says. "Rather, you're just accepting them but also changing them as much as you can."

This type of ad hoc urbanism gives the clients—low on funds but high on ambition—a pay-as-you-go expansion plan. The strategy allowed the charter school to transform a "pretty grimy" block into an educational one, and let it anticipate change over a long period rather than just during the moment of capital allocation. "It's also proof you can do it without the \$20 million you need to buy the block outright—a lesson that the big school districts out here have not learned." —PM

Shey, India / Arup Associates

[DRUK WHITE LOTUS SCHOOL](#)

Innovation: Holistic design educates students and architects.

For the past decade or so, Arup Associates has been involved in developing a set of educational buildings for the north-Indian village of Shey, in the remote Ladakh region of the Himalayas. The project marries local materials, such as granite, timber, and mud bricks, with traditional building methods and Arup's expertise in environmental engineering—a crucial need in this climate of extreme temperatures and limited water resources.

The earthquake-resistant buildings draw on the iconography of local monasteries, relying on eco-sensible moves such as smart orientation, natural ventilation, solar panels, and Ventilation Improved Pit dry latrines, a low-tech method of renewable sanitation that uses heat from the sun to drive a natural ventilation system, thereby avoiding the use of water and reducing smells and insects. (The waste, in turn, is used as fertilizer.)

What started out as a nursery school for 86 children will eventually grow into a complex with education facilities for up to 800 pupils, a health clinic, a library, an open-air temple, a computer and science lab, vocational workshops, a dining hall, and residential accommodations for pupils and staff. "There is so much we learned from working with local people and artifacts," says Michael Beaven, the principal at Arup who leads the project. He sees it not only as a design and construction triumph but also as a long-term collaboration with the people and culture of Ladakh. "We learned an enormous amount through direct feedback with the school, year after year after year. And we've directly used that experience on our projects in the West by integrating and learning the process of communication, so that we're much better at gauging how occupants use and get the best benefits from our

buildings.” It’s a process he believes requires great humility: “The school has taught us to be passionate about making our designs really work.” —PM

Greensburg, Kansas / BNIM architects

GREENSBURG SCHOOLS

Innovation: Renewable energy

On May 4, 2007, a 1.7-mile-wide tornado struck the west-Kansas town of Greensburg. The hamlet had already seen its population dwindle to about 1,500, but this calamity threatened its very existence. In the immediate aftermath of the storm, the office of Governor Kathleen Sebelius contacted Bob Berkebile—a founding principal of BNIM Architects, in Kansas City, Missouri, and a leader in the green-design movement—and enlisted his help in rebuilding Greensburg. The town has responded in kind: in 2007 the city council mandated that all public buildings larger than 4,000 square feet attain LEED Platinum certification.

As part of that effort, BNIM is currently designing a new building that will combine Greensburg’s three schools into a single K–12 institution. The \$49 million, 130,000-square-foot project, scheduled for completion in September 2010, will have a slew of sustainable features, including rainwater harvesting, recycled and reclaimed materials, daylighting, energy drawn from a municipal wind farm, and an on-site turbine to supply a quarter of the electrical load. The first initiative, however, was a planning move. “Two of the sites they were considering were not closely connected to the core of the city,” says Casey Cassias, a principal at BNIM. The architects suggested an alternative location on Main Street, one that would serve as an anchor for the community. “They were willing to take that risk even though it meant putting the new building on top of the old high school’s football field, taking away a touchstone to the past.” —MP

Toronto / Baird Sampson Neuert Architects

THOMAS L. WELLS PUBLIC SCHOOL

Innovation: Creative financing through sustainability

Six years ago, faced with draconian budget restrictions, the Toronto District School Board got creative about funding new facilities. It needed to build a primary school in the Scarborough neighborhood and decided to go green, leveraging future energy and maintenance savings against the up-front construction costs. “This was to be a model that would provide the board with the information they would need to design subsequent schools,” says Barry Sampson, a partner at the Toronto firm Baird Sampson Neuert Architects, which landed the job.

Although, at \$12.6 million, BSN’s design was more expensive than a comparable conventional building, it favored low-tech, off-the-shelf strategies such as passive solar harvesting over pricey high-tech alternatives, with a projected payback of the added investment in just 15 years. The H-shaped structure orients classrooms toward the south, floods the interiors with sunlight, and maximizes access to green space, but its savviest feature is the heating and ventilation. BSN’s solution ingeniously combines a differential-pressure system, in which air enters low vents, heats up, and rises through return-air ducts that capture and extract lost heat. Because air comes in from the interior side of the rooms and passes over radiant flooring before exiting by the windows, the process is remarkably efficient, making large expanses of glass viable even in Toronto’s cold climate.

Completed in 2005, Thomas L. Wells, Canada’s first LEED-certified public school (earning a Silver rating), has been a success by every measure. Last year it consumed 40 percent less energy than a traditional building (5 percent better than projected). Best of all, Sampson says, “Principal Ruth Jory volunteered that the fact that test scores improved significantly from one year to the next is indicative of a good learning environment.” —KC

Fun Facts:

In the fall, nearly 50 million students headed off to about 97,000 public elementary and secondary schools.

Before the school year is out, reports the National Center for Education Statistics, an estimated \$489 billion will be spent on their education.

In 2006 and 2007, according to the National Center for Education Statistics, 38.3 percent of American students attended schools in suburban school districts. City school districts served 30.4 percent, rural schools 18.9 percent, and town school districts 12.4 percent.

The United States currently has approximately 126,000 schools for grades K–12. The U.S. Green Building Council reports that about 1,000 of them, both public and private, have now registered for or achieved some level of LEED certification.

A 1999 study of more than 21,000 students by the Heschong Mahone Group found a strong correlation between daylit schools and student performance—including 20 percent faster progression in math, and 26 percent in reading.

In 2007, according to the National Center for Education Statistics, there were 3,940 charter schools, comprising more than 4 percent of all public schools in the United States.

Also, be sure to check out [IDEO's Ten Tips For Creating a 21st-Century Classroom Experience](#) from this month's issue of *Metropolis*.

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