Exploring Six Principles of Sustainable School Design

By Randall Fielding, Chairman, Fielding Nair International, Architects and Change Agents for Creative Learning Communities

The science of ecology provides us with a marvelous framework for understanding sustainable school facilities. Just as ecosystems in nature are sustained by the biodiversity within them, high performing schools support a diversity of learning modalities with a wide variety of spaces and building systems. Six guiding principles of ecology can also be applied to school design in order to create sustainable facilities: Networks, Cycles & Waste, Flow, Partnerships, Diversity and Dynamic Balance. Each of these principles help us conceptualize some of the complex challenges in creating schools that not only reduce their impact on the earth, but also teach students about ecological systems.

Beyond this framework, there’s an even broader concept that covers and unites these principles, and that is the strong link any school facility has to the curriculum taught inside it. The traditional school model is one that’s no longer sustainable, since it was designed to teach one way and produce a particular sort of graduate, primarily an industrial worker. Today, schools need to do more, to facilitate individualized learning in multiple ways, and assist students to become global citizens with strong problem solving and creative skills. Let’s see how the six principles can create sustainable schools, and support 21st century learning at the same time.

1. Networks
There is a network of energy that flows between the sun, rain, earth, plants and animals. Similarly, there is a network of city streets, technology, capital and knowledge within society and our schools—creating schools with more permeable boundaries for allowing these resources in and out should be the goal of every educational system. Sustainability can be achieved through the use of shared resources within the community and with the greater world, by leveraging amenities like libraries and athletic facilities with global assets like high-level challenges and programs conducted on the web.

On the right, a concept design for the North Central Shared Facility in Regina, Saskatchewan combines an educational facility with a health center, fitness and performing arts center, police services, library and childcare center. This community hub is centered in a challenged neighborhood, and provides not only services, but also opportunities for internships and mentorship in the businesses on the campus site. This facility is a perfect model of a healthy network, both in its creation and usage.

2. Cycles and Waste
By-products from one organism become nutrients for another—there’s no net waste in nature. How much non-programmed, wasted space is in a traditional school of classrooms connected by hallways? Circulation requires 20 - 25% of a typical school building, yet halls are used
only to move people during transition periods, not for learning. Fielding Nair International designs schools based on the learning community model, which divides a school into smaller units clustered around a commons area; this learning space contains few hallways, and most of the space is used for educational purposes. Schools can be made with a smaller footprint, and the cycles of learning in them become both more human in scale and less wasteful.

Harbor City School in Duluth, Minnesota was designed with a learning community on each floor of a city building. As you can see in the diagram, there are no hallways, and all the space is used for learning. Recycling an existing building and creating an efficient space inside is a sustainable practice that doesn’t waste a building, but retrofits it.

3. Flow

Nature flows through the seasons, during the life cycle, the way energy moves inside a living being. Just as we can harness nature’s flow to create energy, as we do with hydro-electric plans and wind turbines, we can also use flow to passively heat or cool an educational facility. As stated by Energy Star, a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy, “America’s schools spend more than $7.5 billion annually on energy—more than they spend on textbooks and computers combined. Energy costs are the largest operating expense for school districts after salaries and benefits, and in recent years those costs have increasingly strained their budgets.”

Lighting in schools uses nearly the same amount of energy as heating and cooling. Ample day-lighting not only reduces the need for energy, it’s beneficial to students and increases their learning ability. Data shows that day-lit schools have improved their verbal test scores by 26%, and math scores by 20%; more windows and access to light also improves school attendance in general.

Flow of the sun: When building a new facility, positioning the building in orientation to the sun increases day-lighting, and can also reduce energy costs in warmer climates as well.

4. Partnerships

Living organisms and their environments co-evolve. As the oak tree develops, so does the life on the surrounding forest floor. Other trees are impacted by the oak’s need for light and water. Animals that depend on acorns for food also enable the oak’s progeny to continue the cycle of life. Even cells form partnerships, becoming permeable when it benefits them and closing off when it doesn’t. One could say that nature is nothing but a series of partnerships, and couldn’t exist at all without them.

Schools should co-evolve with the residential, civic, business and global communities that they’re a part of. A sustainable model is one where the assets of an entire system can be shared in turn, where space is
never wasted, not heated, cooled or lit without occupancy. FNI is currently planning three schools in San Antonio, called Inspire Academies, and we’re designing them on a site that’s within a mile of a community park. The park has a beautiful swimming facility, athletic fields and indoor basketball courts. So rather than building a gymnasium on the school campus, a partnership with the community facility will enable the academy to share this local resource during the school week when the park sees little use.

At Jackson Elementary School in Medford Oregon, the commons and meeting rooms near the entrance are used by the local community as meeting and performance spaces after hours, creating a social hub for the immediate neighborhood.

5. Diversity
A lake is stable because of a diverse set of relationships—it might derive water from a stream, rain and runoff. One of the tenets of ecological health is that the more varied a system is, the more it will be successful. The same holds for schools. Parental involvement, leadership from vibrant educators, and strong state support all contribute to a school’s stability.

A variety of spaces, rather than one kind of classroom space, is another form of stability, since a more flexible space has a longer future than one that is rigid, like a traditional classroom. Sustainability in school facilities is manageable when enrollment can be adjusted more readily, and varied spaces can be more agile. Accommodating change is critical for a school system; new curriculums and the rise and fall of enrollment is more easily managed when the district buildings can adjust to the number of students without expensive modifications. FNI designs schools that function effectively even if the student count increases or decreases by 30%.

Each building at Sinarmas World School contains a commons large enough for the whole student body to gather in. Portable furnishings create a diverse system that expands the capability of the area. Storage is easily accessible, allowing the space to be also be used for art classes, performances and dining from a portable food station.

6. Dynamic Balance
Drought and flood, light and dark, feast and famine; both natural and human systems are in a continuous state of flux. The ecologist Fritjof Capra says, “All ecological cycles act as feedback loops …the ecological community regulates and organizes itself, maintaining a state of dynamic balance characterized by continual fluctuations.” Innovative schools not only adapt to the “feast or famine” of enrollment, they provide for a more dynamic curriculum than traditional schools typically do. In the teacher-centric lecture modality, learning is imparted in one direction, from the teacher to the class.

In contrast, during a day in a 21st century school, a student might move from modality to modality, from a presentation to a small group
project, to independent study, all within a proximate space. Individualized programs provide the feedback, and enable a student’s dynamic progress to be evaluated in a feedback loop.

The diagram at the bottom shows features that are carefully designed to balance the effects of sun and prevailing winds, using tree breaks and berms to block wind and window positions to maximize the sun exposure in the extreme northern climate experienced by Douglas Park School. In addition, green roofs insulate the facility and solar panels heat the water in the building.

Outdoor areas on a school campus can be used for more than recreation. At this grade school in Medford, Oregon, an outdoor learning space is often used for messy projects or science experiments, and allows students to get fresh air and exposure to sunlight at the same time. Balancing indoor and outdoor time is important for students, particularly in the lower grades.

### Beyond the Six

The six principles of Networks, Cycles & Waste, Flow, Partnerships, Diversity and Dynamic Balance illustrate the need for sustainability to mean more than a Net-zero or LEED approved school building or campus. 21st century learning should replace the old curriculum model just like infrastructure should be updated to meet the evolving needs of our society. The link between facilities and human endeavor are clear—agile buildings help create agile people, ready to solve the sustainability issues that will challenge our planet in the future.

With consultations in over 41 countries, Fielding Nair International is the global leader for educational facilities planning and architectural design. FNI designs schools for today and tomorrow with one primary goal in mind: to improve learning.

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**Sustainable Strategies for Douglas Park School**

![Diagram of Douglas Park School](image)

- **Green Roof**: Intensive green roof reduces harmful runoff from roofs into the environment. Green roofs also act as great insulators, reducing heating loads. Green also offers opportunity for students to learn about indigenous plants, and gardening as the maintain the roof.

- **Maximize Windows to Southern Exposure**: All Personal Learning Communities face south with generous windows to allow the warmth of the sun in, and reduce the need for artificial lighting.

- **Coniferous Tree Wind Break**: Protects playfields and parking from storm and strong seasonal winds from the northwest.

- **Bike Racks**: Encourage a healthy transportation options and reducing fossil fuel transportation.

- **South facing Solar Collectors for Solar Water Heating**: South facing roof of the second floor could be ideal for placing collectors to use the sun’s energy to heat water.