

*School leaders are using
their buildings to provide
students with lessons about
sustainability*



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Teaching Green

Sustainability is no longer purely an architectural concept

in the design of contemporary K-12 school buildings. It has evolved into a sophisticated educational tool supporting specific curricula for students at many different levels.

Numerous sustainable technologies are being used in schools, ranging from geothermal, ice storage, and heat recovery systems to photovoltaics and daylighting. Each has the potential to be incorporated into school curricula. The challenge for school facilities managers is to include this technology in a way that students can observe it at work and collect data from it for class discussion.

You can ask your architect for programs he or she has seen work, or make up your own by assessing how your facility can educate your students. Find the educational tools in your school building and grounds and create lesson plans based on how your building functions.

Solar energy and daylighting

Since 2003, 50 K-12 schools across New York state have installed two-kilowatt (KW) photovoltaic systems to generate electricity for school buildings. The solar energy and data collection systems are typically installed on roofs. Funding for the program comes from the New York State Energy Research and Development Authority (NYSERDA), which required the schools to contribute only \$1,500 toward the \$24,000 systems.

Each system, which is designed with classroom work in mind, includes a photovoltaic array that collects sunlight and converts it to direct current (DC) electricity. A device called

an inverter, which converts the DC electricity into alternating current (AC) electricity, is connected to the school's electrical system.

The teaching opportunity lies in the data collection. Students, faculty, and interested community members can monitor the system's daily and cumulative production of electricity. Anyone can monitor the data from any of the 50 schools by logging on to the NYSERDA website at www.powernaturally.org.

The reduction of fossil fuel usage provides a relevant topic for discussion and related research. NYSERDA supplies multi-disciplinary curricula and lesson plans for grades five through 12 that match the state's education standards. The curricula discuss how a 2-kW system meets 25 percent to 30 percent of a typical home's energy needs, how solar electricity works, and why the energy it produces is clean, reliable, and inexhaustible.

Architects should design schools to take advantage of sunlight by orienting the buildings in proper relation to the sun. Research has shown that controlled daylighting and proper artificial lighting together improve the performance of students and teachers, along with their health and well-being.

Daylighting strategies often include auxiliary designs to control glare and heat from direct sunlight. Instead of adding cost to a design to provide exterior solar shading, encourage the architect to make those same overhangs and canopies pay for themselves. In other words, use a photovoltaic system as a

canopy above windows to provide shade and generate electricity at the same time.

Water resources

Most buildings must have a way to control storm water runoff. Some schools have turned this basic drainage requirement into an environmental learning opportunity.

At the Roy Lee Walker Elementary School in McKinney, Texas, the cistern used to collect rainwater running off the building roof has been designed to include a large glass tube. A red ball floats on top of the water in the tube, which has been installed at the front entrance to the school. As students arrive every morning, they can see the water level and how it has changed from the day before.

This measurement of water conserved is a simple visual tool that students easily understand. Rainfall data is used in various curricula, from science to geography to the history of climate change in the world.

Taking the idea a step further, many schools must collect runoff and direct it into storm water retention ponds. After five years, according to the U.S. Environmental Protection Agency, a storm water retention pond evolves into a wetland, making it an ideal tool for biology, environmental, and other science curricula.

In some instances, retention ponds can be designed to be near science rooms. Classroom doors could be added to provide direct access to hands-on environmental studies. In the case of a new school, science rooms and retention landscaping can be planned in tandem to provide the best water control along with access to the flora and fauna of a wetland ecosystem.

Different kinds of water must be managed in different ways. Storm water, gray water, and black water require careful handling. Gray water from sinks, showers, dishwashers, and other drains can be collected, filtered, and used for irrigation, toilets, and other applications. While architects long have believed that gray water might make a good lesson plan, few if any curricula are readily available for different grades and courses.

Surprisingly, black water (waste water from toilets) has received more attention from the education community. Some schools, for instance, are working with a biological technology called the Living Machine, a natural ecosystem housed in a greenhouse-style structure. Living Machine technology—microorganisms, snails, fish, basic plant life, and other components of an ecosystem—can process black water from buildings and eliminate organic pollutants.

Once treated, water is returned to natural streams, water tables, and possibly the local water supply for reuse. Information about the Living Machine and its processing capabilities can be a resource to develop lesson plans, entire courses, or even a path of study in centers for higher education.

Treasured trash

Schools can offer examples of recycling and composting every

- **Alliance to Save Energy:** www.ase.org/greenschools
- **American Electric Power's Solar Schools Project:** www.aep.com/environment/solar
- **Energy Quest:** www.energy.ca.gov/education
- **Energy Smart Schools:** www.eren.doe.gov/energysmartschools
- **Maryland's Solar Schools Program Plan:** www.energy.state.md.us/executiv.htm/Plan
- **Online Renewable Energy Education Module:** <http://solstice.crest.org/renewables/re-kiosk/index.shtml>
- **Solar Energy: A Science Unit for Intermediate Grade Students:** <http://alpha.fsec.ucf.edu/ed/solar-unit>
- **Solar Quest:** www.solarquest.com
- **Solar Schools:** www.eren.doe.gov/solarschools
- **Training Student Organizers Program:** www.cenyc.org/HTMLEE/mainee.htm
- **Watts on Schools:** www.wattsonschoools.com

day in the cafeteria. Students who have finished their meals could proceed through a line, dropping food waste into one receptacle and trash into another. Food waste is sent to composting operations while trash is sorted and recycled.

Each of these activities can provide rich environmental benefit and even richer mental fodder for lesson plans. Composting teaches basic biology, agriculture, and more while recycling lessons teach about the scarcity of our natural resources.

Measurement is the key to transforming building components, processes, or procedures into tools that teach about sustainability. NYSERDA's photovoltaic systems include meters that measure the creation of electrical power. The graduated cisterns that capture storm water runoff provide data about rainfall amounts.

The Living Machine uses devices to measure impurity levels in black water entering the system and compares them to measurements of water leaving the system. You also can measure the effect of the water's nutrients on the organisms.

Recycling and composting systems also provide statistical reference points. How about a sign, for instance, comparing the energy required to make aluminum from bauxite ore to the amount of energy to recycle an aluminum soda can? The difference is worthy of a lesson plan.

School buildings and the everyday activities they support offer many opportunities for illustrating sustainable building systems. All you need is the added thought process to determine how to incorporate them into the curriculum. It's another example of how architects should and can collaborate with the administration, teachers, and students to design sustainable schools and develop creative strategies that support your district's educational goals. ■

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