At the Michael E. Capuano Early Childhood Center of Somerville, daylighting techniques are employed to illuminate this hallway.

High-performance green school buildings provide enhanced learning environments, reduce operating expenses, and reduce negative impacts on the natural environment.
As communities face the prospect of building new schools or renovating existing school buildings, many are considering high-performance green schools. A high-performance green school provides three key advantages over a typical school:

- an enhanced learning environment for students and staff,
- decreased operating costs, and
- reduced impact on the natural environment.

The Renewable Energy Trust, a division of the Massachusetts Technology Collaborative (MTC), provides grants and other support to encourage high-performance green school design and construction at schools throughout Massachusetts. The Massachusetts School Building Authority (MSBA) offers up to an additional 2 percent reimbursement incentive for school districts that demonstrate green building excellence and have their school project certified as a Massachusetts High-Performance Green School.

The Trust and the MSBA are working together to inform school districts of the benefits of high-performance green schools and available resources. Learn more about green schools in this brochure, and by visiting www.masstech.org/greenschools.

An MTC-sponsored study that compared the incremental costs and financial benefits of green schools versus traditional schools found that green schools are highly cost effective. Read the study at www.masstech.org/greenschools.

Grounds and building of the green Dedham Middle School
High-performance green schools have enhanced learning and working environments with features such as:

- lighting techniques that use natural indirect light and high-efficiency, low-glare lighting fixtures, which provide uniform light.
- carefully designed heating, ventilation, and cooling (HVAC) systems that improve the indoor air quality and comfort for students, teachers, and staff.
- use of sustainable technologies that offer energy-related learning opportunities.

Operating costs of green schools are lower because of features such as:

- energy-efficient, durable, technologically advanced building design that provides maximum insulation and requires less maintenance.
- efficient lighting techniques that reduce electricity use.
- high-efficiency HVAC systems that reduce fuel use and can be simpler and easier to maintain.
- water-conserving fixtures and systems that reduce the amount of water used and wastewater produced.

Green schools conserve important natural resources through features such as:

- smart site planning that conserves existing natural areas.
- reduction in energy and water use.
- renewable energy technologies that reduce the use of fossil fuels and lessen greenhouse gas emissions.

A 2006 National Research Council study identified the health benefits of green schools.

Read the study at [www.masstech.org/greenschools](http://www.masstech.org/greenschools).
Designing the high-performance green school is not “business as usual.”

Design choices for the school are guided by the Massachusetts Collaborative for High-Performance Schools (MA-CHPS) Green Schools Guidelines. The guidelines outline prerequisite standards and give the owners and architectural team design and technology options in six categories:

1. site considerations
2. water efficiency
3. energy and atmosphere
4. materials selection
5. indoor environmental quality
6. school district policies and operations

These design options are consistent with the best national practices for designing and building energy-efficient, sustainable, high-performance green schools. The MA-CHPS Certification Review Committee evaluates and scores each school design according to the MA-CHPS Criteria Scoresheet. Schools that earn high scores are then certified as Massachusetts High-Performance Green Schools.

The design process requires an active building committee that:

- sets performance standards early in pre-design and is committed to MA-CHPS.
- includes all community stakeholders.
- chooses a committed design team experienced with green buildings.
- focuses on the life-cycle cost of the building rather than focusing solely on first costs.
Massachusetts School Building Authority

In July of 2004, the Massachusetts Legislature created the Massachusetts School Building Authority (MSBA). The MSBA assumed the public K-12 school construction oversight and financing responsibilities for the Commonwealth and became MTC’s new partner in the Green Schools Initiative. In September of 2006, the MSBA Board of Directors approved new regulations for Massachusetts school construction that include certain mandatory green building elements such as commissioning and improved indoor environmental quality, plus optional provisions for schools to become certified as High-Performance Green Schools via the MA-CHPS Guidelines.

A school district must first submit a statement of interest to the MSBA. If the MSBA decides to engage further with the school district, then the district is invited to submit budget information, a facilities master plan, and educational program information. At this point, the school district may also indicate its resolution outlining the decision to design and build a high-performance school. Schools that design to MA-CHPS Guidelines and are certified as High-Performance Green Schools may earn additional MSBA reimbursements of up to 2 percent of the total project costs.

Massachusetts Technology Collaborative

The Massachusetts Technology Collaborative (MTC) administers the Renewable Energy Trust for the Commonwealth. The Green Schools Initiative is one of the Trust’s exciting programs. Building upon the success of pilot green schools projects and incorporating the lessons learned, the Trust offers the following services and incentives to school projects approved by the MSBA:

- outreach services for school committees, town meetings, and the school design team.
- “green team” support services to assist the design team with the integrated design approach and compliance with MA-CHPS.
- technical support for energy modeling, acoustics studies, and life-cycle cost studies.
- MA-CHPS Certification Review Committee services.

Schools that design to MA-CHPS Guidelines and are certified as High-Performance Green Schools can earn MTC grants for the installation of solar electric (photovoltaic) systems and/or wind electric systems. (The school project must be in an investor-owned electric utility territory.)
1. Site Considerations
MA-CHPS outlines environmentally responsible considerations to guide initial site decisions, such as investigating centrally located sites, which protect green fields and existing natural habitats and take advantage of existing infrastructure such as transportation networks and public parks. Orientation of a new building on an east-west axis will maximize daylighting opportunities. Careful siting of the building can reduce stormwater runoff during and after construction.

2. Water Efficiency
Basic water efficiency measures can reduce a school's sewer and water usage by more than 20 percent. Such a reduction lowers a school's operating expenses and benefits the environment, locally and regionally. MA-CHPS promotes the reduction of potable water use by 20 to 30 percent beyond the baseline required by the Massachusetts plumbing code. Water-efficient products, including automatic lavatory faucet shut-off controls, low-flow fixtures, water-efficient dishwashers, and waterless urinals, can help a school meet this goal. MA-CHPS also promotes reduced use of potable water by collecting and using rain water; selecting indigenous, drought-tolerant plants for landscaping; and avoiding permanent irrigation systems for non-playing field areas.

3. Indoor Air Quality (IAQ)
Excellent indoor air quality positively impacts student and teacher performance, and reduces absenteeism and health problems, such as asthma. A well-designed, constructed, and maintained building envelope that prevents penetration of water and outdoor pollution is critical to good occupant health and a long-lasting building. MA-CHPS addresses the importance of achieving good indoor air quality by requiring fresh ventilated air to be supplied to the classroom areas through ventilation systems that meet high standards. Good indoor air quality is also achieved by using non-toxic materials, controlling point sources of pollution, and establishing an IAQ management plan, such as the U.S. EPA's Tools for Schools plan.

4. High-Efficiency Heating, Ventilation and Cooling (HVAC) System
The HVAC system is one of the largest energy consumers in a school. Modest improvements in system efficiency can yield relatively large savings in a school's operating budget. MA-CHPS encourages the design of energy-efficient mechanical and electrical systems by requiring the school to be at least 20 percent more efficient than the Massachusetts building energy code. This can be achieved by installing high-efficiency heating systems, premium efficiency motors, efficient cooling equipment, and variable-speed pumps and fans. The school should be designed for an optimally sized HVAC and mechanical system with natural ventilation where appropriate. The equipment choices should be based on the life-cycle cost method.

5. High-Efficiency Lighting System
Well-designed lighting improves the visual comfort of students, teachers, and staff, while also reducing the facility's operating budget. Electric lighting can account for 30 to 50 percent of a school's electric power consumption. MA-CHPS design provides efficient, superior electric lighting by integrating complementary electric lighting and daylighting design strategies. The design team specifies high-efficiency lamps and ballasts, optimizes the number and type of light fixtures for each application, and incorporates dimming and occupancy sensors and lighting system controls.

Daylighting and high-efficiency light fixtures at the Dedham Middle School library reduce electricity use and improve visual comfort.
6. Daylighting
The use of natural light (daylighting) provides one of the largest returns on investment of any high-performance design element. Natural light is the highest quality light source for visual tasks, as it enhances the color and appearance of objects, improves visual comfort, and creates a superior overall classroom environment. Properly designed daylighting systems can substantially reduce the need for electric lighting. MA-CHPS requires the design team to use daylight modeling techniques to ensure proper building orientation, classroom location, and design of elements that provide natural light such as windows, clerestories, top lighting, light tubes, and roof monitors. Good daylighting design controls glare from direct sunlight and provides uniform light levels in each room with the use of light shelves, light-colored ceilings, and roof monitors.

7. Thermal Comfort
Thermal comfort is a function of the temperature and relative humidity in a room. Both hot, stuffy rooms and cold, drafty ones can reduce attention spans and limit learning and productivity. They also waste energy, adding unnecessary cost to a school’s bottom line. MA-CHPS ensures that rooms and HVAC systems are designed to allow temperature and humidity levels to remain within the “comfort zone” at all points in an occupied space. Allowing teachers some control over classroom comfort via temperature controls or by opening windows helps ensure a thermally comfortable learning environment.

8. Acoustic Comfort
Students’ concentration can be affected by noise from many different places—the outside, hallways, other classrooms, mechanical equipment, and sounds within the classroom itself. This can be especially problematic for students for whom English is a second language, those with special needs, and those with hearing impairments. MA-CHPS provides guidance on superior acoustical classroom environments through design strategies that limit transmission of sound from outside the classroom and minimize background noise.

9. Materials, Products, and Equipment
MA-CHPS emphasizes the importance of using environmentally preferable materials, which contribute to the health and well-being of occupants and are less harmful to the environment. Materials for a school construction project should have at least one environmental attribute, including salvaged material content, recycled content, bio-based content, or sustainable wood certification. High-performance school design also encourages the use of regionally produced/ harvested materials and Energy Star appliances.

10. Renewable Energy Technologies
Renewable electricity technologies, such as wind turbines and solar photovoltaics, can produce clean energy to offset a school’s operating costs. Producing renewable energy on-site lessens the environmental impacts of burning fossil fuels in power plants and reduces the dependence of the school upon these non-renewable energy sources. On-site renewable energy applications can also serve as effective components of school curricula, educating students on a wide variety of topics. MA-CHPS encourages the building committee and design team to consider renewable technologies through a feasibility study and early energy modeling. Investigation into available financial incentives and rebates at an early stage will help the committee’s decision-making process.

Solar panels at the Whitman-Hanson Regional High School offset electricity costs and provide renewable energy learning opportunities for students.
MTC Green Schools Initiative Pilot Schools

Ashland High School, 90 Concord Street, Ashland
Berkshire Hills Regional Middle School, 313 Monument Valley Road, Great Barrington
Centerville Elementary School, 17 Hull Street, Beverly
Blackstone Valley Regional Vocational Technical High School, 65 Pleasant Street, Upton
North Quincy Street Elementary School, North Quincy Street, Brockton
Holten-Richmond Middle School, 55 Conant Street, Danvers
Dedham Middle School, 70 Whiting Avenue, Dedham
Falmouth High School, 874 Gifford Street, Falmouth
Great Falls Middle School/Turner Falls High School, 222 Turnpike Road, Montague
MATCH Charter Public High School, 1001 Commonwealth Avenue, Boston
Melrose Veterans Memorial Middle School, 350 Lynn Fells Parkway, Melrose
Collicot/Cunningham Elementary School, 44 and 80 Edgehill Road, Milton
Newton South High School, 140 Brandeis Road, Newton Centre
Carlton Elementary School, 10 Skerry Street, Salem
Michael E. Capuano Early Childhood Education Center, 150 Glen Street, Somerville
Wachusett Regional High School, 1401 Main Street, Holden
William F. Stanley Elementary School, 250 South Street, Waltham
Whitman-Hanson Regional High School, 600 Franklin Street, Hanson
Williamstown Elementary School, 115 Church Street, Williamstown
Woburn Memorial High School, 88 Montvale Avenue, Woburn

MTC-funded Pilot Green Schools

75 North Drive
Westborough, MA 01581
Phone: (508) 870-0312
Fax: (508) 898-2275
greenschools@masstech.org