



sustain



Building the School of the Future

Discovery Brief 6: Building Better Learning Environments with Green Building Design



FAST FACT: If all new school construction and school renovations went green starting today, energy savings alone would total \$20 billion over the next 10 years.

A sustainable learning environment

The School of the Future is the result of an ambitious collaboration between Microsoft Corporation® and the School District of Philadelphia to construct a learning environment that addresses the needs of the 21st century learner in a 21st century world.

Our unique 162,000 square-foot, 750-student high school incorporates best practices of technology, new learning methodologies as well as a range of environmentally responsible design and construction features – indoors and out.

Our “green stripes” are integrated into the vibrant fabric of our academic community. The school uses natural lighting and emphasizes water conservation and recycling. Photovoltaic glass not only generates a portion of the building’s power supply, but also transmits real-time data for students so they can see how much energy is being generated.

The School of the Future offers an opportunity to connect learning to the outside world and to bring environmental issues to life in the classroom. Whether measuring the school’s solar-panel generation or studying wildlife in the adjacent wetlands, the School of the Future is in and of itself an inspiring and innovative teaching tool. Students have unique opportunities to see how the world and its life forms and resources are interconnected and how one action can have an effect on other people and the environment.

Green from the start

Because the School of the Future was built from the ground up as a new facility, our vision was green from the very beginning. Selecting the building site and then designing and constructing the actual school building to meet the educational and environmental needs of a changing world were integral planning decisions from earliest phases.

Microsoft and the School District of Philadelphia embarked on this journey of building the School of the Future on the shared belief that student and educators perform better in schools whose physical spaces are designed to inspire a “live and learn” appreciation and awareness of each person’s physical connection to the world and its shared resources.

Why Should All Schools Become More “Energy Smart?”

Consider these school facts and findings from the U.S. Department of Energy:

- Schools spend more on energy costs than any other expense except personnel
- A high-performance school doesn't have to cost more to construct than a conventionally built school
- High-performance schools can lower a school district's operating costs by up to 30%
- Energy is one of the few expenses a school can reduce without sacrificing educational quality
- Schools are central to the communities they serve and should reflect community values – like energy and resource conservation
- Schools are a great place to teach the nation's children about energy and resource conservation

“When the school district embarked on a partnership with Microsoft to build the School of the Future in 2004, many experts considered the project groundbreaking. The LEED Gold Certification clearly demonstrates the School of the Future is not only technologically advanced, but also environmentally friendly.”

Fred Farlino, Former Chief Operations Officer, School District of Philadelphia

A learning environment that protects and respects the physical environment

Environmental quality is essential to the long term well being of every person on the planet as well as the very planet itself. From site design to material choice, the School of the Future's physical structure and surroundings have been successfully guided by the principles of high performance “green design” to deliver maximum positive impact for our world.

Among these principles are energy and atmosphere conservation, water efficiency, materials and resource conservation, indoor air quality, and a healthier and more environmentally-aware approach to living that extends beyond the school's campus into the local community it operates in and serves.

LEED in green

The Leadership in Energy and Environmental Design (LEED) Rating System was designed by the U.S. Green Building Council to encourage and facilitate the development of more sustainable buildings. The School of the Future was evaluated according to this system and was one of the first schools to receive an official LEED Gold Certification award.

The LEED-certification recognizes that the School of the Future's building construction is safer for students and teachers and more environmentally friendly. The School District of Philadelphia and Microsoft were honored to be recognized for our successful strides in smarter building.

Schools that adhere to the standards of sustainable design delineated by the LEED rating system can expect an impressive range of benefits in student learning, teacher performance, operational efficiencies, community relations, and even reduce the facility's risk liabilities.

By being accessible and of service to the community, the School of the Future represents the community and instills a sense of pride which translates into people taking greater care to maintain and care for the school building for generations to come. One of the greatest benefits seen is in the school's attendance records. The average Philadelphia high school attendance is +/- 75% and this school's attendance average is over 90%. Better education and learning results are more easily achieved when students are in school.

Surrounded in green

An early requirement for the site selection of the School of the Future was to find a location to construct a state-of-the-art educational facility that respected and protected its natural surroundings. With a 21st century mission for making the most reasonable sustainable site design decisions, the School of the Future is a shining example of a learning environment built with the environment keenly in mind.

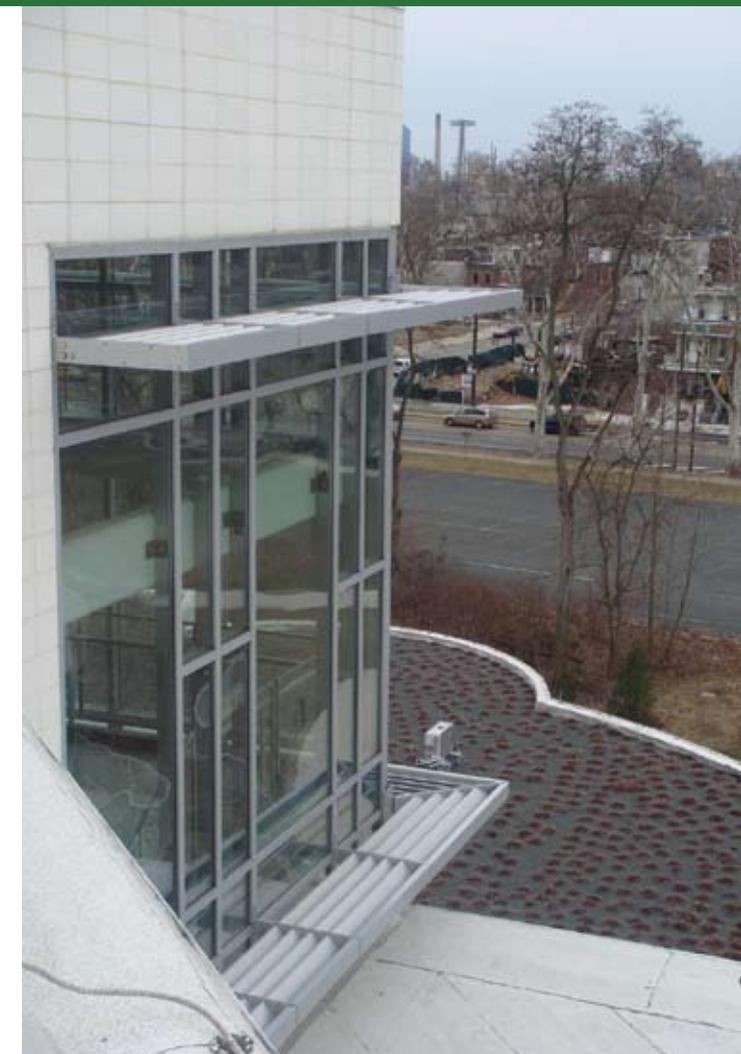
Our site location, covering seven acres in West Philadelphia's Fairmount Park, posed unique challenges to our architectural and construction teams because of its steep slopes and park setting and meeting the environmental sensitivity requirements involved with working on a site adjacent to the Philadelphia Zoo, residential neighborhoods, and wetland areas.

The School of the Future was sited and designed to reflect the tranquility of the natural setting and to take advantage of the park's natural beauty and its ability to promote individual learning and stimulate personal reflection.

Turning environmental challenges into conservation and learning opportunities, the School of the Future's expansive outdoor campus within an urban setting and its close proximity to the Zoo are “built-in” curricular tools for affording relevant ecological and environmental learning opportunities and connections.

To protect the natural amenities and restore the ecosystem whenever possible, great efforts were made to protect existing trees on the site and to ensure the reuse of trees that were necessary to cut down in other aspects of the construction project. Since the school's primary use is between the months of September and May, and the Zoo's busiest months are June, July, and August, the decision to share the Zoo's overflow parking area helped to mitigate the need for building a larger parking lot on the school grounds.

Two other significant decisions were made early in the design process in regard to conservation and the protection of the outdoor environment. The first was to eliminate the irrigation system in order to conserve water and gain additional LEED points. The other was to maintain a larger green footprint by incorporating brick pavers that allow for grass to grow while still providing the necessary emergency fire truck access to the school. This decision eliminated the need to pave a roadway around the entire building – saving money, time, and preserving the natural habitat.



Start now! Tip #1

Recycle used inkjet and laser cartridges. Enlist with a company that will provide you with prepaid shipping boxes and pay you to send them your school's used cartridges. Send less to landfills and make money for your school.



Covered in green

Without a doubt, School of the Future students are proud and intrigued to learn each day under the cooling shade of the green roof. With a \$116,000 grant from the Philadelphia Water Department, the School of the Future is not only “cool” but also cooled with the application of our 11,603 square feet vegetated green roof. This landscaped roof provides insulation, retains storm water in lieu of creating additional run off, and adds longevity to the roof system by blocking harmful ultraviolet light. The balance of the roof, approximately 85,000 square feet, is a reflective ENERGY STAR® roofing material.

ENERGY STAR Materials Built into the School of the Future

ENERGY STAR is a government-backed program helping organizations and individual consumers protect the environment through superior energy efficiency. Results are already adding up. According to the U.S. Department of Energy, in 2008, Americans, with the help of ENERGY STAR, saved enough energy to power 10 million homes and avoid greenhouse gas emissions from 12 million cars - all while saving \$6 billion.

According to research provided by the U.S. Green Building Council, students educated in green classrooms score as much as 20% higher on standardized tests and report fewer problems with asthma.



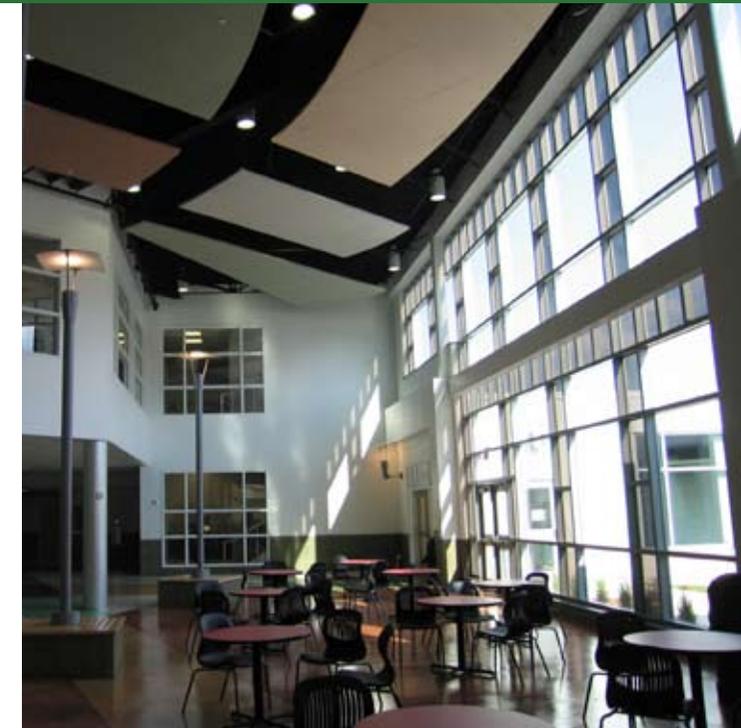
Learning in the light of day

A top priority of the design team was to construct a learning environment that truly lets the sun shine in and take advantage of natural site features such as wind, trees, and scenic green views. Learning classroom wings are oriented for north and south exposures to maximize natural light for most hours of the school day.

Ninety-three partially transparent building-integrated photovoltaic (BIPV) insulated windows installed in the school produce electricity from sunlight while allowing light to enter the building. As key components in the School of the Future's educational platform premised on innovative technology, the BIPV windows will teach students how solar electricity is produced and how architecture can be designed to be environmentally friendly and energy efficient.

Through energy and day light modeling, the School of the Future is sited to optimize daylight, energy use, mitigate the urban heat-island effect, and optimize sizing of heating, ventilation and air conditioning (HVAC) systems. These energy efficiency strategies combined with high-efficiency indirect fluorescent lighting and a well-designed building envelope have resulted in energy savings estimated to exceed current building codes by almost half.

Investments in optimal lighting are well spent as studies conducted on behalf of the U.S. Green Business Council demonstrate that student performance on math and language tests increase more than 25% simply through the implementation of natural lighting.



A green lesson on photovoltaic glass

What is photovoltaic glass and why is it such a valuable component of the School of the Future's green building design? Ask our most committed young “environmentalists” who've learned first-hand an important lesson on the benefits of this special glass, and this is what they'll explain to you in their own words:

Photovoltaic glass is a special glass with integrated solar cells to convert solar energy into electricity. This means that the power for a portion of the building can be produced within the roof and façade areas. The solar cells are embedded between two glass panes using the latest thin-film silicon technology, encapsulated in a module that is imbedded in an insulated glass panel to form a system which generates a direct electrical current when light shines on the cell.



Environmental and energy enlightenment in the classroom

The School of the Future's general classroom is designed to function as an excellent learning example of environmental and energy efficiency. Rejecting the traditional rows-of-desks forward-facing standard, the classroom spaces are flexible and adaptive to a variety of instructional methods, allowing a single room to quickly and easily change from a lecture setting to a circular discussion group format.

Averaging 800 square feet, each classroom features controlled daylight, consisting of sufficient natural light from windows, and supplemental artificial indirect lighting to reduce computer glare. By providing indirect lighting, the entire room, including walls, ceilings, floors, and desks, are showered with light which creates a visually more comfortable space and a perceived brighter environment. A classroom can be lit appropriately with 30 maintained footcandles, as opposed to the traditionally accepted 40 maintained footcandles, by using indirect lighting and, ultimately, saving energy. Windows were designed to accommodate exterior sunscreens at a specific height of the windows that effectively controls the light at southern building exposures. In addition, windows are equipped with interior shades that can be easily raised and lowered to prevent sun glare and diffuse the controlled daylight.

Footcandles are a unit of measurement used to calculate adequate lighting levels of workspaces in buildings or outdoor spaces. Footcandles are also commonly used in museums, galleries, and educational institutions where lighting levels must be carefully controlled to conserve light-sensitive objects such as prints, photographs, and paintings from fading after long periods of exposure to bright light.

Start now! Tip #2

Implement an energy efficiency improvement program. According to the U.S. Department of Energy, American schools spend roughly \$6 billion each year on energy – or approximately \$110 per student per year. For most school districts, energy use is the second biggest operating expense. The department estimates schools can save 25% of these high costs through better building design and energy efficiency improvements.

Water conservation

With the financial support from the Philadelphia Water Department, the School of the Future implemented water conservation technologies and design techniques to reduce, reuse, and eliminate water waste throughout the facility. The result has been an impressive near 70% overall water use reduction through the installation of low-flow urinals, showers, and water fountains as well as the use of captured rainwater for flushing. The decision to not install an outdoor plant watering irrigation system is estimated to reduce water usage for landscaping by 50%. This becomes another valuable lesson incorporated into the curriculum. Students can monitor the total amount of water conserved and calculate the financial benefit and the positive impact on the environment.

Material and resource conservation

A guiding principle throughout the design and building phase of the new facility was to recycle, conserve, and reuse materials and resources wherever and whenever possible, with a minimum goal of 70% waste recycling. High recycled content from local providers was specified for ceiling tile, windows, flooring, insulation, and wall coverings. In fact, the project achieved 15.75% of the total material content, by value, using recycled content material and this ultimately added two LEED points for innovation in the design process. Approximately 22% of the building materials, by value, were manufactured within 500 miles of the site, conserving energy and reducing air pollution of transportation deliveries. Over half of the total wood-based building materials were harvested from forests certified by the Forest Stewardship Council (FSC). During the construction process contractors were also mandated to recycle metals, glass, concrete, and other materials.



“The School of the Future is the result of a dynamic collaboration between The School District of Philadelphia, Microsoft Corporation and the Architectural team. From a design perspective, the facility was designed to be a template for a 21st Century learning and educational environment that can be replicated nationally and internationally. As architects, we thought that designing this project with an eye to protecting our physical, social, and environmental surroundings would be the best way to achieve that goal.”

Mayia Entcheva, Principal, EQ Architecture, LLC



A lesson in the many benefits of sustainable design

Going green and preserving our world is essential to our well-being and our children's futures. Designing green – whether from the ground up in new construction or in retrofitting an existing school – is a necessary benefit to everyone in the long run.

Additionally, building sustainably does not need to be an “all or nothing” approach. School construction and renovation projects that make decisions to adhere to the standards of sustainable design delineated by the LEED rating system can expect significant benefits in a variety of areas. Some of these reported benefits delineated by the LEED rating system include:

- 20-26% better performance from students on language and math tests
- 16% better performance from educators and other school employees on the job
- Dramatic reduction in sick days
- 40-90% lower maintenance and operating costs
- School building as a valuable and interesting teaching tool
- Decreased or no liability from Sick Building Syndrome
- Improved public image and community relations

Learning by Design: School of the Future Learners Produce Global Warming Public Service Announcement

School of the Future Environmental Science and Earth Science educator Charlena Martin has integrated the green aspects of the building into her classroom curriculum. Using the School of the Future as a learning and instructional tool, several of her learners prepared a Global Warming Awareness Public Service Announcement (PSA) which was used for a pre-panel discussion held at Drexel University on April 9, 2008.

The theme of the discussion was “Your Health, Your Home, Your Neighborhood” and highlighted a number of the unique aspects of attending a green school. Among the benefits highlighted were the use of environmentally-friendly cleaning products in facility maintenance, the installation of motion sensed bathroom fixtures to reduce the spread of germs, findings of educational studies that indicate a direct positive impact of day lighting in improving student test scores, and how the school's excellent air quality seems to help several learners literally breathe easier and feel healthier throughout the day.

The School of the Future learners involved were Janika Bennett, John DeGregorio Jr., Kevin Hyman, Khalil Hobson, Al-Nisa Mills, Raheem Robinson, Ryan Taylor, Terrell Young, Victoria Thornton, and Allen McPherson Jr., who was the videographer.



Learning in Green – involve your educators and learners and the entire community in projects and programs that teach the value of going green!

Energy Audits

Encourage educators to incorporate an “Energy Audit” into a class project. Form student teams to conduct audits to calculate and assess energy efficiencies throughout the school, including water usage, electricity, and waste disposal. By researching and performing energy efficiencies and illustrating their findings in the form of graphs and charts, students learn first-hand what to look for and ways to conserve energy both at the school and at home. Consider assessing the excessive consumption of everyday occurrences such as:

- Light bulbs left on when not being used
- Drafty windows and doors
- Leaky faucets
- Temperature settings on air conditioners and heating systems
- Inefficient use of appliances, computers, and printers
- Unnecessary paper waste
- Inadequate recycling procedures

Tree drives

Involve the school's community members, including educators, learners, parents, siblings, and administrators to donate saplings to plant on school grounds. Inform everyone that planting trees near air conditioners creates shade that saves valuable energy.

Gardening

If your school has outdoor space to spare, establish a garden as an outdoor learning project. Everyone in the school community can take part and enjoy the “fruits” of their labor in making the tending of the school's garden a part of the school routine. Ask parents to volunteer to provide gardening lessons, or even seeds and seedlings. Make a composting station near the garden for any organic waste the school produces.

Reduce, Reuse, Recycle

Start a recycling club at the school. Members can go around on a weekly or daily basis to collect recyclable material from classrooms for pickup by the city. Also encourage students to buy reusable water bottles and lunch boxes and other reusable containers to help minimize the amount of plastic and paper being used in the school eating and vending areas on a daily basis.



“Beyond creating a building where teaching and learning merely happen, we focused on integrating technology, curriculum, and sustainable design elements in ways that enable students and educators to use the building and all of its features as ‘built-in’ learning tools.”

Scott Prisco, Principal/CEO, EQ Architecture, LLC



Indoor environmental quality

The School of the Future offers acoustic comfort, effective ventilation, and indoor pollution control measures. Energy modeling of the facility was completed to ensure high efficiency performance for the building. Throughout the facility, motion sensors turn off lights and HVAC to conserve energy when rooms are not in use and individual room controls allow for optimal user comfort. An indoor air quality (IAQ) management plan was used during construction which included the use of air handling equipment during construction in accordance with the Sheet Metal & Air-conditioning Contractors National Association's (SMACNA) guidelines. An additional IAQ test was performed prior to occupancy to ensure all sealant and adhesive materials, paints, and indoor chemical and pollution control measures met established safety standards. The majority of these elements are water soluble solvents which reduce the negative off-gases (noxious odors) that normally occur from new construction projects. The carpet also complies with the Volatile Organic Compounds (VOC) limits of the Carpet and Rug Institute (CRI) Green Label Testing Program.

The HVAC system uses thermal storage for air conditioning, direct and indirect evaporative cooling, and extensive heat recovery systems. It also is unique in that it includes a dual duct air delivery system for optimal temperature control and is equipped with occupancy sensors throughout the building. The combination of a well designed building envelope and this innovative HVAC system are estimated to exceed current energy savings requirements by 49% and deliver almost 80% fresh air – more than three times the 25% minimum code requirement. In addition, this high efficiency HVAC system is designed to produce ice to cool the building during off-peak night hours when the cost of electricity is more economical.

Well worth the green price tag

Green school design almost certainly requires more upfront investment, as architects, engineers, and builders work together much earlier in the process and more frequently. Yet, the School of the Future clearly has proven that these initial development costs can reap tremendous savings over the lifetime of the building. While green schools cost about 2 percent more than regular schools, districts typically save approximately \$100,000 annually – roughly enough to pay for two more teachers.

By going green, schools that successfully embrace the concept of sustainable building – whether during a brand new building construction or as part of a renovation – become increasingly cost-effective to operate and offer more opportunities for learning over time.

FAST FACT: Green schools typically cost less than \$3 per square foot more to build, an investment that is paid back within a few years of operation. Over the lifetime of the school, the savings keep adding up.



Start now! Tip #3

Be smart about your light bulbs.

If your school uses incandescent bulbs, consider that for every 60-watt incandescent bulb switched to a 13-watt compact fluorescent, the school could save 75% in energy use – an average of \$45 over the life of each bulb. Schools can also install occupancy sensors that turn lights off when rooms are vacant, or install task lighting to further reduce energy usage.

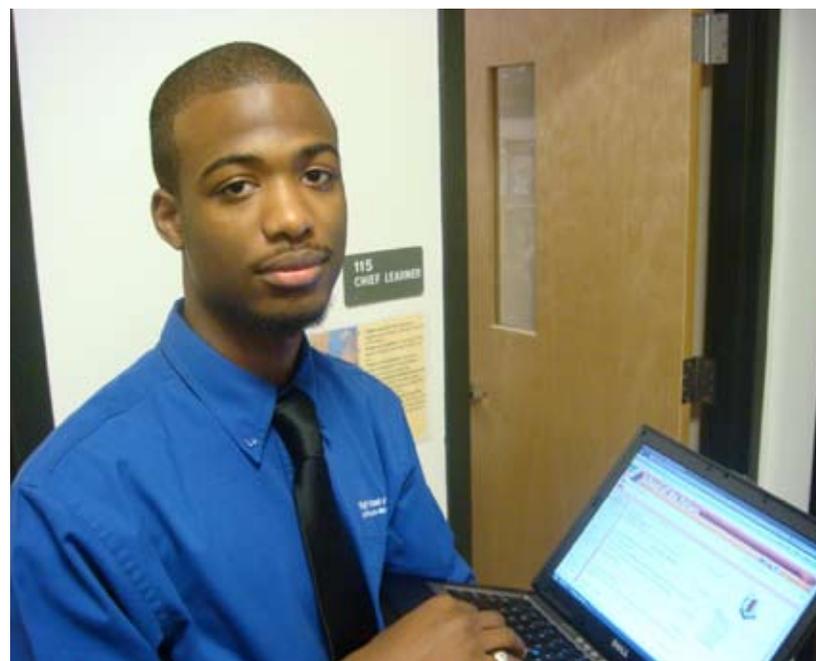


Microsoft Educating Educators on Green Computing

At Microsoft, we believe software is foundational to solving today's environmental challenges and to enabling the long term goal of sustainability. Many people don't realize that the average desktop PC wastes nearly half the power it draws from the wall socket. This excess energy is dissipated as heat. The average server wastes 30 to 40 percent of its power. Through electricity usage, a computer running 10 or more hours per day can account for as much as one-tenth of a car's annual CO2 emissions. With more than a billion computers in use worldwide today, the wasted electricity and resulting CO2 emissions are tremendous.

Microsoft is helping to reduce the direct impact of computing on the environment in a growing roster of educational institutions and school districts. These Microsoft education customers are focused on consolidating servers using virtualization to drive down energy costs, with environmental concerns as an added benefit. Windows Server 2008® power management and virtualization settings provide significant opportunity to optimize existing hardware, maintain or increase output, and effectively manage energy usage. Hyper-V® makes it possible to consolidate servers onto a much smaller number of physical machines, significantly reducing power consumption without sacrificing performance.

Additionally, Microsoft's education customers who currently use Windows Vista® are able to benefit from the energy savings afforded through the operating system's power management features and default settings.



Start now! Tip #4

Consider buying recycled paper and e-communicate. The Natural Resources Defense Council reports that 40 cases of 30% recycled copy paper (400 reams) will save more than seven trees, 2,100 gallons of water, and 1,230 kilowatt-hours of electricity, while emitting 18 fewer pounds of air pollution. Offset the cost of using recycled paper by using less paper overall. Email when necessary, go electronic with your school newsletter, and send emails instead of flyers for special school announcements.