Sustainable Schools Create Better Learning Environments

The objective of this Sustainable Schools Guide is to provide you with information that will allow your school system to make informed decisions regarding energy and environmental issues that are important to your school, community, and country.

The concept of sustainable development reflects an understanding that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. A Sustainable School not only embraces the concept of sustainability but is, in itself, a teaching tool for sustainability.

"Good teachers never teach anything. What they do is create conditions under which learning takes place."

S.I. Hayakawa

By implementing the sustainable design practices included within these guidelines, you will be taking a significant step forward in creating the physical conditions in which the learning process can thrive.

Photo: Innovative Design

Photo: Innovative Design

Improving Academic Performance

Supporting Your Educational Mission

Photo: Innovative Design

At the very heart of your educational mission is the goal of improving academic performance. Two sustainable design strategies can help you. Through the implementation of natural daylighting and the inclusion of measures that improve indoor air quality, your school, like other Sustainable Schools, will be a healthier learning environment, result in increased attendance, and improve academic performances.

Daylighting

Over the past two decades, a growing number of research efforts are indicating the same thing -- that there is a link between the amount of controlled sunlight a person receives and personal health and productivity. Within this research there is a consensus that sunlight has a nurturing effect on humans.

Today it is common knowledge that sunlight triggers the development of vitamin D in the skin. Sunlight intensifies the enzymatic processes of metabolism, increases hormone activity, and improves the tone of the central nervous and muscular systems. More importantly to educators, recent research indicates that there is a strong correlation between the introduction of controlled daylighting in classrooms and student attendance and academic performance.

Indoor Air Quality (IAQ)

Twenty percent of the US population -- 55 million students, teachers, and staff -- spend much of their time daily in elementary and secondary schools. A 1995 analysis by the US General Accounting Office of 80,000 public elementary and secondary schools found that over 8 million students are now attending 15,000 schools with severe indoor air quality problems. These indoor air quality problems can be effectively addressed through simple design strategies, the result being improved health, increased attendance, and better grades.

Insuring Success

✔ Become Knowledgeable about the Issues

Over the past decade remarkable studies have indicated a correlation between the way our schools are built and student performance. Investigate for yourself the important relationships between daylighting and productivity and between indoor air quality and health. You will see how easy it is to address these issues and how significant an impact you can make in improving academic performance.

✔ Establish Goals on Daylighting and IAQ

Once you understand the ramifications of implementing controlled daylighting strategies and good indoor air quality practices, you should establish clear goals for your A&E team.

- Set indoor air quality objectives that:
  - define a level of indoor air quality desired during occupied times;
  - place limitations on the use of materials, products, or systems that creates biological, chemical, or physical IAQ problems; and
  - require monitoring equipment.
- Set daylighting objectives to:
  - develop intentional visual connections between the indoor and outdoor environment; and
  - include controlled daylighting in all classrooms, administrative areas, the gymnasium, and other significantly occupied spaces.

✔ Select a Qualified Design Team

Select a design team that has specific experience in dealing with the integration of daylighting and indoor air quality strategies into school projects. When qualifying firms, ask them to provide you with examples of their successes in designing green schools. Have them provide information on the computer daylighting and energy simulation tools that they use in the design process and what indoor air quality measures they typically employ.

✔ Involve Students, Teachers, and Maintenance Staff

To realize these benefits the school must be operated in a manner that does not override the intent of the design. The more your students, teachers, and maintenance staff are involved in, and knowledgeable about, the sustainable features incorporated in your school, the more your school will benefit.

Photo: Robert Flynn

Daylit gymnasium at Durant Middle School, Raleigh, NC

"There is no area of our mental and bodily functioning that the sun does not influence. Our bodies were designed to receive and use it in a wide range of ways. We were not designed to hide from it in houses, offices, factories, and schools. Sunshine, reaching us through our eyes and our skin, exercises a subtle control over us from birth to death, from head to tail."

D. Downing, 1988

"The results indicate that work in classrooms without daylight may upset the basic hormone pattern, and this in turn may influence the children's ability to concentrate or cooperate, and eventually have an impact on growth and absenteeism."

Kuller and Lindsten, 1992

Academic Performance

The following checklist outlines key sustainable elements that should be considered by your A&E team during the design of your school.

Daylighting & Windows

Photo: Innovative Design

Sterling Montessori Academy, Morrisville, NC

General Windows Guidelines

- employ high-performance windows, with low-e glazing in windows not integral to daylighting strategy
- create deliberate connections to outside environment so that climatic changes are apparent, as well as stimulating to students
- minimize east- and west-facing glass and tint and/or shade that which is installed
- provide proper overhangs over south windows to eliminate excessive radiation during hotter months
- provide window treatments to eliminate glare and avoid direct beam radiation from entering teaching and working spaces

General Daylighting Guidelines

- use south- and north-facing glass to maximize daylighting
- daylight the most utilized spaces, particularly classrooms, gymnasiums, and administrative spaces
- incorporate strategies that result in quality daylighting for at least two-thirds of the daytime school hours
- incorporate glass and properly-sized overhangs to insure that no more than the optimum amount of radiation for lighting enters the space during peak cooling times
- to effectively daylight a particular space to 60 footcandles, incorporate a daylighting strategy that uses a clear glass aperture area equal in size to 10-12% of the floor area to be daylit
- create daylighting strategies that eliminate glare and direct beam radiation from entering teaching and working spaces
- use light colored wall, floor and ceiling finishes inside rooms to better reflect light deeper into spaces
- develop an overall building structural design that integrates the daylighting strategies and minimizes redundant structural elements
- avoid the use of skylights that do not control summer overheating

Photo: Innovative Design

Daylit classroom at the New School, Apex, NC

Photo: Innovative Design

East Clayton Elementary, Clayton, NC

Photo: Innovative Design

Roof monitor at Clayton Middle School, Clayton, NC

Daylighting with Roof Monitors

- where possible, use roof monitors in one-story buildings
- design roof monitor to bring in light in a more controlled manner by:
  - employing translucent baffles within lightwells to reduce glare, block direct beam radiation and uniformly distribute light
  - using south-facing monitors with well-designed overhangs to seasonally optimize the solar gain entering the space (less in summer, more in winter)
  - secondarily, employing north-facing monitors
  - using white roof areas adjacent to roof monitors to bounce additional radiation through the glass area

Photo: Mytech

Lighting sensor

Daylighting with Controls

- incorporate lighting controls that automatically reduce light levels as daylighting increases
- select continuously dimming (best option) or multi-staged lighting controls, lamps and ballasts to enhance economic benefits and provide a smoother transition between varying lighting conditions
- in spaces that need to be temporarily darkened, install durable motorized vertical blinds or rolling dark-out shades

Photo: Innovative Design

Lightshelves at Roy Lee Walker Elementary, McKinney, TX

Daylighting with Lightshelves

- employ lightshelf strategies in offices and classrooms that have southern exposures and are elongated in the east-west direction (narrow from north to south)
- use highly-reflective lightshelves below south-facing daylighting glazing areas to bounce light deeper into the spaces
- incorporate separate window treatments above and below lightshelves

"The daylit classrooms have increased the well being of the students and teachers and are at least partly responsible for our record high attendance rates."

"We are running about 3 percent ahead of the rest of the county in attendance. We stay about 98%."

Tom Benton, Principal
Durant Road Middle School

Photo: Robert A Flynn

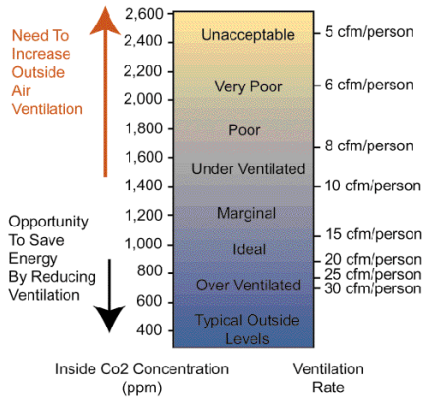
Durant Road Middle School. Raleigh, NC

Mechanical & Ventilation Systems

- comply with ASHRAE Standard
- consider different strategies to efficiently ensure adequate fresh air in occupied areas, including capability to introduce one hundred percent of outdoor air during mild weather
- incorporate carbon dioxide and VOC pollutant sensors to control amount of ventilation air required
- do not oversize cooling equipment because it will not adequately remove humidity
- use nighttime ventilation strategies in the cooling season to flush out air prior to morning occupancy
- if a particular mechanical system serves more than one space, insure that each space served has the same orientation and fulfills similar functions
- install ductwork that has smooth surfaces and transitions to minimize the collection of microbial growth
- design ductwork and plenums to minimize accumulation of dirt and moisture and provide access areas in key locations for inspection, maintenance, and cleaning
- locate outdoor-air intakes a safe distance from polluted and/or overheated exhaust grilles and away from loading docks
- separate vehicle traffic and parking from fresh air inlets or spaces employing natural ventilation strategies

Indoor Air Standards

- The American Society of Heating, Refrigerating, and Air-Conditioning Engineers recommends:
  - Relative Humidity - 30% to 60% (ASHRAE 55-1992)
  - Temperature - 68 degrees to 78 degrees (ASHRAE 55-1992)
  - Ventilation Rate - minimum of 15 cubic feet per minute per person (ASHRAE 62-1989)
  - Carbon Dioxide - maximum 1000 parts per million (ASHRAE 62-1989)
- The US Environmental Protection Agency recommends:
  - Radon - maximum of four picocuries (pCi/L) per liter



Condition of indoor air. Courtesy of TelAir, Goleta, CA

"In order to have a good learning environment, you must have a learning environment that's conducive to education, and that means good air quality. Children don't learn well if they're too hot, too cold, or if the lack of fresh air leaves them drowsy."

Ed Melanson, Superintendent of Schools

"It's an environment that is going to enhance our educational efforts. We expect to take off and do some remarkable things. The environment will now help us do that"

Jane Lacasse, Principal
Boscawen Elementary School

- locate exhausts in such a way that prevailing winds carry exhausts away from building
- create landscaping buffers between high traffic areas and building intakes or natural ventilation openings
- separate and ventilate highly polluting spaces (e.g., copy rooms)
- incorporate outdoor spaces that can be used for:
  - teaching
  - breaks and lunch
  - recreation

Environmentally-Sensitive Building Products and Systems

- improve indoor air quality by eliminating or minimizing:
  - VOCs in paints, carpet, floor base materials, and adhesives
  - products that may release particulates
  - formaldehyde in plywood, particleboard, composite doors, and cabinets
  - toxic termite control
- select low-VOC emitting, environmentally-friendly cleaning agents
- eliminate or minimize building materials and furnishings containing toxics
- incorporate interior planting strategies
- develop an indoor pollutant source assessment and control plan
- insist on materials and equipment with low maintenance requirements
- incorporate air and vapor retarders in the building envelope to control unwanted air movement through walls
- separate polluting materials by carefully considering placement, encapsulation, or the creation of architectural barriers
- if necessary, implement radon mitigation strategies
- select local products

Photo: Collins & Aikens

Recycled carpet

Indoor Air Quality: Tools for Schools" is designed to give schools the information and skills they need to manage air quality in a low-cost, practical manner. The IAQ Tools for Schools kit includes hands-on material schools will need to prevent/or manage existing air quality problems.

The kit is published by the US Environmental Protection Agency and co-sponsored by the American Lung Association. For information, please call:
1-800-LUNG-USA
or visit:
www.lungusa.org
www.epa.gov

Improving your school's indoor air quality will:

- decrease the potential of short- and long term health problems for students and staff
- reduce student and teacher absenteeism and improve student learning environment
- save your school money by preventing IAQ problems from developing into expensive repairs
- help prevent bad publicity and tensions between schools, parents and community

Photo: Innovative Design

The facts on...

... Indoor Air Quality

Tools for Schools

US Environmental Protection Agency and the American Lung Association

Americans are strongly affected by indoor air quality since they spend 90% of their time indoors. Because 55 million students, teachers, and staff spend much of their day in schools, the condition of these schools becomes closely linked to student performance. Unfortunately, Sick Building Syndrome is becoming commonplace and results in short- and long-term health problems.

Short-term impacts:

- asthma episodes
- allergy symptoms
- irritated eyes, nose, or throat
- congestion and coughing
- shortness of breath or wheezing
- fevers or chills
- fatigue, lethargy
- headache
- nausea
- drowsiness
- dizziness
- skin rashes

Long-term impacts:

- asthma onset
- increased severity of asthma
- recurrent pneumonia and bronchitis
- frequent upper respiratory infections
- lung and other cancers
- hearing loss
- cognitive impairment
- personality change
- neurological damage
- reproductive disorders

Poor air quality can affect anyone's health, but for the one student in thirteen who has asthma, indoor pollution can be particularly devastating.

Asthma is the leading cause of long-term illness in children and is currently responsible for 10 million missed school days each year. The incidence in children has increased by 160% over the past 15 years and now affects 5.3 million children.

However, schools can incorporate many commonsense approaches that effectively address the physical, biological, and chemical pollutants. Good indoor air quality contributes to a favorable learning environment for students, productivity for teachers and staff, and a sense of comfort, health, and well-being for all school occupants. These combine to assist a school in its core mission: educating students.

School Facilities: Condition of America's Schools

United States General Accounting Office

In 1995 the US General Accounting Office investigated the condition of our country's 80,000 public schools attended by 42 million elementary and secondary students. The conclusions of the study were that 60% of all the schools were in need of extensive repairs totaling $112 billion, and that 50% had unsatisfactory environmental conditions. The most problematic issues having an impact on health, comfort, and productivity, and in turn academic performance, are noise control, lack of adequate ventilation, physical security, poor air quality, comfort, and below standard lighting conditions.

Environmental Problems in Schools	Number of Schools	Number of Students
Acoustics	21,900	11.0 million
Ventilation	21,100	11.6 million
Security	18,900	10.6 million
Indoor Air Quality	15,000	8.3 million
Heating and Air Conditioning	15,000	7.8 million
Lighting	12,200	6.7 million

Photo: Heschong Mahone Group

Classroom. Capistrano, CA

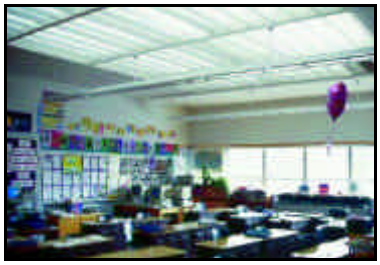


Photo: Heschong Mahone Group

Classroom. Seattle, WA

Photo: Heschong Mahone Group

Classroom. Fort Collins, CO

Variables Examined in Model:

Physical Conditions

- ▶Vintage
- ▶School size
- ▶Classroom type
- ▶Skylight type
- ▶Window area and tint
- ▶Operable window
- ▶Air conditioning type

School Site (accounts for:)

- ▶Special programs
- ▶Year round schedules
- ▶PTA or staff morale at site

Socioeconomic

- ▶ Free & reduced lunch classroom percentage
- ▶ Absences and tardies
- ▶ Gifted and talented
- ▶ English as a second language
- ▶ Ethnicity
- ▶ Gender

School and Class Size

- ▶ Students per class
- ▶ Students per school

Grade Level

... The Effect of Daylighting on Student Performance

"Daylighting in Schools - An Investigation into the Relationship between Daylighting and Human Performance" is a 1999 study conducted by the Heschong Mahone Group that looked at the effect of daylighting on human performance. It isolates daylighting as an illumination source, and separates illumination effects from other qualities associated with daylighting from windows. This research establishes a statistically compelling connection between daylighting and student performance.

Student performance data from three elementary school districts was obtained and correlations were investigated between the performance data and the amount of daylight provided within each student's classroom environment. Data from second through fifth grade students in elementary schools was used because there was extensive information available from highly standardized tests administered to these students, and because elementary school students were generally assigned to one teacher in one classroom for the school year. Thus, it was reasoned that if the physical environment does indeed have an effect on student performance, such a correlation could be established by looking at the performance of these elementary school students.

The research analyzed test score results for over 21,000 student records from the three districts, located in Orange County, California; Seattle, Washington; and Fort Collins, Colorado.

The data sets included information about student demographic characteristics and participation in special school programs. Architectural plans, aerial photographs and maintenance records were reviewed and the research team visited a sample of the schools in each district to classify the daylighting conditions in over 2000 classrooms. Each classroom was assigned a series of codes on a

Capistriano	Analysis Results				Percentage Effect	
NEA Core Level Test Range:-29 to +79	Difference in Average Test Improvement (normalized RIT Point)		Statiscal Certainty		Difference as a % of District Average Improvement	
Change, Fall to Spring	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	2.8	2.3	99.9	99.9	26%	20%
Operable windows	0.8	-	99.8	n/s	7%	-
Model 2						
Windows, Min. to Max.	2.4	1.7	99.9	99.9	23%	15%
Skylight A	2.0	2.3	99.7	99.9	19%	20%
Skylight B	-2.2	-	94.9	n/s	-21%	-
Operable windows	0.9	0.8	99.6	99.9	8%	7%

Capistrano Delta Normalized Results. Source: Heschong Mahone Group, CA

simple 0-5 scale indicating the size and tint of its windows, the presence and type of any skylighting, and the overall amount of daylight expected.

The study used multivariate linear regression analysis to control for other influences on student performance. Regressions were compared using data from two separate tests, math and reading, for each district. Each math and reading model was also run separately using first the window and skylight codes, and then the overall daylight code. It was reasoned that if daylight effects were truly robust the variables should perform similarly in all models. Thus, a total of twelve models were created for comparison, consisting of four models for each of three districts.

The daylighting conditions at the Capistrano school district were the most diverse, as well as the most detailed. Thus Capistrano provided the most precise model. In this district, it was possible to study the change in student test scores over a school year. Controlling for about 40 other variables, it was found that students with the most daylighting in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than those with the least. Similarly, students with the largest window areas were found to progress 15% faster in math and 23% faster in reading than those with the least. And students who had a well-designed skylight in their room, one that diffused the daylight throughout the room, reduced glare, and allowed teachers to control the amount of daylight entering the room, also improved by 19-20% faster than those students without a skylight. The research team also discovered that students in classrooms with operable windows progressed 7% to 8% faster than those with fixed windows, regardless of whether they also had air conditioning. These effects were all observed with 99% statistical certainty.

The studies in Seattle and Fort Collins also found positive and highly significant effects from the daylighting. Students in classrooms with the most daylighting had 7% to 18% higher math and reading scores than those with the least.

The three districts have different curriculum and teaching styles, different school building designs and very different climates. And yet the results of studies show consistently positive and highly significant effects. This consistency persuasively argues that there is a valid and predictable effect of daylighting on student performance.

The report, "Daylighting in Schools -- An Investigation into the Relationship between Daylighting and Human Performance," was prepared for Pacific Gas & Electric Company and funded by California utility customers under the auspices of the California Public Utilities Commission. The research was undertaken by the Heschong Mahone Group and submitted to a review process, and the report was released in August of 1999. Additional research is now being planned.

Fort Collins	Analysis Results				Percentage Effect	
NEA Core Level Test Normalized Scale 1-99	Difference in Average Test Scores (Normalized RIT Point)		Statiscal Certainty		Difference as a % of District Average Scores	
Spring Scores	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	3.8	3.4	99.9	99.9	7%	7%
Model 2						
Windows, Min. to Max.	10.2	7.0	99.9	99.9	18%	14%
Skylight Monitor	-	1.6	n/s	99.7	-	3%

Poudre Normalized Results. Source: Heshong Mahone Group, CA.

Seattle	Analysis Results				Percentage Effect	
ITBS Iowa Test of Basic Skills NCE Scale 1-99	Difference in Average Test Improvement NCE percentage points		Statiscal Certainty		Difference as a % of District Average Score	
Spring Scores	Reading	Math	Reading	Math	Reading	Math
Model 1						
Daylight, Min. to Max.	7.5	5.6	99.9	99.9	13%	9%
Model 2						
Windows, Min. to Max.	7.7	8.7	99.9	99.9	13%	15%
Skylights, Min. to Max.	3.9	3.4	99.9	99.8	7%	6%

Seattle Normalized Results. Source: Heshong Mahone Group, CA.

	Capistrano learning rate	Seattle higher scores	Ft Collins higher scores
Windows	15% - 23%	13% - 15%	14% - 18%
Skylights	19% - 20% A	6% - 8%	0% - 3%
Daylight	20% - 26%	9% - 13%	7%
Operable Windows	7% - 8%	-	-

Photo: Innovative Design

Johnston County's Daylit Schools

Johnston County, North Carolina

"I firmly believe every child deserves an environment like this - one designed to be conducive to learning. This is a vision of what all schools should be like for every child."

Photo: Innovative Design

Dr. Peggy Smith, Principal
East Clayton Elementary School

Contact:
Four Oaks Elementary School
Hatcher & Main Street
Four Oaks, NC 27524
Phone: 919-963-2166
Clayton Middle School
490 Guy Road
Clayton, NC 27620
Phone: 919-553-5811
East Clayton Elementary School
2075 NC HWY 42 East
Clayton, NC 27520
Phone: 919-550-5311

Since 1990 Johnston County Schools have constructed four daylit schools with amazing results. An analysis of the Four Oaks Elementary (120,000 square feet), Clayton Middle (120,000 square feet), and Selma Middle (98,000 square feet), the first three schools, showed that students attending the daylit schools outperformed students attending non-daylit schools in the same county by as much as 17% in their end-of-grade achievement tests. The fourth daylit school to be built in Johnston County, East Clayton Elementary School (96,800 square feet) is having equally impressive results. The school has been singled out by the State of North Carolina as a "School of Distinction" the last three years. Every year the school has exceeded its academic improvement goal of 10%.

Photo: Innovative Design

The 1997 evaluation investigated the level of improvement in End-of-Grade (middle schools) or California Achievement Tests (elementary schools) achieved at the daylit schools and compared this to the improvement experienced by other, non-daylit county schools during the same time frame. In Johnston County, there were 16 elementary schools and 8 middle schools.

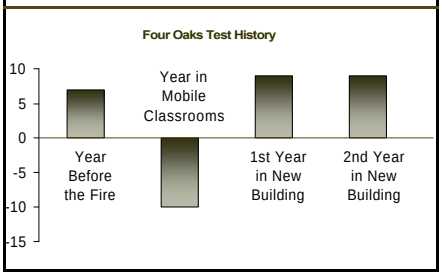
All four schools were designed to maximize daylighting and take advantage of passive heating by incorporating south-facing roof monitors that allowed sunlight to enter into the major occupied spaces within the schools. The monitors, with vertical glass and properly sized overhangs, provide excellent controlled lighting in excess of 60 footcandles two-thirds of the typical school hours. In all cases, white, translucent baffles are suspended in the lightwells to eliminate any potential glare and light sensors were included to automatically control the artificial lights.

In December of 1988, the original Four Oaks Elementary School was destroyed by fire. The students were temporarily located in mobile classrooms while a new daylit school was being constructed. If

you trace the California Achievement Test grades of these students, you can see some interesting results - results that speak clearly to the benefits of better designed learning environments. Immediately prior to the fire the students were averaging, in combined math and reading scores, 7% above the norm. The year following the fire the same students were moved into the mobile classrooms and their grades dropped to a level that was 10% below the norm - a one year drop of 17%. However, once they were moved into the new daylit school, their grades immediately improved again but, now to a level 10% above the county norm - 3% above where they were originally and 20% better than the year they moved to the mobile classrooms.

Four Oaks Student Performance in California Achievement Tests

(indicates % above or below county average in reading and math)



"The daylight contributes to a higher level of morale - a positive, upbeat attitude. It helps me in hiring teachers. Our students are also performing at a very high level. Eighty to eight-four percent are performing on grade level, in an area where approximately half are below the poverty level. I think that the daylighting is one of the variables that is responsible for this success."

Cathy Truitt, Principal
Four Oaks Elementary School

Because of the success of the Four Oaks Elementary School, Johnston County Schools decided to design a prototype daylit school that resulted in two middle schools being completed in the spring of 1993. The student performance at these two schools was even more impressive.

"My favorite parts of the new school are the windows. They let in a lot of light."

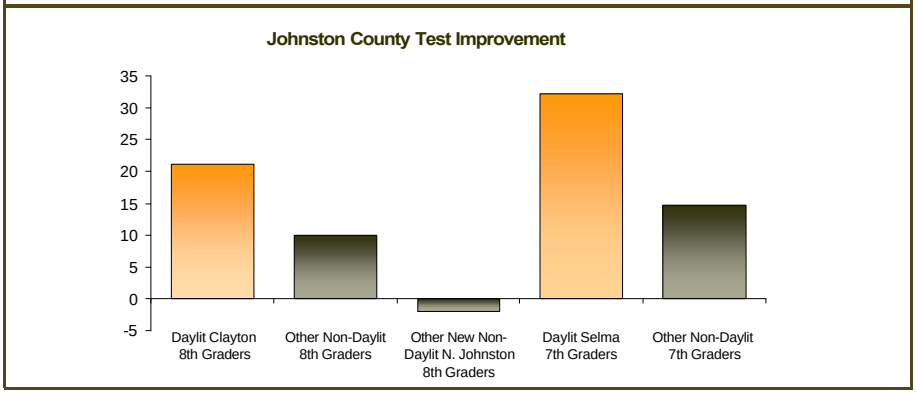
Student
Four Oaks Elementary School

Photo: Innovative Design

Four Oaks Elementary School Four Oaks, NC

Clayton and Selma Middle School Student Performance in End-of-Grade Tests

(indicates % improvement in combined reading and math, between 1993 or1995)



If you track the performance of the graduating students at these two daylit schools you will see that their End-of-Grade tests for combined math and reading were 11.1% (21.1% - 10.0%) above the county norm at the daylit Clayton Middle School and 17.5% (32.2% - 14.7%) above other students at Selma Middle School. This is even more remarkable when you compare these results to that at the other, newly built, but not daylit middle school, that showed a decrease in student performance.

If this isn't impressive enough, the two middle schools, because of the daylighting, were averaging $.32/square foot less in energy costs as compared to other similar schools in the county.

Photo: Innovative Design

Four Oaks Elementary School, Four Oaks, NC

"Our scores did come up tremendously." The daylight "enables kids to stay on task. I think it has been wonderful."

Vickie Ivey, 7th grade teacher
Selma Middle School

For Helpful Resources and More Information

Initiatives

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 $mart Schools
www.eren.doe.gov/energysmartschools
Maryland's Solar Schools Program Plan
www.energy.state.md.us/executiv.htm#Plan
On-Line Renewable Energy Education Module
solstice.crest.org/renewables/re-kiosk/index.shtml
Solar Energy: A Science Unit for Intermediate Grade Students
alpha.fsec.ucf.edu/ed/solar-unit
School Going Solar Program- IREC
www.schoolsgoingsolar.org
Solar Schools - Brighter Future
www.ises.org
Solar Now
www.eren.doe.gov/solarnow/solarnow.htm
SolarQuest
www.solarquest.com
Solar Schools
www.eren.doe.gov/solarschools
Training Student Organizers Program
www.cenyc.org/HTMLEE/mainee.htm
Watts on Schools
www.wattsonschools.com

Organizations

American Solar Energy Society
www.ases.org/solarguide
Center for Renewable Energy and Sustainable Technology (CREST)
solstice.crest.org
Energy Center
www.caddet-re.org
Energy Efficiency and Renewable Energy Network (DOE)
www.eren.doe.gov
Florida Solar Energy Center
www.fsec.ucf.edu
International Solar Energy Society
www.ises.org
Interstate Renewable Energy Council
www.irecusa.org
Million Solar Roofs Initiative
www.millionsolarroofs.org
National Energy Education Development (NEED)
www.need.org/need
National Network of Energy and Environmental Education Professionals
www.leeric.lsu.edu/network/network.htm
National Renewable Energy Laboratory
www.nrel.gov/ceb.html
North Carolina Solar Center
www.ncsc.ncsu.edu
Solar Energy Industries Association
www.seia.org
Solar Energy Research and Education Foundation
www.seref.org
US Department of Energy
www.doe.gov

This document has been developed by Innovative Design with technical assistance from Padia Consulting, BuildingGreen, and the Sustainable Buildings Industry Council and has been extensively reviewed by a technical review committee with broad based expertise in education, as well as energy and environmental issues.

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This document was specifically developed for school board members and school system administrators and it is part three in a six part series on how implementing energy-efficient, environmentally-sound construction practices can help you in addressing your educational mission.

The Sustainable Schools Guide includes:

- Reducing Operating Costs
- Buildings that Teach Sustainability
- **Improving Academic Performance**
- Protecting our Environment
- Improving Health, Safety & Comfort
- Supporting Community Values