



U.S. Department of Energy
Energy Efficiency and Renewable Energy

High Performance Schools: An Overview

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Why high performance design?





The State of U.S. Schools

- Average age of U.S. schools – 42+ years
- Majority of schools built before 1970
- GAO Report – 41% report unsatisfactory energy efficiency
- Schools spend \$7.8 billion on energy each year – the largest budget item after salaries
- More \$\$ is spent on energy than for computers and textbooks combined.
- Approximately \$54 million spent daily on school construction.



What is a High Performance School?

- Healthy
- Comfortable
- Efficient
- Easy to Maintain and Operate
- Commissioned
- Environmentally Responsive
- A Teaching Tool
- Safe and Secure
- A Community Resource
- Stimulating Architecture





Healthy





Comfortable

- Thermally
- Visually
- Acoustically





Efficient

- Energy
- Materials
- Water





Easy to Maintain and Operate





Commissioned





Environmentally Responsive





A Teaching Tool





Safe and Secure





A Community Resource





Stimulating Architecture





Why Are High Performance Schools Important?





Increased Student Learning and Teacher Performance.





Increased Average Daily Attendance (ADA).





Increased Teacher Satisfaction and Retention.



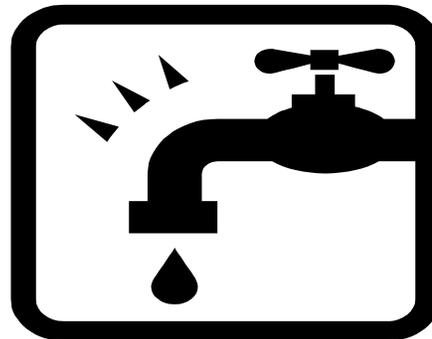


Reduced Operating Cost.

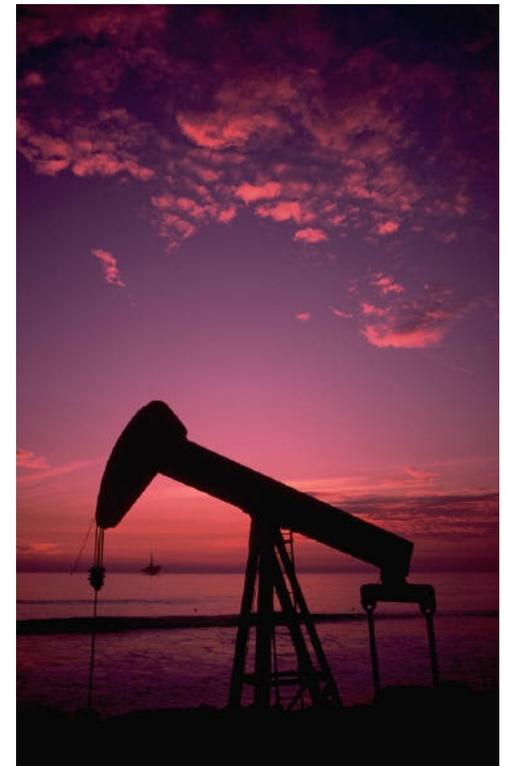
Maintenance



Water

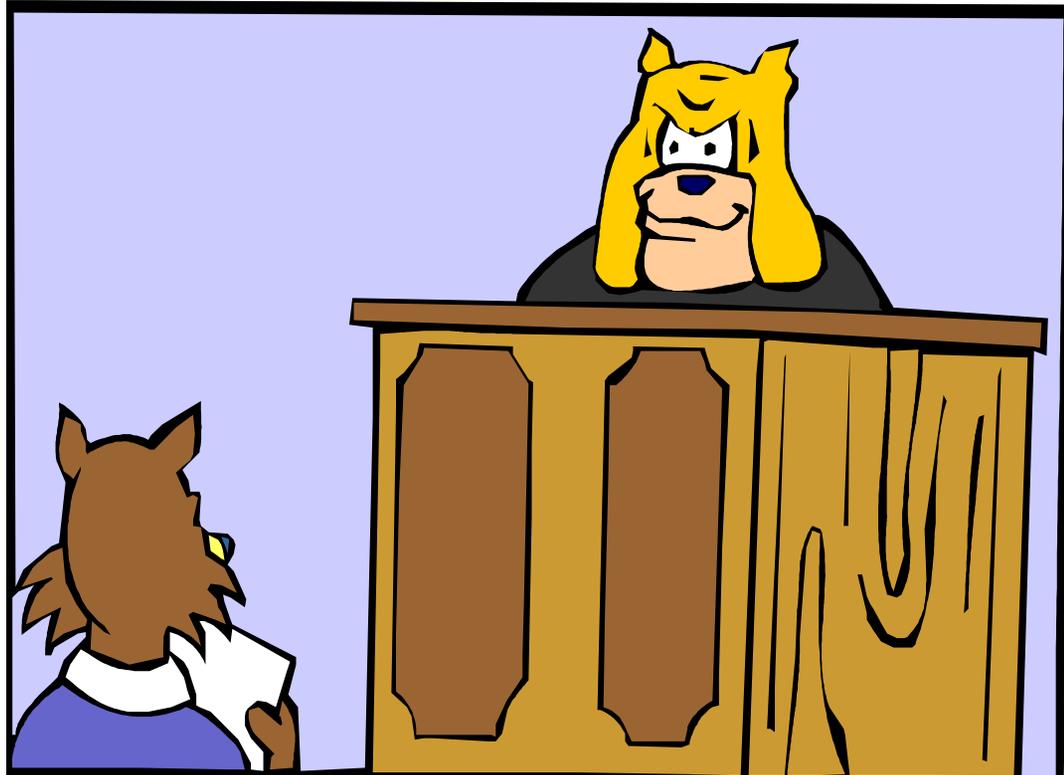


Energy





Reduced Liability





Reduced Environmental Impact





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The High Performance Classroom





Goals of a High Performance Classroom

- Visual, thermal and acoustic comfort.
- Good outside air ventilation.
- Excellent indoor air quality.
- Energy, material, and water efficiency.
- Provide a lesson on sustainable design.



High Ceilings

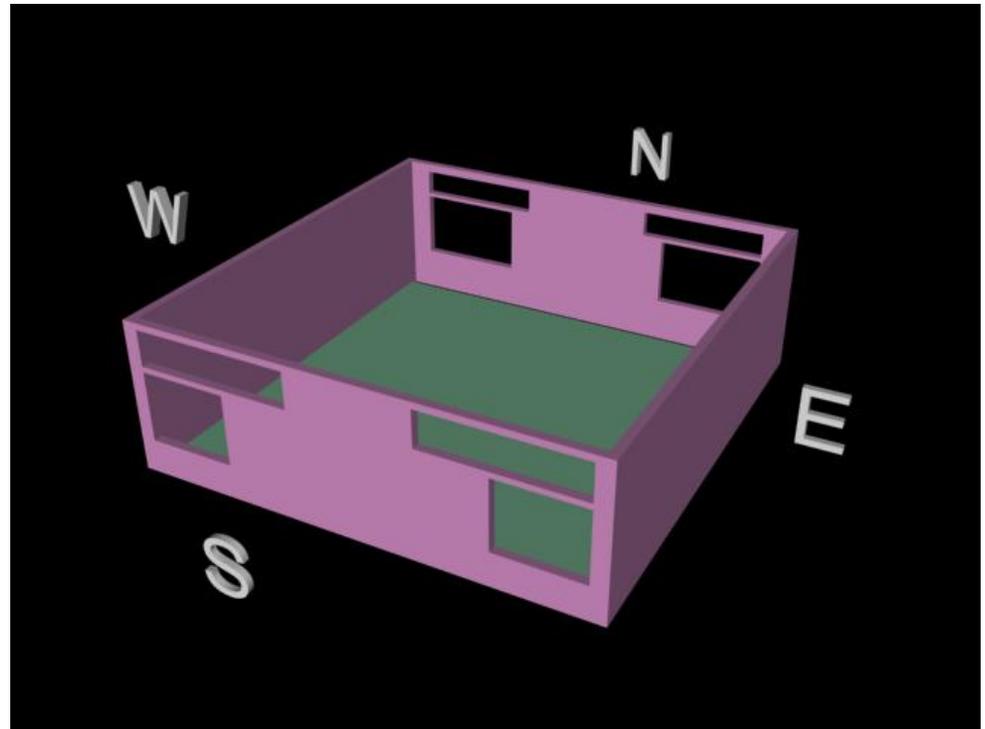
- Average classroom is 30' x 30'.
- High ceilings enhance space and provide better illumination, ventilation, and acoustics.
- Floor-to-ceiling height should be at least 10'.





Orient Windows North/South

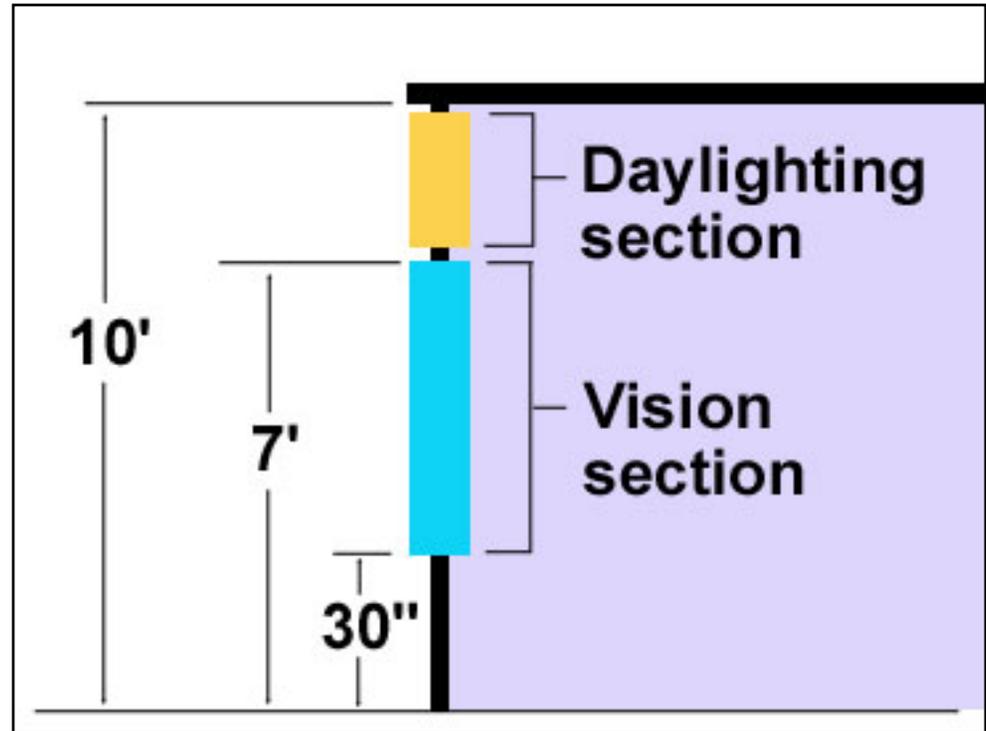
- Windows should be oriented either north or south.
- Locate windows at edges of room to prevent dark corners and wash teaching wall.





Window Sections

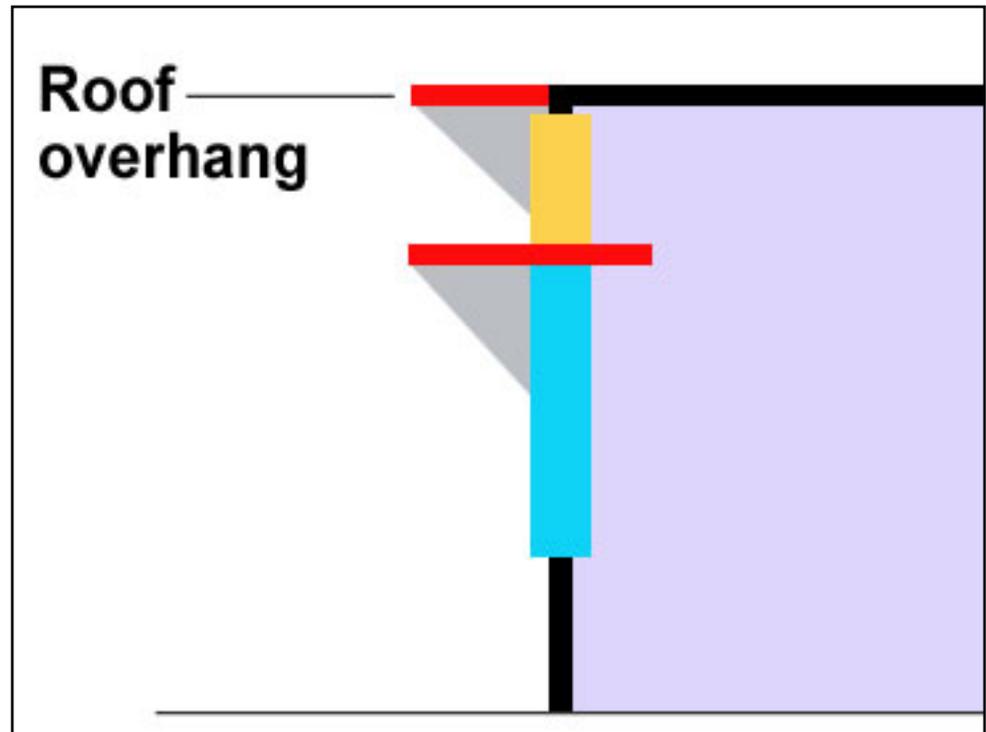
- Daylighting section allows sunlight in to illuminate room.
- Vision section glass should be double glazed and should be operable.





Roof Overhangs

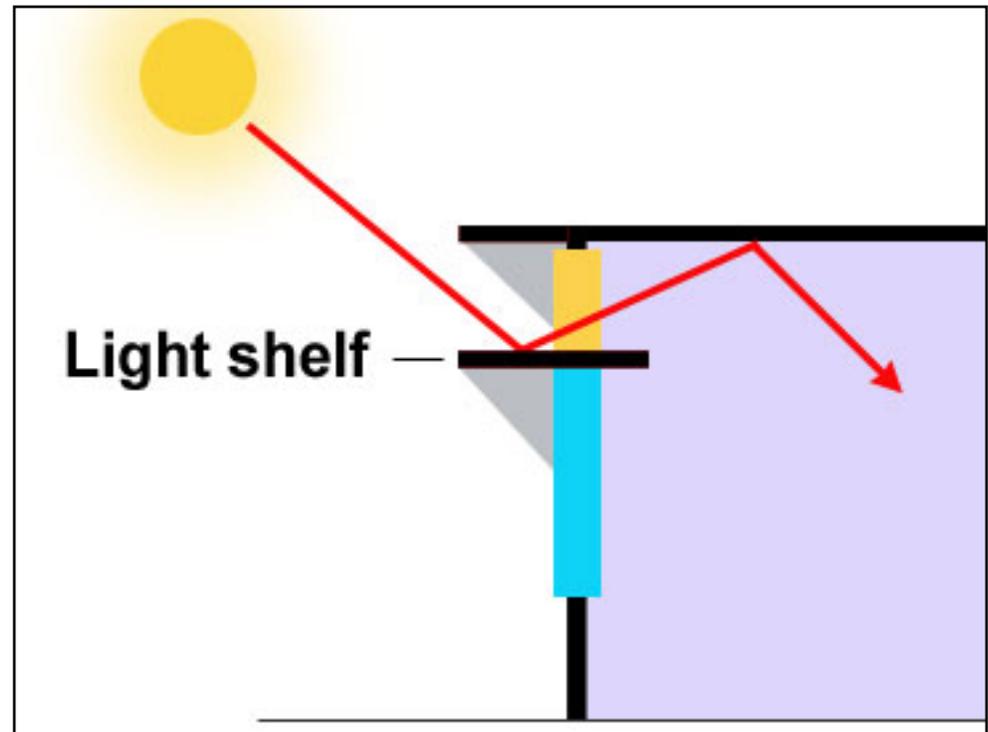
- Overhangs should be added to south-facing windows to prevent glare and to reduce solar heat gain.





Light Shelves

- Light shelves can shade vision apertures
- Light shelves can bounce light on to ceiling to increase even light penetration into space





Electric Lighting

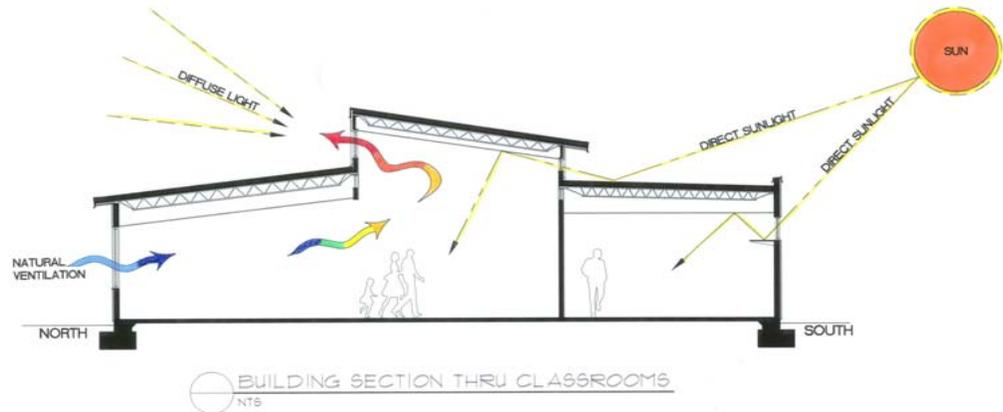
- Designed according to the characteristics and use of the space
- A light shelf should be added to reflect light onto the ceiling and into classroom.
- Light shelf also acts to shade the vision section of the window.





Skylights

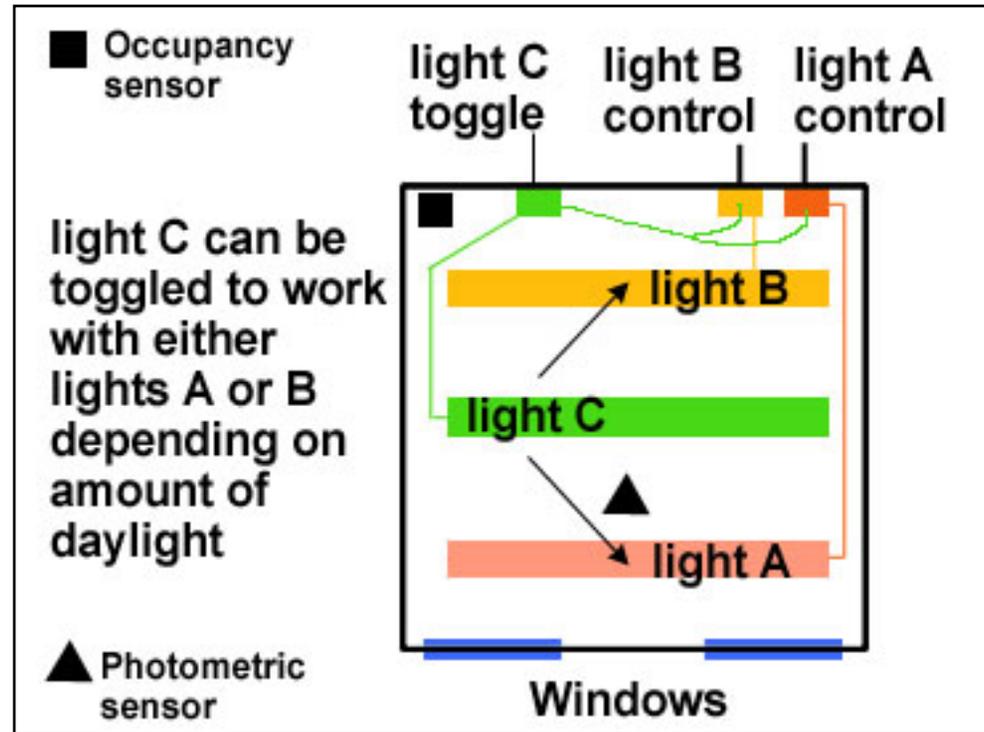
- Skylights or clearstories should be used to illuminate the back wall of the classroom. Light shelf also acts to shade the vision section of the window.
- Use skylights with glazing to diffuse light.





Lighting Control

- Occupancy sensors shut off lights if room is unoccupied.
- Separate controls for each light based on daylighting availability.





Chilled Water with Thermal Storage

- Fresh air is preconditioned and dehumidified.
- Thermal storage allows off-peak energy usage for reduced energy costs and better utilization of generation capacities.



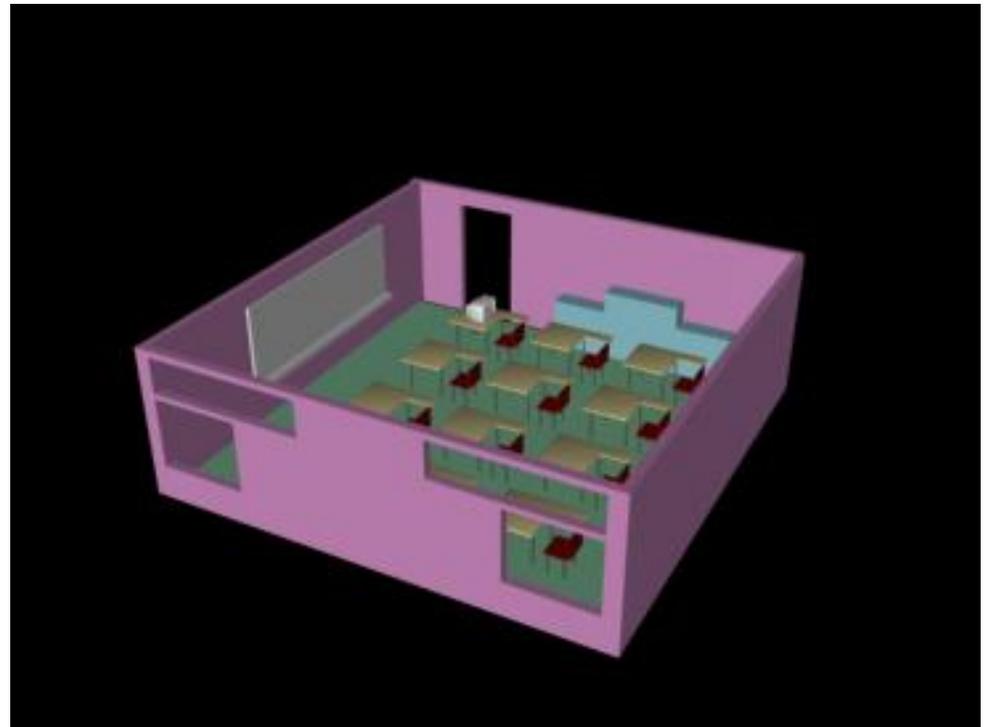
Furnishings & Materials

- Choose flooring materials that are resource efficient.
- Avoid particle board.
- Use low-emitting paint and adhesives, and apply them before installation of carpet or ceiling tiles.
- Ceilings and upper walls should be light in color with 80%+ reflectance.



Classroom Layout

- Locate teaching wall and desks perpendicular to window wall.
- Angle computer monitors to prevent glare on screen.





The Importance of Integrated Design

Goals/Cross-Cutting Issues

	Health and IAQ	Thermal Comfort	Visual Comfort	Acoustic Comfort	Security and Safety	Ecosystem Protection	Energy Efficiency	Water Efficiency	Materials Efficiency	Building as a Teaching Tool
General Conditions	●				●	●	●	●	●	
Site Planning	●	●	●	●	●	●	●	●	●	●
Interior Surfaces & Furnishings	●			●		●	●		●	●
Electric Lighting and Controls		●	●				●			●
Daylighting and Fenestration		●	●		●		●		●	●
Building Enclosure		●		●			●		●	●
HVAC	●	●		●	●		●	●	●	●
Other Equipment and Systems							●	●	●	●