



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

# High Performance Schools: An Overview

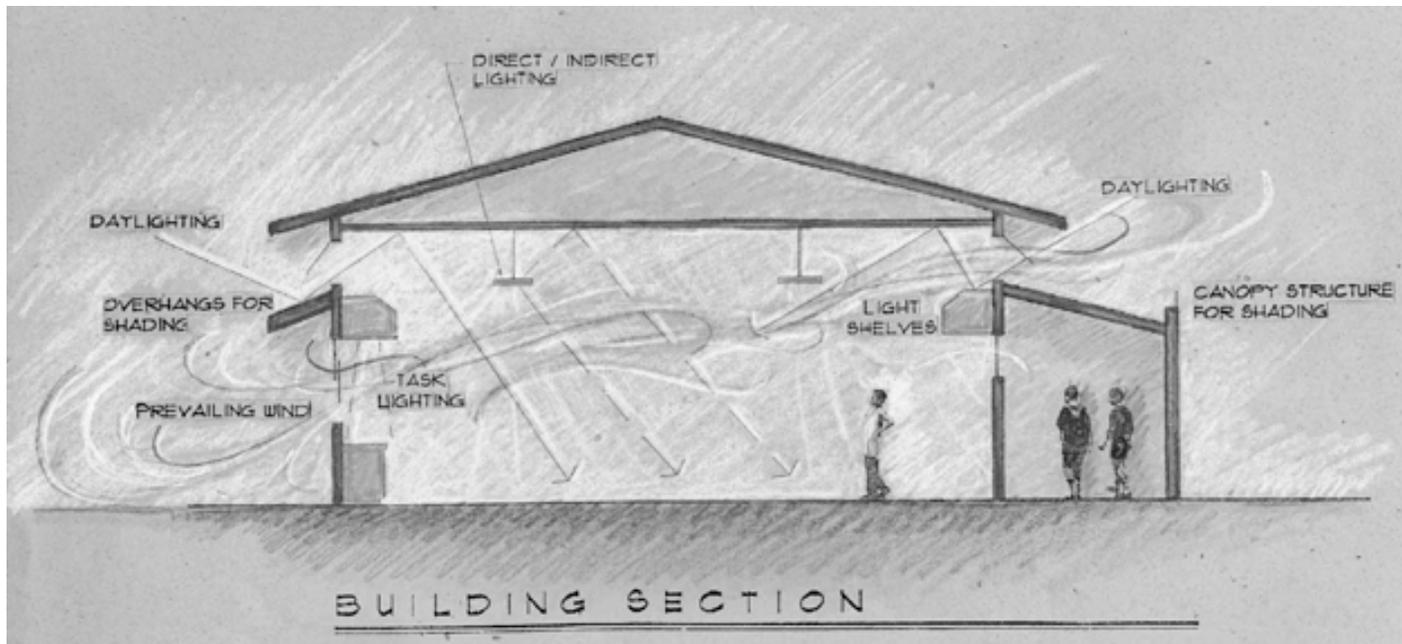
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**BEERYRIO**  
ARCHITECTURE+INTERIORS



# 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 \$6 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



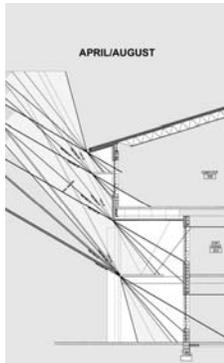
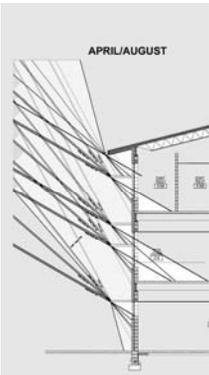


# Commissioned





# 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.



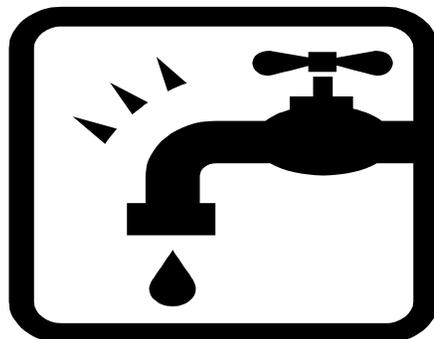


# Reduced Operating Cost.

## Maintenance



## Water

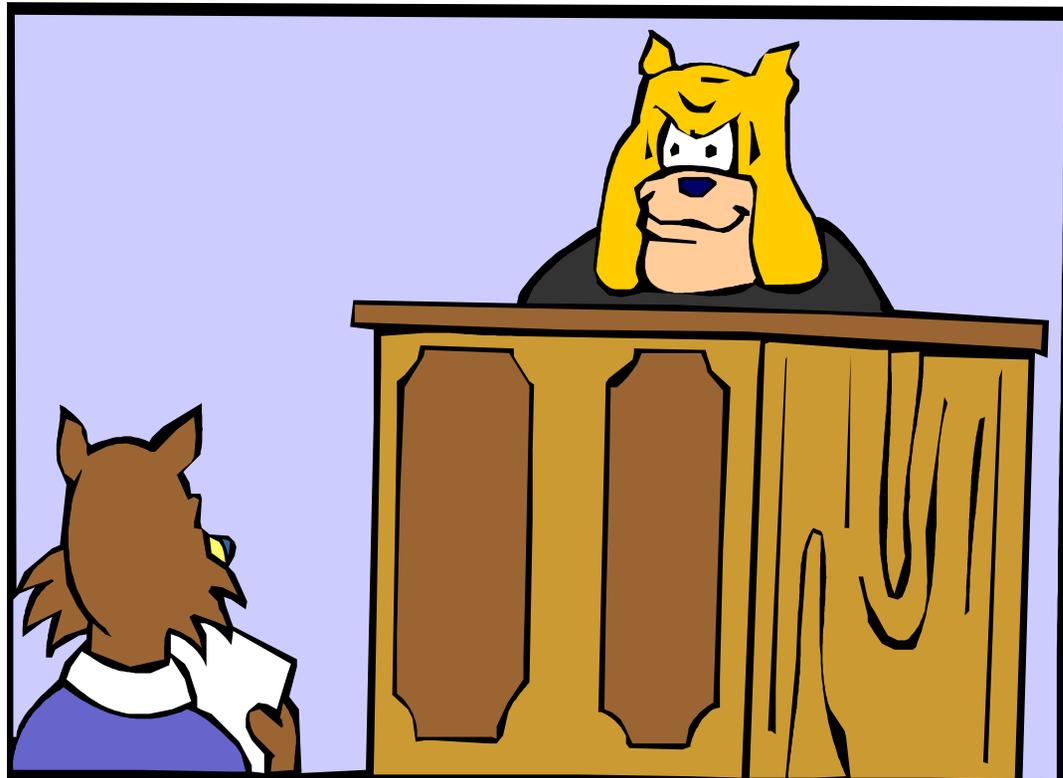


## Energy





# Reduced Liability





# Reduced Environmental Impact





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# The High Performance Classroom





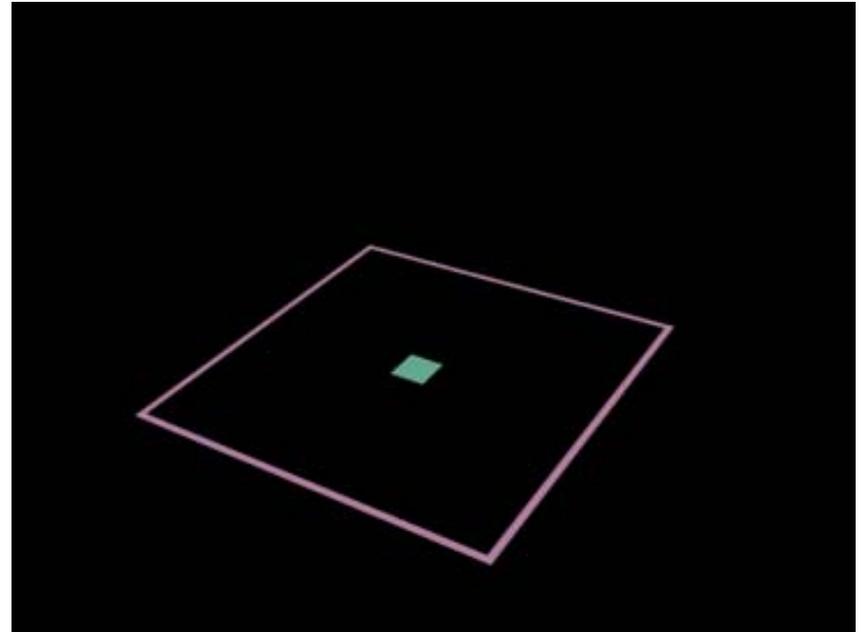
# Goals of a High Performance Classroom

- 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

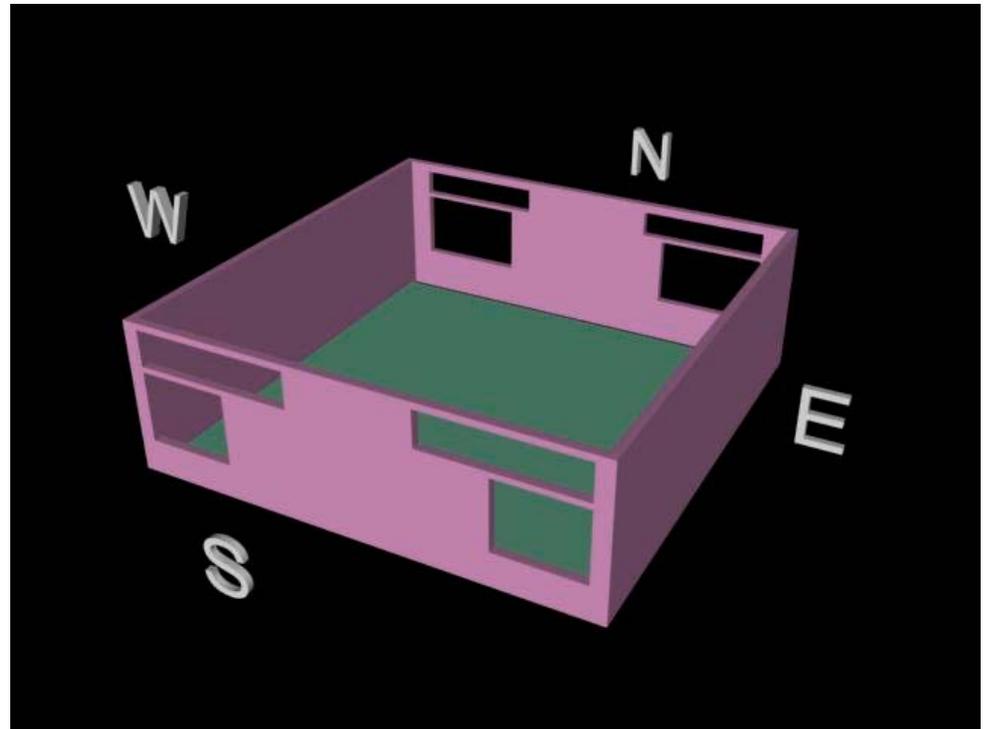
- Average classroom is 30' x 30'.
- High ceilings enhance space and provide better illumination, ventilation, and acoustics.
- Floor-to-ceiling height should be at least 10'.





# Orient Windows North/South

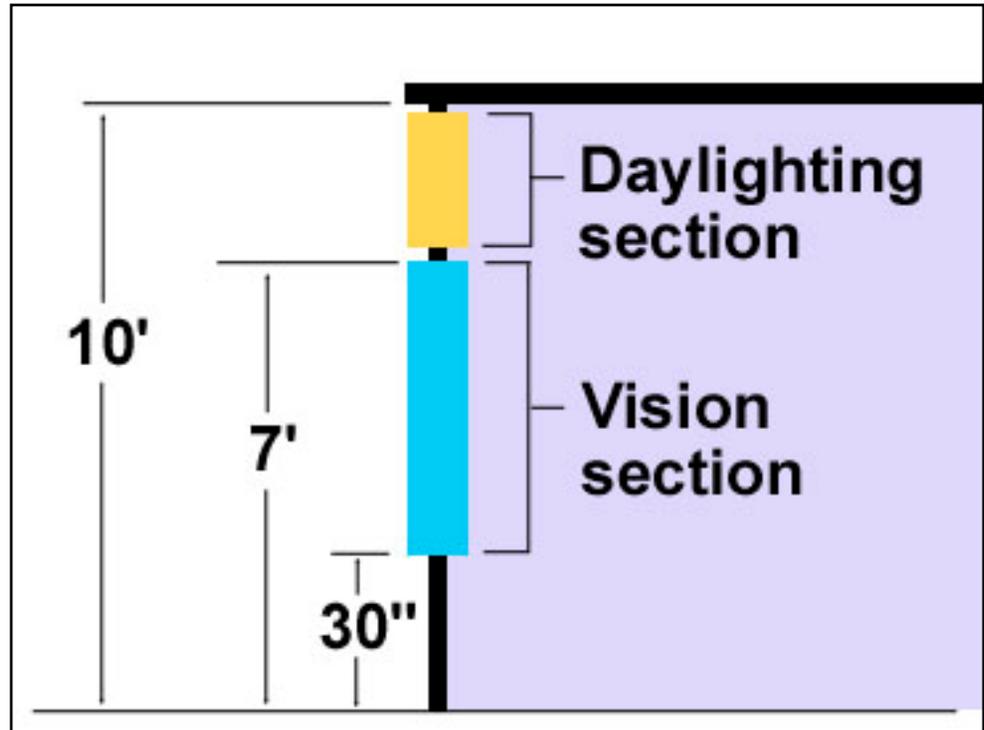
- Windows should be oriented either north or south.
- Locate windows at edges of room to prevent dark corners and wash teaching wall.





# Window Sections

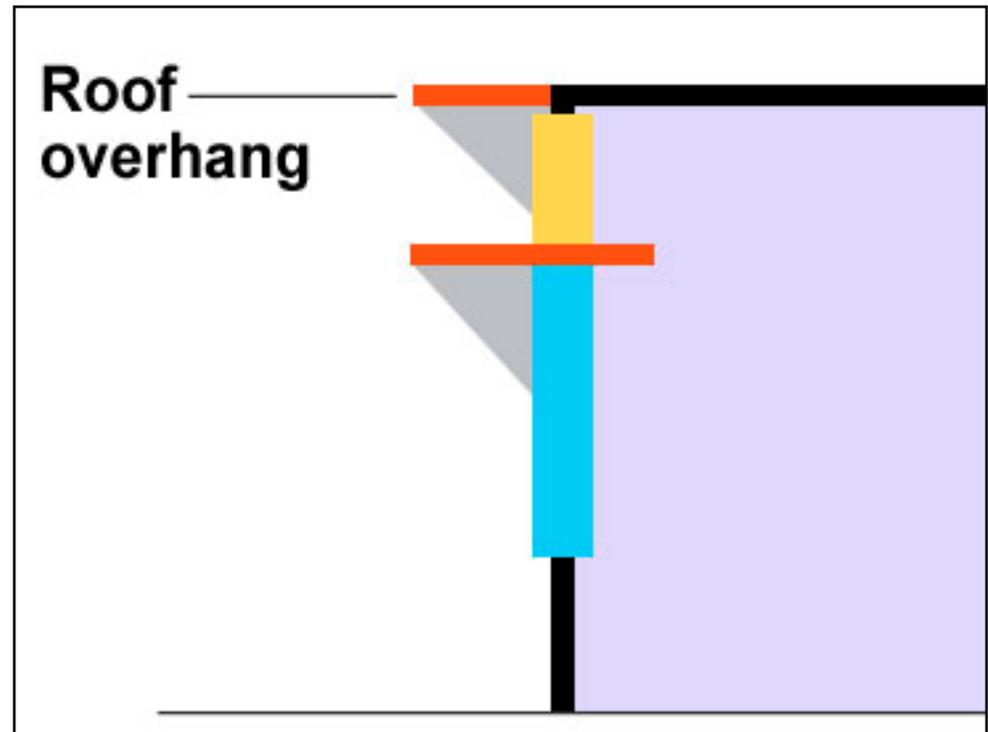
- Daylighting section allows sunlight in to illuminate room.
- Vision section glass should be double glazed and should be operable.





# Roof Overhangs

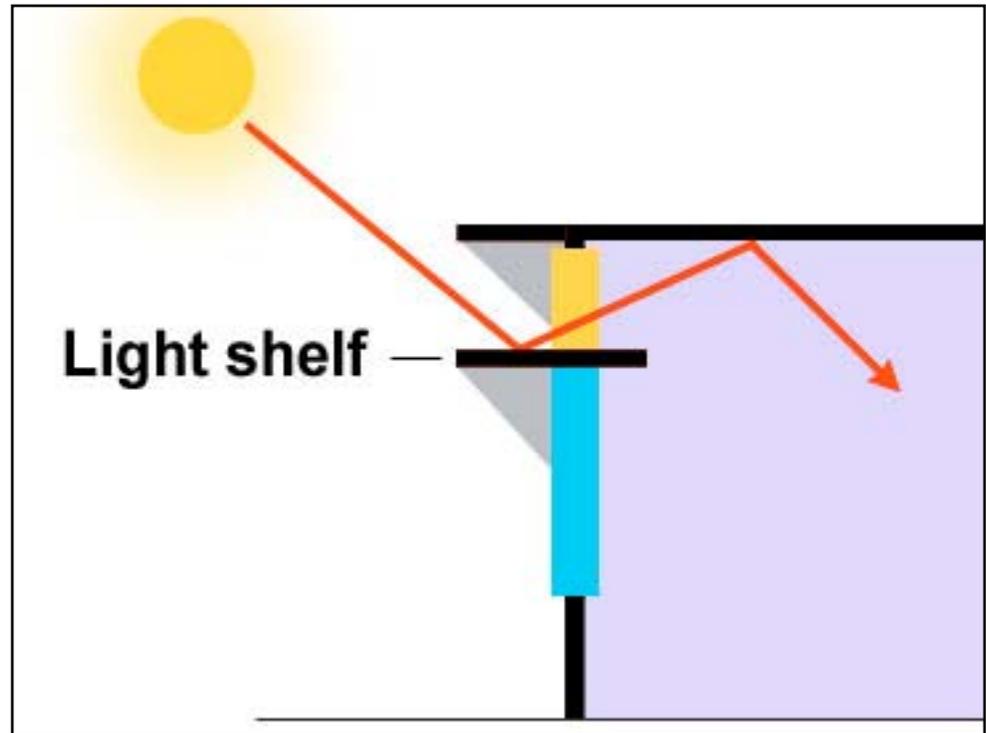
- Overhangs should be added to south-facing windows to prevent glare and to reduce solar heat gain.





# Light Shelves

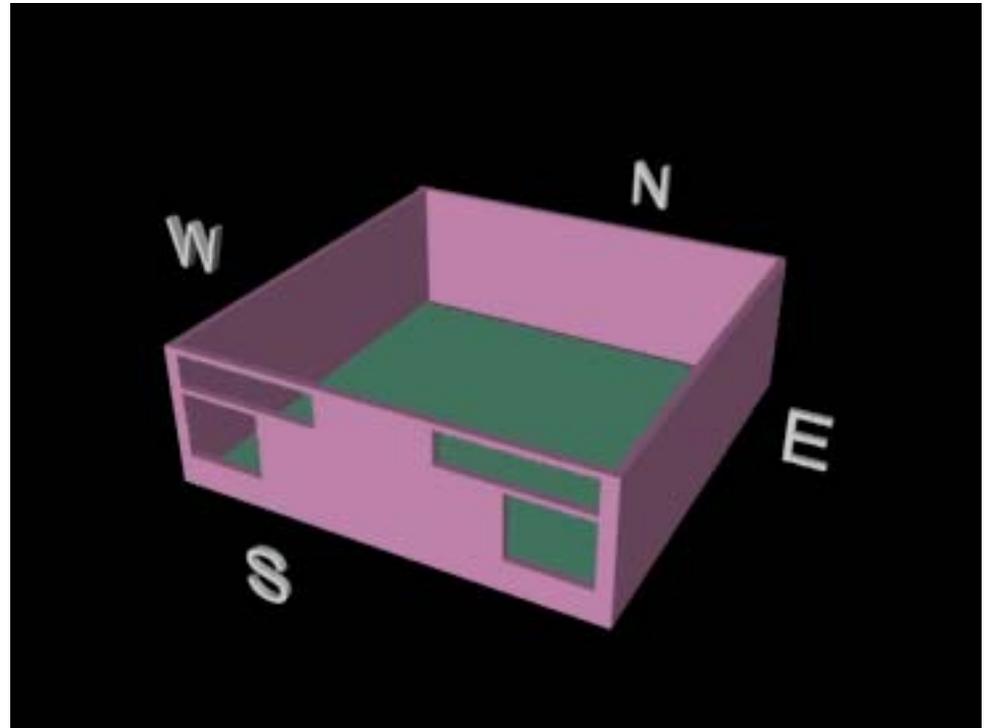
- A light shelf should be added to reflect light onto the ceiling and into classroom.
- Light shelf also acts to shade the vision section of the window.





# Skylights

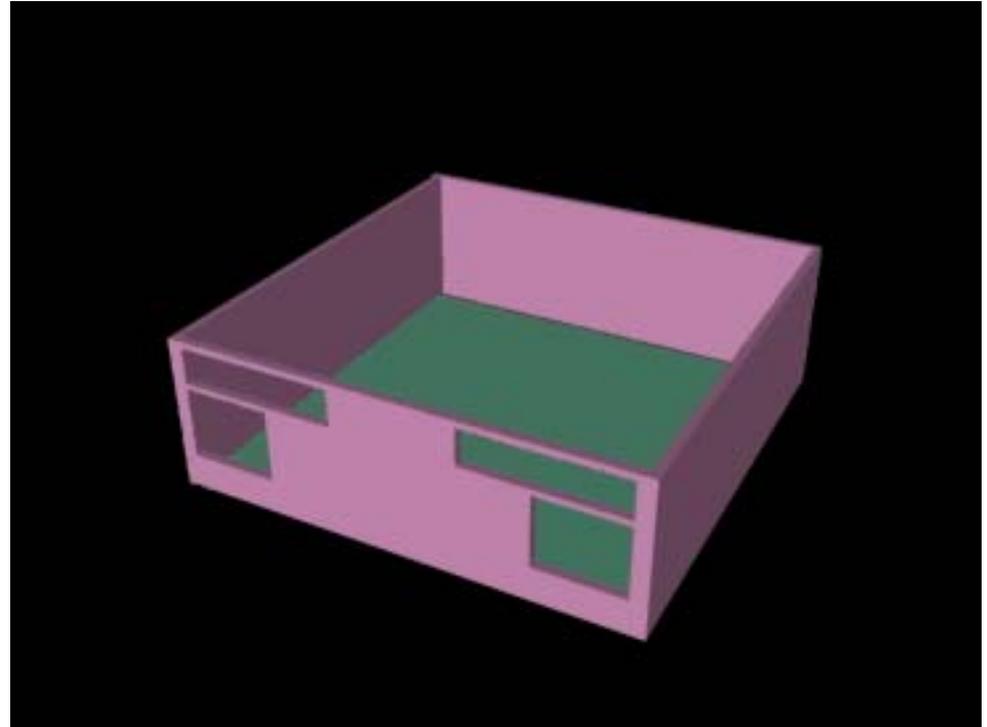
- Skylights or clearstories should be used to illuminate the back wall of the classroom. Light shelf also acts to shade the vision section of the window.
- Use skylights with glazing to diffuse light.





# Electric Lighting

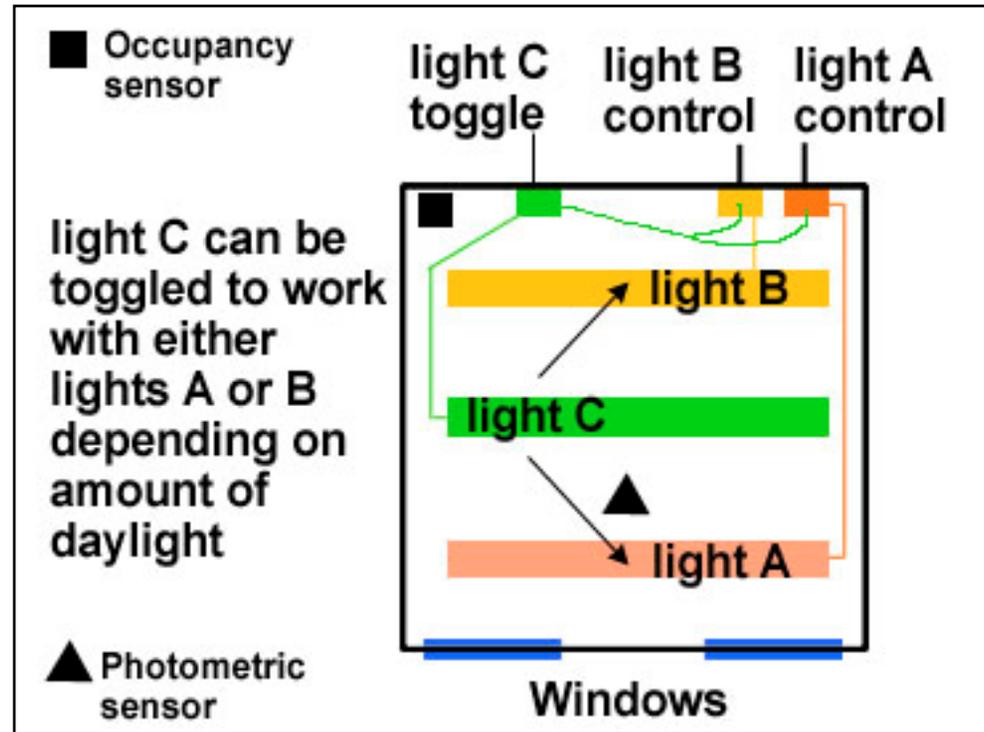
- Three rows of pendant-mounted electric lights are positioned parallel to the window wall.





# Lighting Control

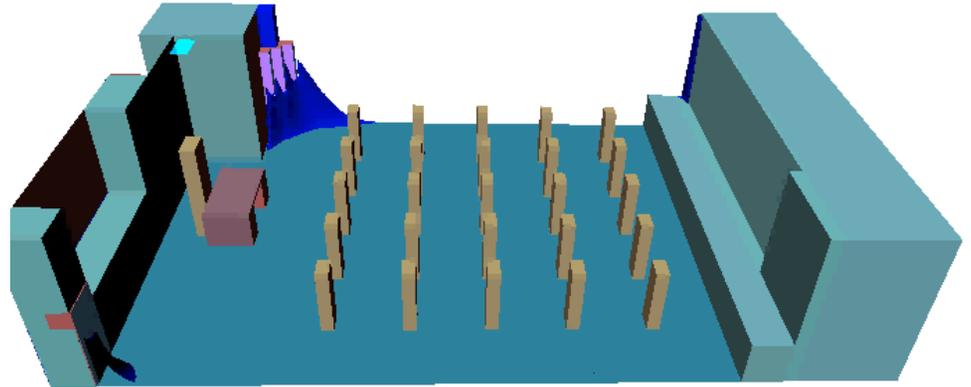
- Occupancy sensors shut off lights if room is unoccupied.
- Separate controls for each light based on daylighting availability.





# Displacement Ventilation

- Fresh cool air is slowly supplied near the floor.
- Air rises as it warms.
- Air is exhausted near the ceiling.



Courtesy H. L. Turner Group



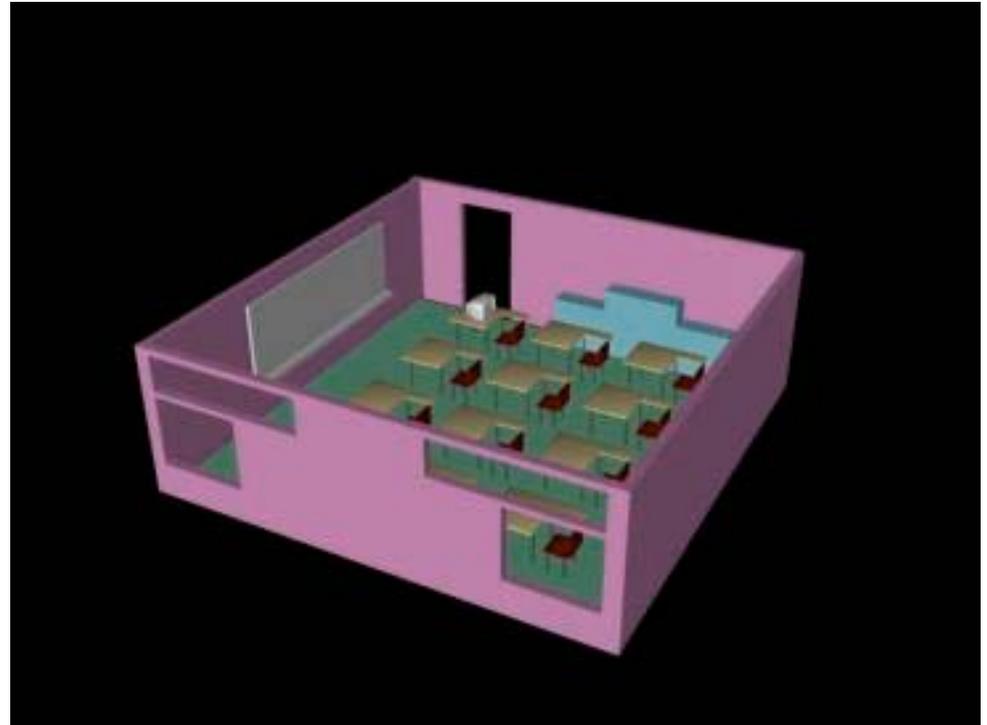
# Furnishings & Materials

- 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							●	●	●	●