LEED and Lighting for Schools

James R Benya, PE, FIES, FIALD, LC

Developed by

BENYA LIGHTING DESIGN

This presentation courtesy of Visa Lighting

Many materials in this program were developed through funding from

FINELITE

Better Lighting For A Better Workplace

LEED for Schools

Yes	?	No			
			Sustainable Sites		**16** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
Y			Prereq 2	**Environmental Site Assessment**	Required
			Credit 1	**Site Selection**	1
			Credit 2	**Development Density & Community Connectivity**	1
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.2	**Alternative Transportation**, Bicycle Use	1
			Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehicles	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
			Credit 5.1	**Site Development,** Protect or Restore Habitat	1
			Credit 5.2	**Site Development,** Maximize Open Space	1
			Credit 6.1	**Stormwater Design,** Quantity Control	1
			Credit 6.2	**Stormwater Design,** Quality Control	1
			Credit 7.1	**Heat Island Effect,** Non-Roof	1
			Credit 7.2	**Heat Island Effect,** Roof	1
			Credit 8	**Light Pollution Reduction**	1
			Credit 9	**Site Master Plan**	1
			Credit 10	**Joint Use of Facilities**	1

Yes	?	No			
			Water Efficiency		7 Points
			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
			Credit 2	**Innovative Wastewater Technologies**	1
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1
			Credit 3.3	**Water Use Reduction,** 40% Reduction	1
			Credit 4	**Process Water Use Reduction,** 20% Reduction	1

Yes	?	No			
			Materials & Resources		13 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
			Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1
			Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
			Credit 3.1	**Materials Reuse**, 5%	1
			Credit 3.2	**Materials Reuse**,10%	1
			Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
			Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
			Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionall	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Energy & Atmosphere — 17 Points

Y	Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required
Y	Prereq 2	Minimum Energy Performance	Required
Y	Prereq 3	Fundamental Refrigerant Management	Required
	Credit 1	Optimize Energy Performance (2 pt minimum)	2 to 10
		14% New Buildings or 7% Existing Building Renovations	2
		17.5% New Buildings or 10.5% Existing Building Renovations	3
		21% New Buildings or 14% Existing Building Renovations	4
		24.5% New Buildings or 17.5% Existing Building Renovations	5
		28% New Buildings or 21% Existing Building Renovations	6
		31.5% New Buildings or 24.5% Existing Building Renovations	7
		35% New Buildings or 28% Existing Building Renovations	8
		38.5% New Buildings or 31.5% Existing Building Renovations	9
		42% New Buildings or 35% Existing Building Renovations	10
	Credit 2	On-Site Renewable Energy	1 to 3
		2.5% Renewable Energy	1
		7.5% Renewable Energy	2
		12.5% Renewable Energy	3
	Credit 3	Enhanced Commissioning	1
	Credit 4	Enhanced Refrigerant Management	1
	Credit 5	Measurement & Verification	1
	Credit 6	Green Power	1

Indoor Environmental Quality — 20 Points

Y		Prereq 1	**Minimum IAQ Performance**	Required
Y		Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
Y		Prereq 3	**Minimum Acoustical Performance**	Required
		Credit 1	**Outdoor Air Delivery Monitoring**	1
		Credit 2	**Increased Ventilation**	1
		Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
		Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
		Credit 4	**Low-Emitting Materials**	1 to 4
		Credit 5	**Indoor Chemical & Pollutant Source Control**	1
		Credit 6.1	**Lighting System Design & Controllability**	1
		Credit 6.2	**Thermal Comfort,** Controllability	1
		Credit 7.1	**Thermal Comfort**, Design	1
		Credit 7.2	**Thermal Comfort**, Verification	1
		Credit 8.1	**Daylight & Views,** Daylighting	1 to 3
			☐ 75% of classrooms (*required for either points below*)	1
			☐ 90% of classrooms	2
			☐ 75% of other spaces	3
		Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1
		Credit 9	**Enhanced Acoustical Performance**	1 to 2
		Credit 10	**Mold Prevention**	1

Yes	?	No			
			Innovation & Design Process		6 Points
			Credit 1.1	**Innovation in Design**: Provide Specific Title	1
			Credit 1.2	**Innovation in Design**: Provide Specific Title	1
			Credit 1.3	**Innovation in Design**: Provide Specific Title	1
			Credit 1.4	**Innovation in Design**: Provide Specific Title	1
			Credit 2	LEED® Accredited Professional	1
			Credit 3	School as a Teaching Tool	1
Yes	?	No			
			Project Totals (pre-certification estimates)		**79** Points

Certified: 29-36 points, **Silver:** 37-43 points, **Gold:** 44-57 points, **Platinum:** 58-79 points

Recent Work

Almost zero lighting energy

The Sidwell Friends School

LEED Platinum

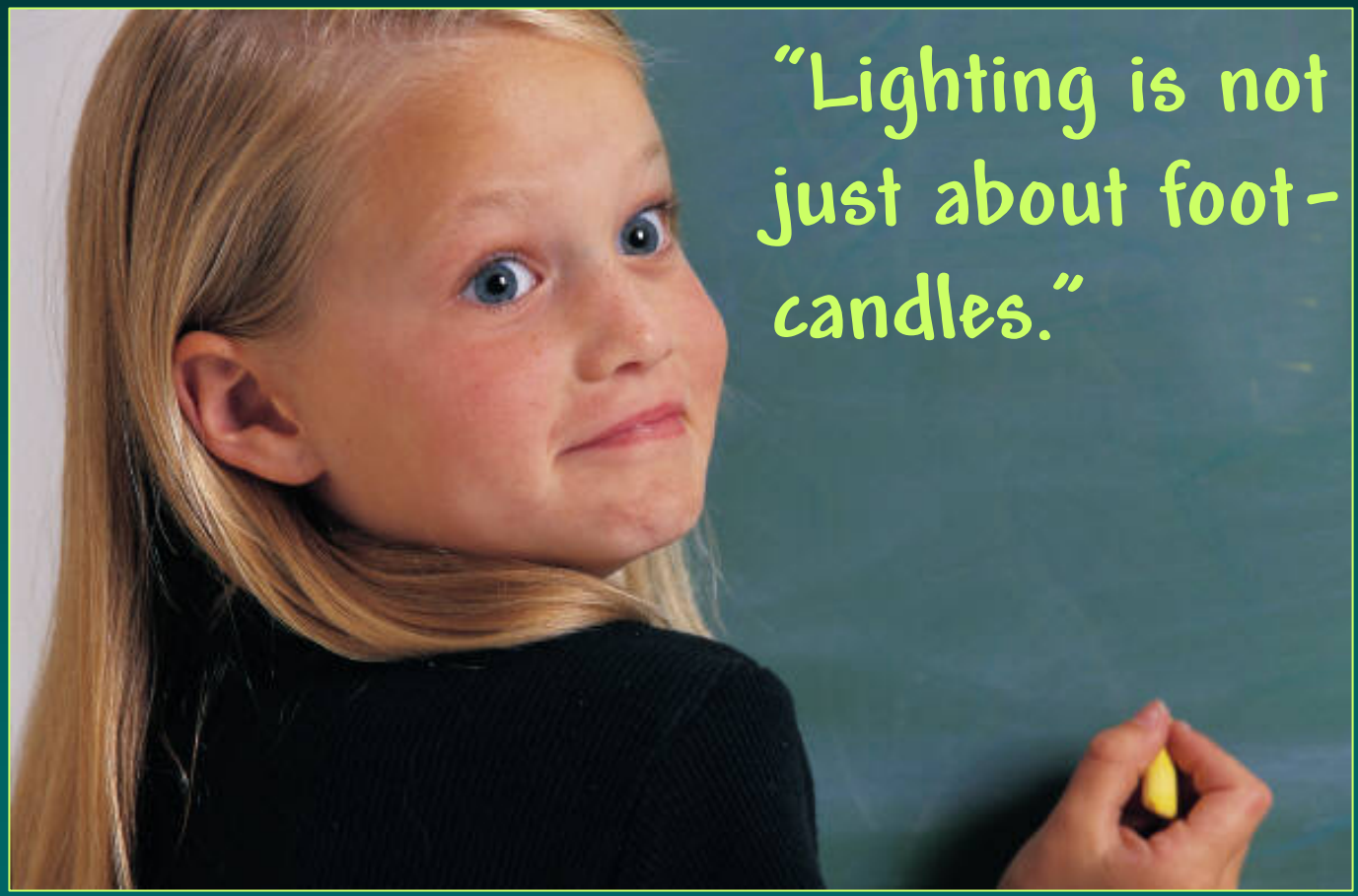
92% Lighting Energy Savings

Net Zero Electricity

The Chartwell School, Seaside CA

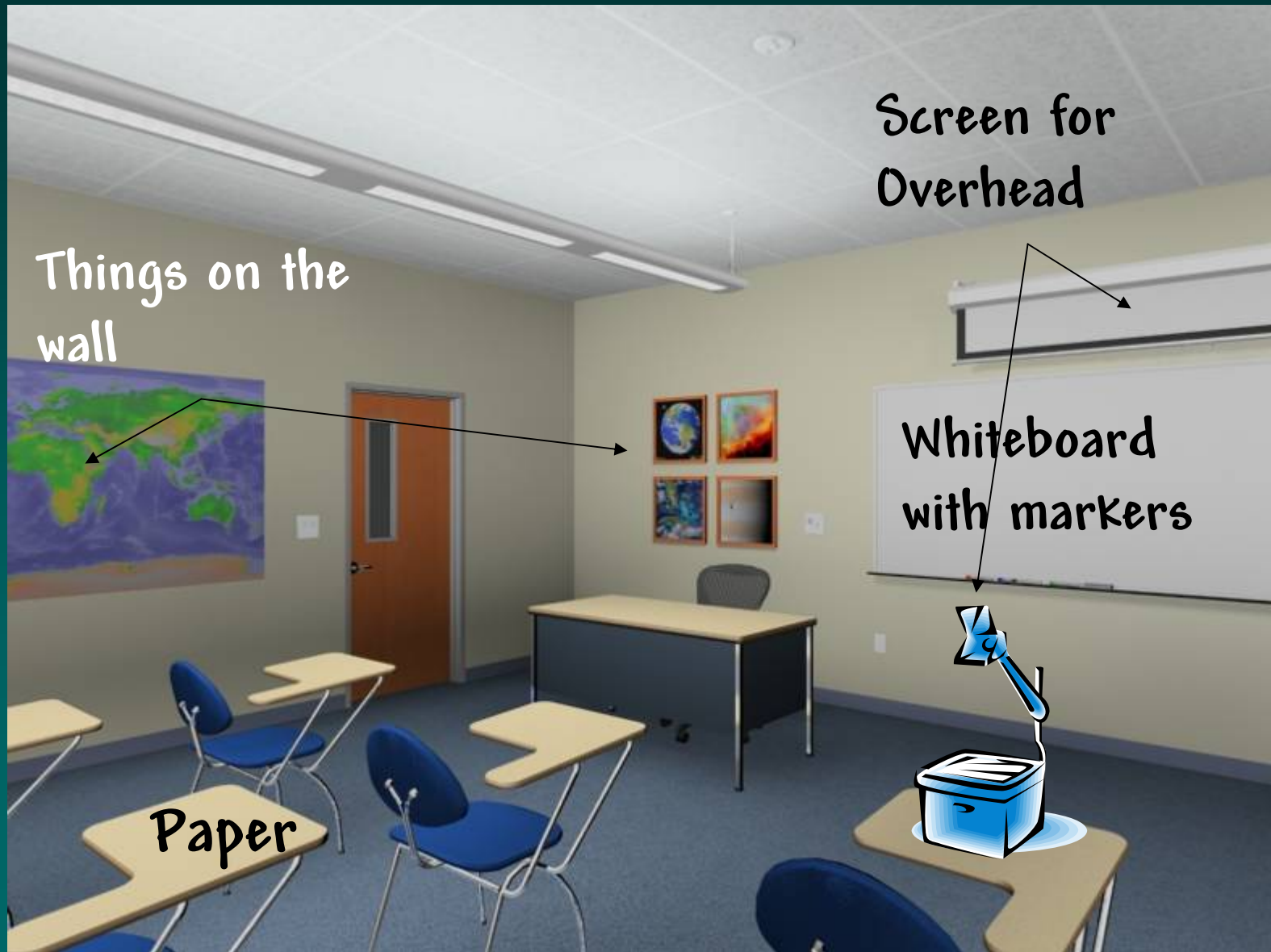
- LEED Platinum
- Net Zero Electricity
- Practical Costs

Design Criteria



TEACHING TECHNOLOGY:
The Traditional Classroom

TEACHING TECHNOLOGY: The Updated Classroom



TEACHING TECHNOLOGY:
The Future Classroom

Video: The Force of Change

Streaming video now playing in classrooms

Area districts, if they have the high-speed capacity, are switching to the versatile digital technology

By LUCIANA LOPEZ
THE OREGONIAN

The video of a hydrogen bomb safety drill, generated from an aging film, played fuzzily on Jeanette Ryan's computer at the Tualatin High School library.

With a few mouse clicks, the school librarian returned to a computerized archive containing similar footage, along with films about the Cold War, checking for other options.

In the past, Ryan would have had to switch tapes or DVDs or even filmstrips to show the images. These days, Tualatin High and many schools throughout the metro area are tapping into a new resource: streaming video, a sequence of images sent over the Internet that can be displayed on a user's computer as they arrive.

School districts are increasingly using digital video files in the classroom, because teachers can download them to show classes, and students can watch and use the files on their own.

Streaming video files, accessed through subscriptions that local education service districts buy, are more versatile than tapes or DVDs, although school officials acknowledge that the high-speed Internet connections streaming video requires

Please see **STREAMING**, Page 4

THURSDAY • APRIL 7, 2005

- PowerPoint Presentations
- Streaming Video Clips
- Internet Sites
- Still Images
- Animations
- Document Camera Projections
- Distance Learning
- Videoconferencing

Which Teaching Technologies Will Last and Be Widely Used?

PROBABLY "YES"

- Whiteboard
- Displays on wall surfaces
- Video projector with computer, VCR and DVD inputs
- Paperwork
- Student laptop or tablet PC

PROBABLY "NO"

- Blackboard
- Overhead projector
- Slide, filmstrip and film projectors
- Costly specialized electronic systems (e.g. "Smart Board")
- Tape recorders
- Blackberries and other small devices

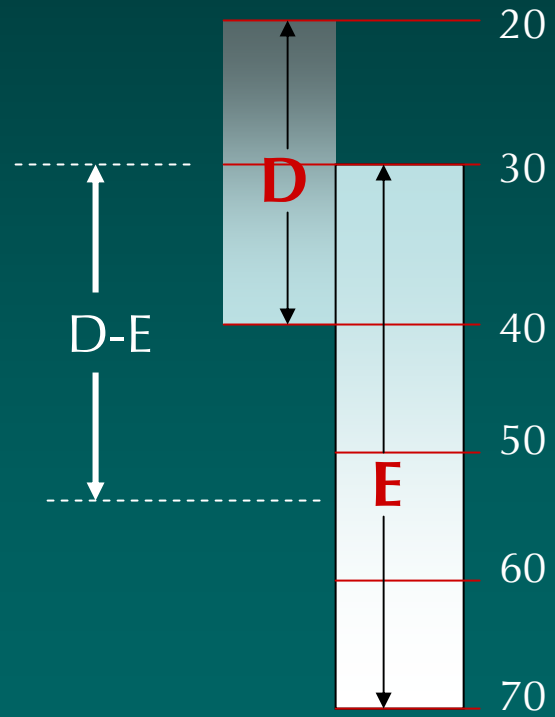
Lighting Levels (Illumination)

From the IESNA Ninth Edition Handbook (2000)

A	Circulation Orientation	2 fc
B	Public Areas	5 fc
C	Simple Tasks	10 fc
D	Large Tasks Good Contrast	30 fc
E	Small Tasks Good Contrast	50 fc
F	Small Tasks Poor Contrast	100 fc

The Principal Task is D-E

- Most tasks in the classroom are “D”, high contrast and large size. IESNA recommends 30 fc average (roughly 20-40 fc throughout the space.
- Some classroom tasks will still be “E”, low contrast/large size or high contrast/ small size. IESNA recommends 50 fc average (roughly 30-70 fc throughout the space).
- A MINIMUM criterion of 30 fc on any desk, is in the mid-range of “D” and just within the “E” range
- Why not set the criteria at 70 FC? (The top of “E”) This is a case where “more” is not better.



Recommended Illumination Criteria

Daylight Mode

Student Desks

- Minimum 30 fc at any desk (meets D-E)
- Maximum 150-200 fc

Whiteboard

- Minimum 30 fc vertical average (meets D)

Walls

- Minimum 10 fc vertical average (meets C)

Recommended Illumination Criteria

General Mode

Student Desks

Minimum 30 fc at any desk (meets D-E) up to 70 fc

Whiteboard

Minimum 30 fc vertical (meets D)

Walls

At least 10 fc average all walls (meets C)

Recommended Illumination Criteria

A/V Mode

Student Desks

Minimum 10 fc at any desk (meets C)

Whiteboard

Not applicable

Screen

No more than 8 vertical footcandles anywhere on screen surface (allows 8:1 video image with a projector <3000 lumens)

Lighting Quality

All of these are quality considerations of the IESNA Lighting Handbook Design Guide

- Appearance of space and luminaires
- Color appearance
- Daylighting integration and control
- Direct Glare
- Flicker and Strobe
- Light distribution on surfaces
- Light distribution on task place (uniformity)
- Luminance of Room Surfaces
- Modeling of faces or objects
- Points of interest
- Reflected glare
- Shadows
- Source/task/eye geometry
- Sparkle/Desirable reflected highlights
- Surface characteristics
- System control and flexibility

Lighting Quality

Recessed troffer lighting and "old school" fluorescent lighting are no longer acceptable except under extreme circumstances due to:

- Negative appearance of space
- Negative appearance of luminaires
- More direct glare than other options
- Dark ceilings and upper walls
- Inability to provide two scene lighting

Recommended Lighting Quality Criteria

- *Aesthetically pleasing/ attractive lighting*
- *Reduce or eliminate direct glare*
- *Provide ceiling and upper wall surface luminance*
- *Flexibility of scenes and easy to use controls*

Setting Cost Budgets

Too often budgets are set according to outdated standards submitted by a contractor.

- Be certain to set the lighting budget carefully and avoid simple low-ball numbers. Otherwise, you will never recover.

Schools are 20-50 year investments. A bad lighting system today will persist and affect the operating costs and quality of the classroom environment for a quarter of a century.

- In setting budgets, emphasize decisions with net life cycle cost benefits and fund them accordingly.

Life Cycle Cost – "Winners"

Design choices that usually result in net life cycle cost benefits

- Lighting systems that anticipate and meet future needs – flexibility is key
- Premium, high lumen lamps
- Efficient electronic ballasts
- Motion sensing controls
- Daylight zone switching controls

Life Cycle Cost – "Questionables"

Design choices that MIGHT result in net life cycle cost benefits depending on site conditions

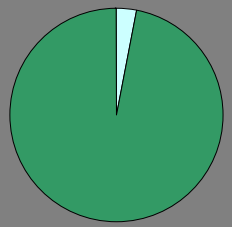
- Automatic daylighting stepped switching or continuous dimming controls (required by code for classrooms in Oregon and Seattle)

Life Cycle Cost – "Losers"

Design choices that NEVER result in net life cycle cost benefits

- Lighting systems that will require future modifications to accommodate changes in the teaching environment
- Lighting systems that save first cost by using less energy efficient components.

Setting the Lighting Budget

 2-4% of school costs	*Good*	*Better*	*Best*
General Lighting System	High performance modern lighting system (optimum layout)	High performance modern lighting system (minimum layout)	High performance modern lighting system (optimum layout)
Teaching Board Lighting System	None (use the light from general lighting system)	Teaching board light	Teaching board light
Costs *With minimum code complying controls* *With full daylighting dimming controls*	 $3,180 ($3.31/sf) $4,560 ($4.75/sf)	 $3,420 ($3.56/sf) $4,800 ($5.00/sf)	 $4,140 ($4.31/sf) $5,520 ($5.75/sf)

Setting Energy Budgets

Applicable Energy Codes		
	Code Requirement	Goal -20%
Ashrae/IESNA90.1-2004	1.4 w/sf	1.12 w/sf
IECC – 2004	1.4 w/sf	1.12 w/sf
California Title 24	1.2 w/sf	0.96 w/sf
Current Best Practices (Pier 4.5 Installations)		**0.82-0.89 w/sf**

Important Research Findings

1999 - 2005

PIER is the Public Interest Energy-Efficiency Research program of the California Energy Commission

- Daylighting in classrooms contributes significantly to student performance (Heschong Mahone Group, 1999 and PIER 2004)
- Views in classrooms also contribute to improved student performance (PIER 2004)
- Teachers prefer and employ multiple scene classroom lighting systems (PIER 2002)
- Daylighting contributes to improved health through reinforcement of the circadian cycle (Lighting Research Center, 2002 and 2004)
- Modern classroom lighting systems with thoroughly integrated controls save considerable energy compared to conventional lighting and controls (PIER, 2004)
- Teaching board lights contribute to student attention and retention (University of Illinois, 2001)

Criteria: Summary

Daylighting

- Optimize daylight and maximize its use

Energy

- Design electric lighting at least 20% less power density than current energy codes
- Employ lighting controls that harvest all possible energy savings.

Lighting quantity and quality

- Meet current IESNA recommendations
- Provide flexibility to meet varying activities and needs
- Address the video environment

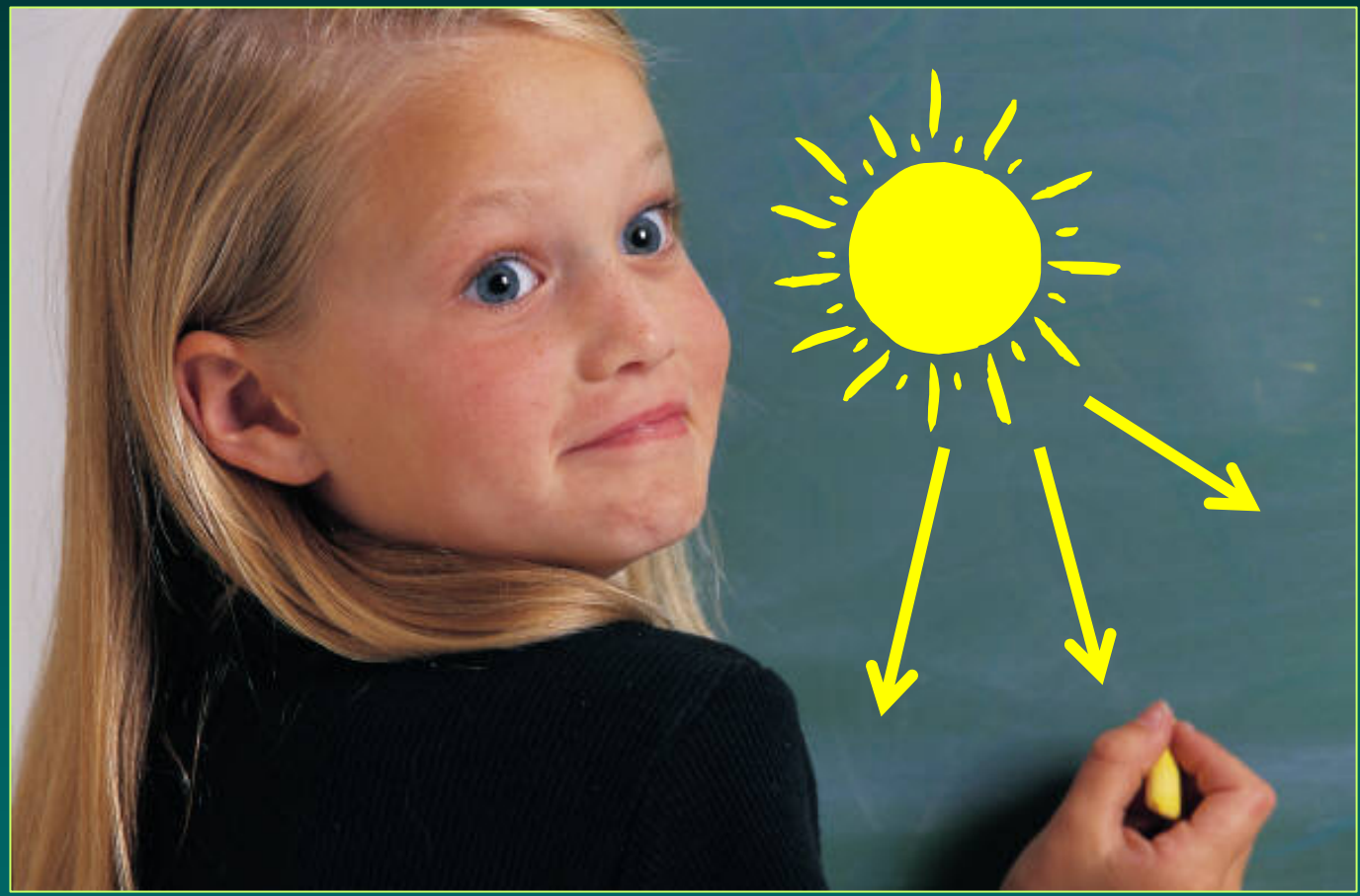
Controls

- Employ lighting controls that are flexible and accommodate daylighting and future teaching technologies

Cost

- Provide these capabilities for modest costs that contribute to overall life cycle cost reductions.

Daylighting



What To Expect from Daylighting

From conventional windows

- Useable light under most conditions for the side of the classroom nearest the windows
- Frequent need to use at least ½ of the electric lighting

From more advanced daylighting designs

- Decreased dependence on electric lights dependent on the daylighting design, solar orientation, climate, etc.

Conventional Daylighting

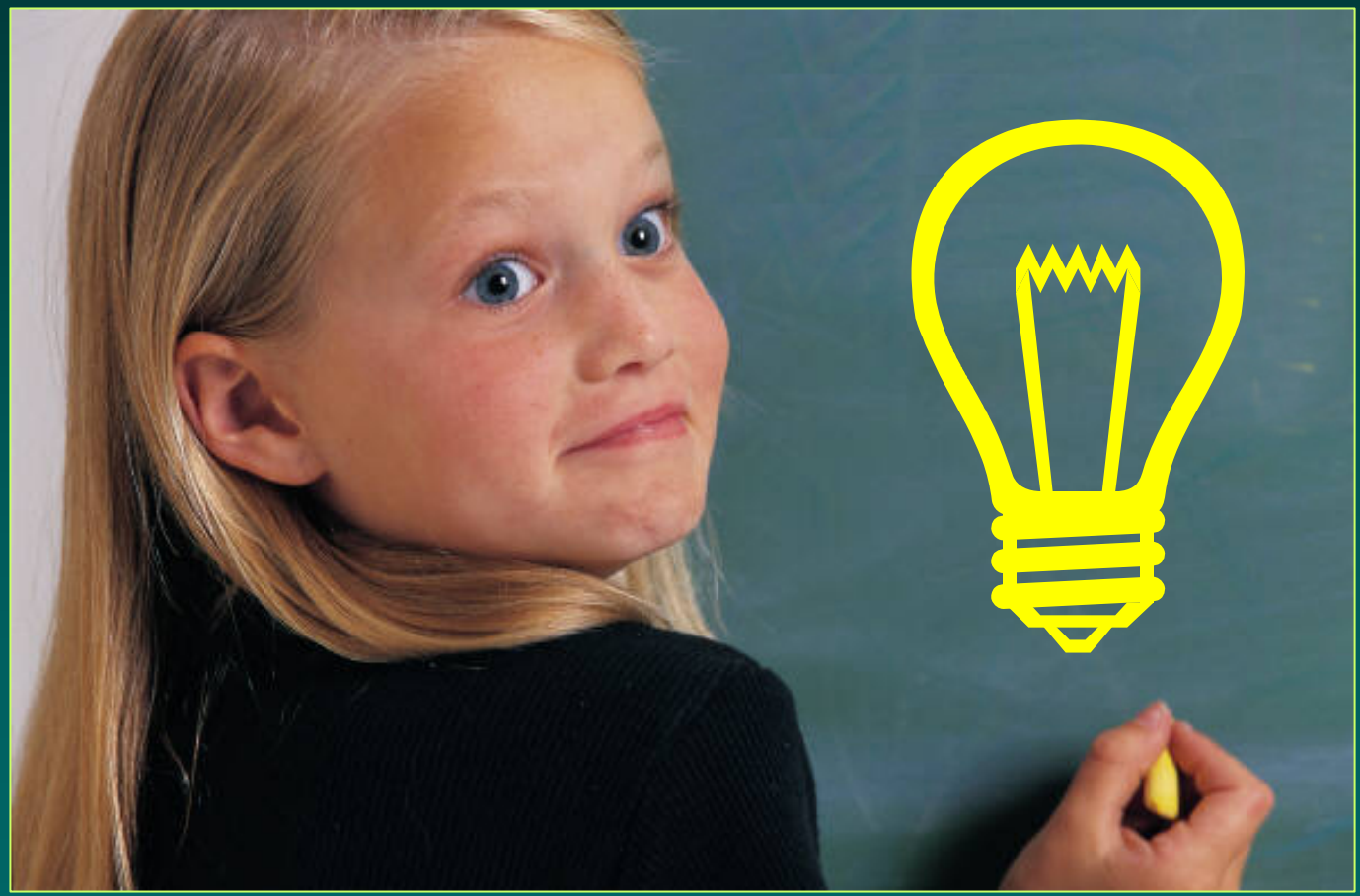
Typical windows will illuminate about ½ of the room to required levels on most days. Electric lighting will be needed for the area away from the windows and on dark days, for most of the room.

Clerestory windows provide light deeper into the room – on many days all lights can be off, but on darker days it still may be necessary to turn on lights for the side of the room away from the windows.

Integrating Daylight

1. Design electric lighting rows PARALLEL to the daylight source.
   - *Provide separate switches so that rows of lights nearest the window can be extinguished.*
2. Provide separate switches for daylighted and non daylighted zones.
   - *Required by California Energy Code*
3. If desired, provide automatic daylight switching or dimming
   - *Be certain to provide override controls when video shading systems are being used*

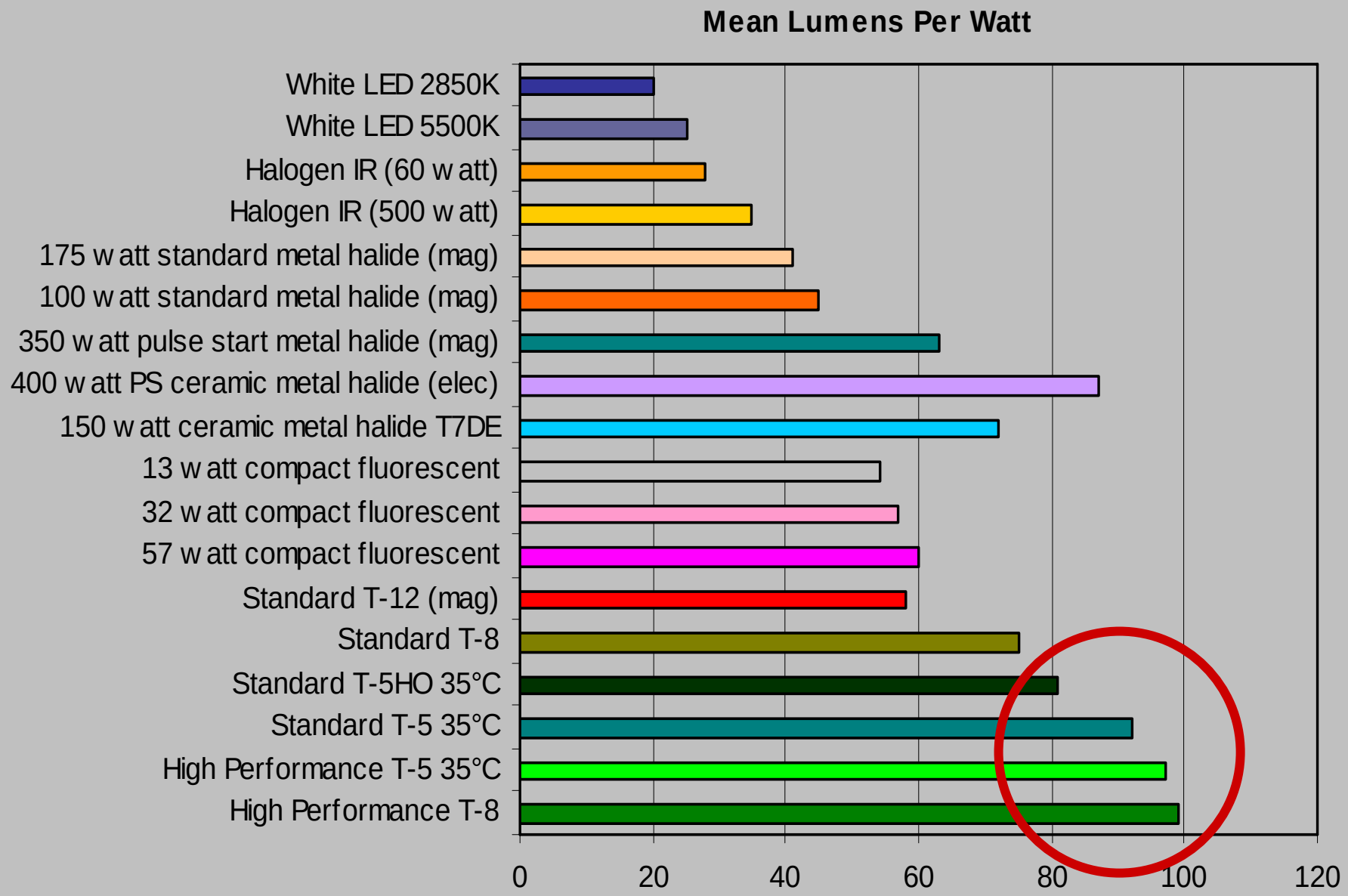
Electric Lighting



Light Source Technology

At this time, we recommend ***only*** fluorescent lighting because it is:

- Energy efficient
- Inexpensive
- Long life
- High quality light
- Easily and readily switched and dimmed



The efficacy of fluorescent lamps is superior

Recommended Lamp & Ballast System

Prefer the T8 system.

The T5 system requires 35°C ambient (about 95°F) for optimum operation. This temperature can only be achieved in an enclosed luminaire.

- Use high performance, high lumen T-8 lamps.

  Products: Sylvania XPS, GE HL, Phillips Advantage

- For classrooms, efficient electronic instant start ballasts are probably the better choice.

  Products: Sylvania QHE, GE Ultramax, Advance Optanium, Universal Ultim8

- Consider high ballast factor (1.15), normal ballast factor (0.88), or low ballast factor (0.71-0.80) as key options in the design.

T-8 dimming options

Dimming ballasts use about 15% more power than non dimming ballasts for the same light level. Use them only when dimming (such as for daylighting) is necessary.

NON DIMMING BALLASTS		
INSTANT START		
2-lamp	88%BF Standard	59 watts
2-lamp	88%BF Efficient	54 watts
PROGRAM START		
2-lamp	88% BF Standard	61 watts
2-lamp	88% BF Efficient	56 watts

DIMMING BALLASTS		
0-10 volt (Sylvania)		
2-lamp	88%BF	62 watts
Two-wire (Advance)		
2-lamp	88%BF	60 watts
DALI (Universal)		
2-lamp	88% BF	62 watts

Control Technology

A classroom can have any or all of the following:

- Predictable Scheduling
  - By calendar, clock, and/or solar time
- Unpredictable Scheduling
  - By motion sensing and/or manual switching
- Daylighting
  - Automatic switching or dimming
- Use (scenes)
  - Manual dimming or multi-level control

In general, automatic scheduling controls of either kind are required by most energy codes. Separate daylight zone controls and/or two level lighting controls are required by some energy codes.

Controls – Best Practices

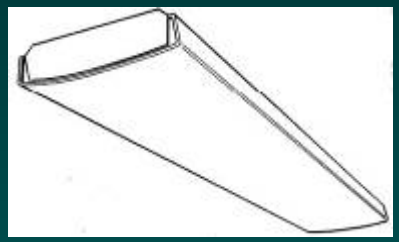
- Dual technology motion sensors and teacher quiet time override provide the best controls with the least cost and complexity
- Automatic daylighting controls should be carefully considered
  - *A switching system should be used, with photoelectric or solar time control, as a minimum*
  - *Dimming should be considered if the average electric lighting power is less than 50% of full power*

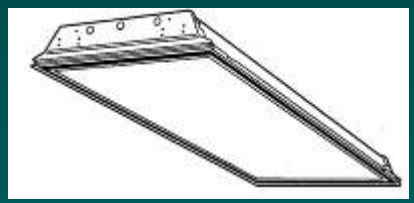
Classroom Lighting Luminaires

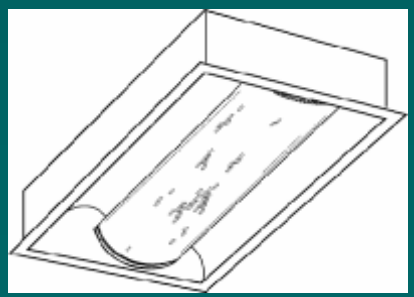
How to Select a Luminaire

1. Efficiency
2. Quality
3. Appearance
4. Flexibility
    a) *For general lighting*
    b) *For daylighting integration*
    c) *For video low light level mode*
5. Cost

Classroom Lighting Choices



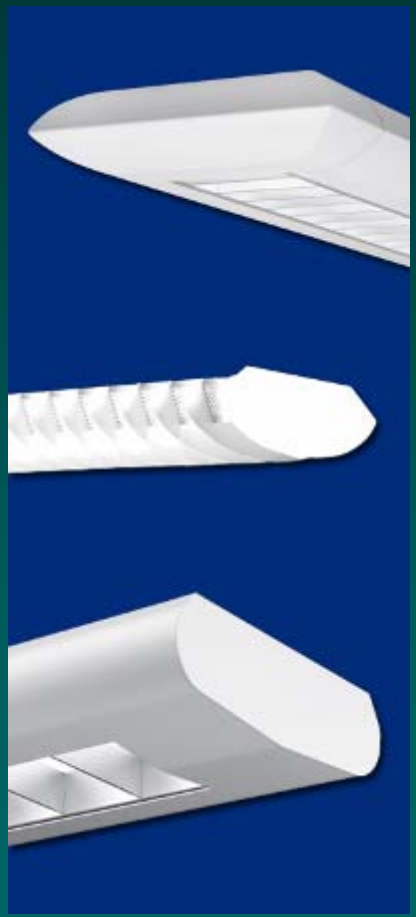




Conventional Surface and Recessed Lighting

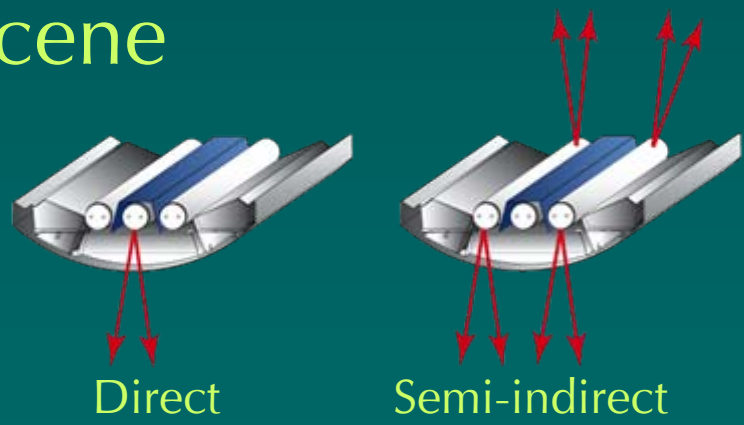
- Wraps
- Lens troffers
- Parabolic troffers
- Basket troffers

Classroom Lighting Choices

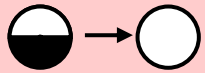


Modern suspended fluorescent lighting

- Indirect
- Direct/indirect
- Two-scene



Classroom Lighting Choices

Lighting System	*Efficiency*	*Quality*	*Appearance*	*Flexibility*	*Cost*
Surface Wraps					$
Lens Troffers					$-$$
Parabolic Troffers					$$
Basket Troffers					$$-$$$
Pendant Uplights					$$
Pendant direct-indirect					$$-$$$
Pendant two-scene					$$-$$$

Performance:

 Excellent

 Very Good

 Good

 Fair

 Poor

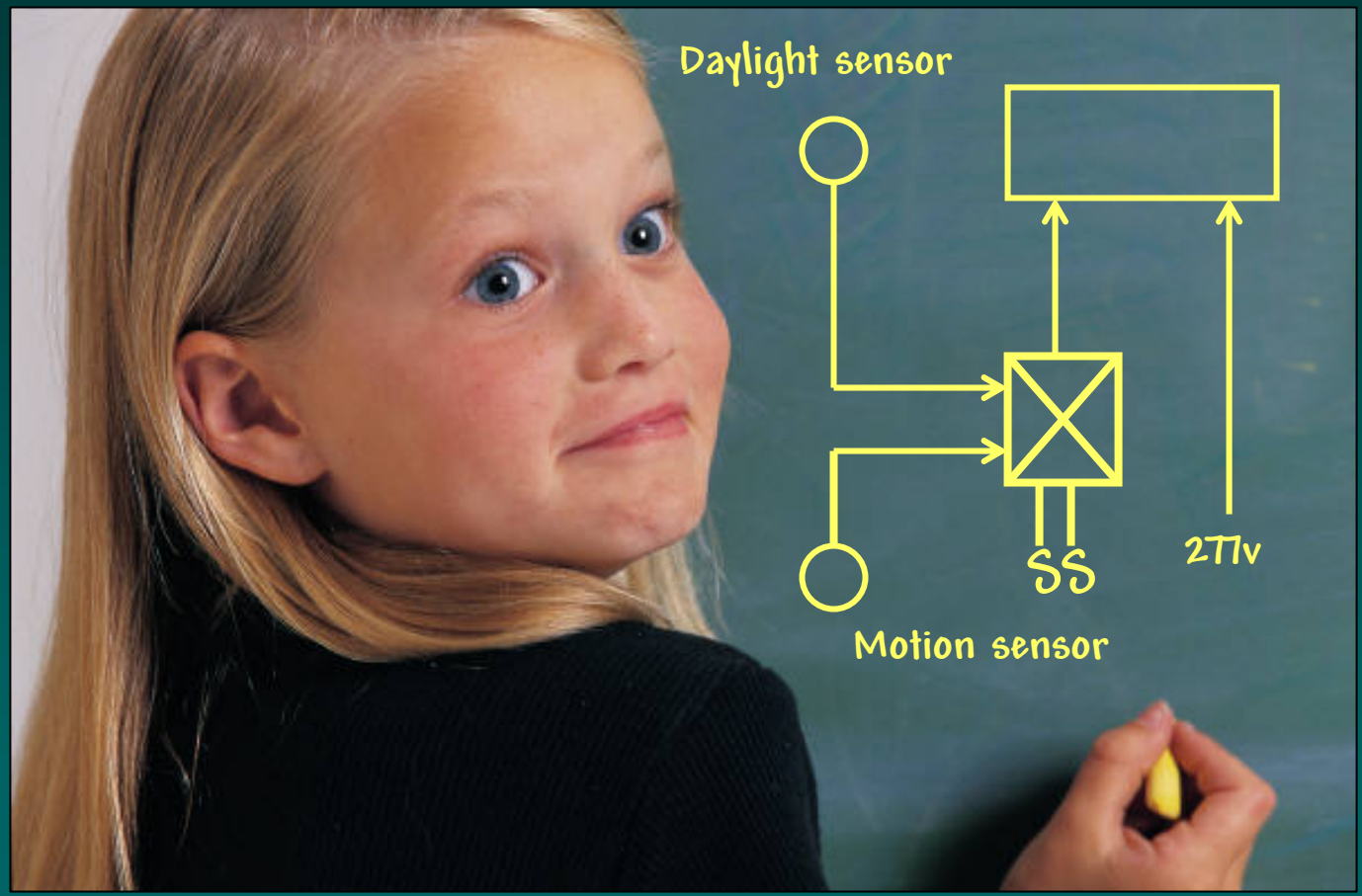
Cost: $ - Low $$ - Moderate $$$ - High

Board Lighting

- Minimum recommended by IESNA: Category "C" (10 fc vertical)
- Practical modern lighting systems actually provide 30-40 footcandles vertical illumination with 2:1 or better uniformity (IESNA Category "D") permitting viewing of details from back of room
- Provide separate switching and locate luminaires to prevent specular reflections from the board

Carefully design lighting to prevent specular reflections from the board surface into student eyes

System Integration Ensures Success



The PIER Lighting System

Developed as a PIER research project conducted by Architectural Energy Corporation. Project goals included

1. Refine the two scene lighting system
2. Achieve extraordinary energy efficiency
3. Meet all project criteria without the need for dimming
4. Manage costs through every means possible
5. Capable of meeting every lighting 2005 energy code

THE PIER CLASSROOM LIGHTING SYSTEM

Based on a 960 sf classroom with a 9′6″ ceiling.

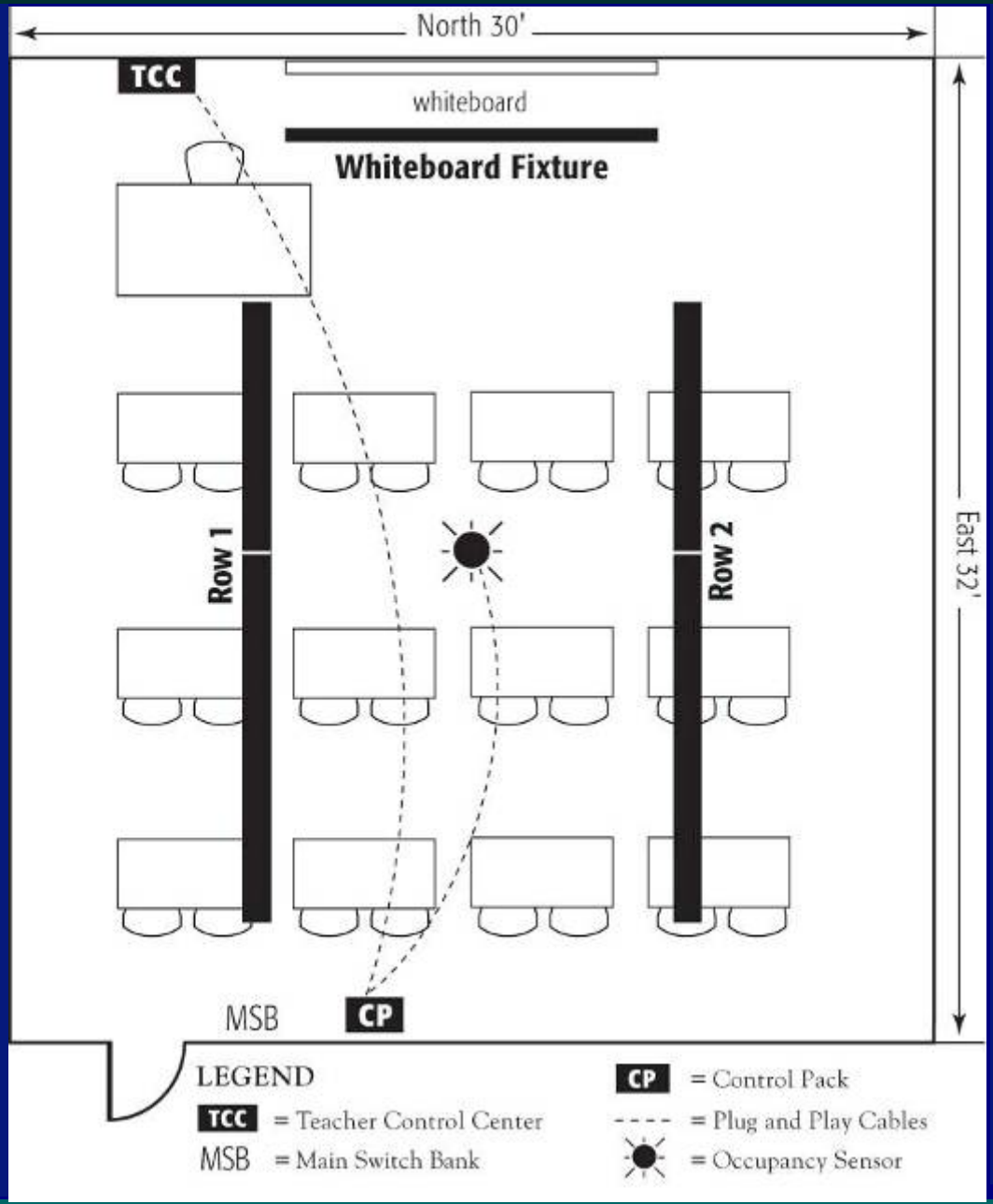
Side daylighting from windows with clerestory panels

Top daylighting possible but not assumed

Two rows of 5 each, two scene semi-indirect/direct luminaires, centered over the student seating area

One row of teaching board lights nom 12′ long.

T8 High Performance



OPTIONS

Good

(2) Rows of 6 two-scene luminaires

No board light

Better

As shown

Best

(2) Rows of 6 two scene luminaires

With Board Light up to 16′ long

Specific Components

Uplight Component of Suspended Luminaires

(2) F32T8 lamps per 4′ section, high lumen (3100 initial) with high light output (BF 1.15) instant start ballast (good and better configurations) or normal light output (BF=0.88) in best configuration

Downlight Component of Suspended Luminaires

(1) F32T8 lamp per 4′ section, high lumen, with normal light output (BF 0.88) ballast

Board Light Luminaire

(3 or 4) F32T8 lamps, high lumen, with normal light output instant start ballast

Controlling Cost

In using more expensive luminaires, PIER had to develop means to control cost in other ways to make the PIER system affordable. The following techniques were used:

- *Minimum number of ballasts*
  - *(4) uplight ballasts per row*
  - *(2) downlight ballasts per row*
  - *(1) board light ballast*
- *Minimum number of power feed points*
  - *(2) rows plus board light*
- *Minimum number of suspension points*

System Integration

- Light level (scene) controls
  - *Manual switching*
  - *Dimming Options*
- Daylighting
  - *Control zones*
  - *Types of Control*
  - *Sensors*
- Motion Sensing
  - *Sensors*
  - *Switching*
  - *Teacher Quiet Time Override*

Light Level Integration

Scenes

- General mode (uplights on)
- A/V mode (downlights on)
- General mode with board
- A/V mode with board

Basic teacher control center at teaching board

Switch turns board light on or off

Switch selects uplights or downlights NEVER BOTH

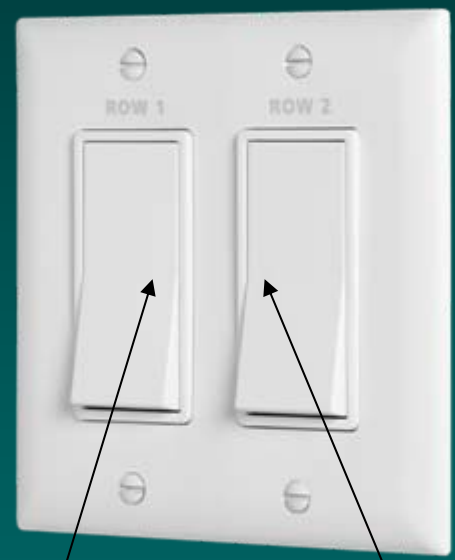
Daylight Integration

Daylighting Controls

- Daylight zone 1 (row nearest windows)
- Daylight zone 2 (row away from windows)

Option A: Daylight zone 1 can be wired in series with a photocell switch

Option B: a daylight dimming photocell can be used if dimming ballasts are installed

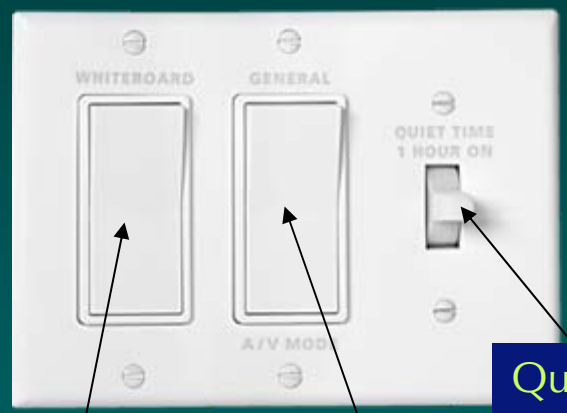


Motion Sensor Integration

Generally, use a large room, dual mode ceiling mounted sensor, wired in series with all lights.

Provide a teacher "quiet time" override because teacher may not move enough to be detected.

Teacher Control Station with Quiet Time Override (1 hour timer)



Quiet time switch

Teaching board light switch

Switch selects uplights or downlights NEVER BOTH

The PIER Integrated Control System

- Motion sensor ceiling mounted center of room
- Entry switches separate rows
- Teacher control station selects uplights, downlights and board lights.

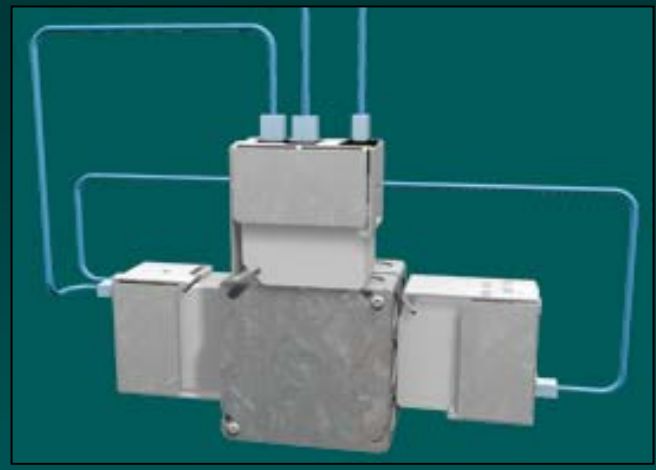
The PIER Integrated Control System

OPTIONS

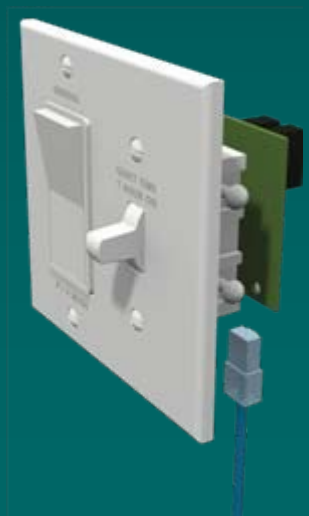
- Switching photocell (window row only)
- Dimming photocell (preferably 2-zone)
- Manual dimmer for downlights

What Makes PIER Work

- Prewired luminaires – simple electrical terminations
- Prewired, plug and play control components
- Low voltage, plenum rated class II control wiring does not require conduit
- Significantly reduced first costs due to plug and play integration

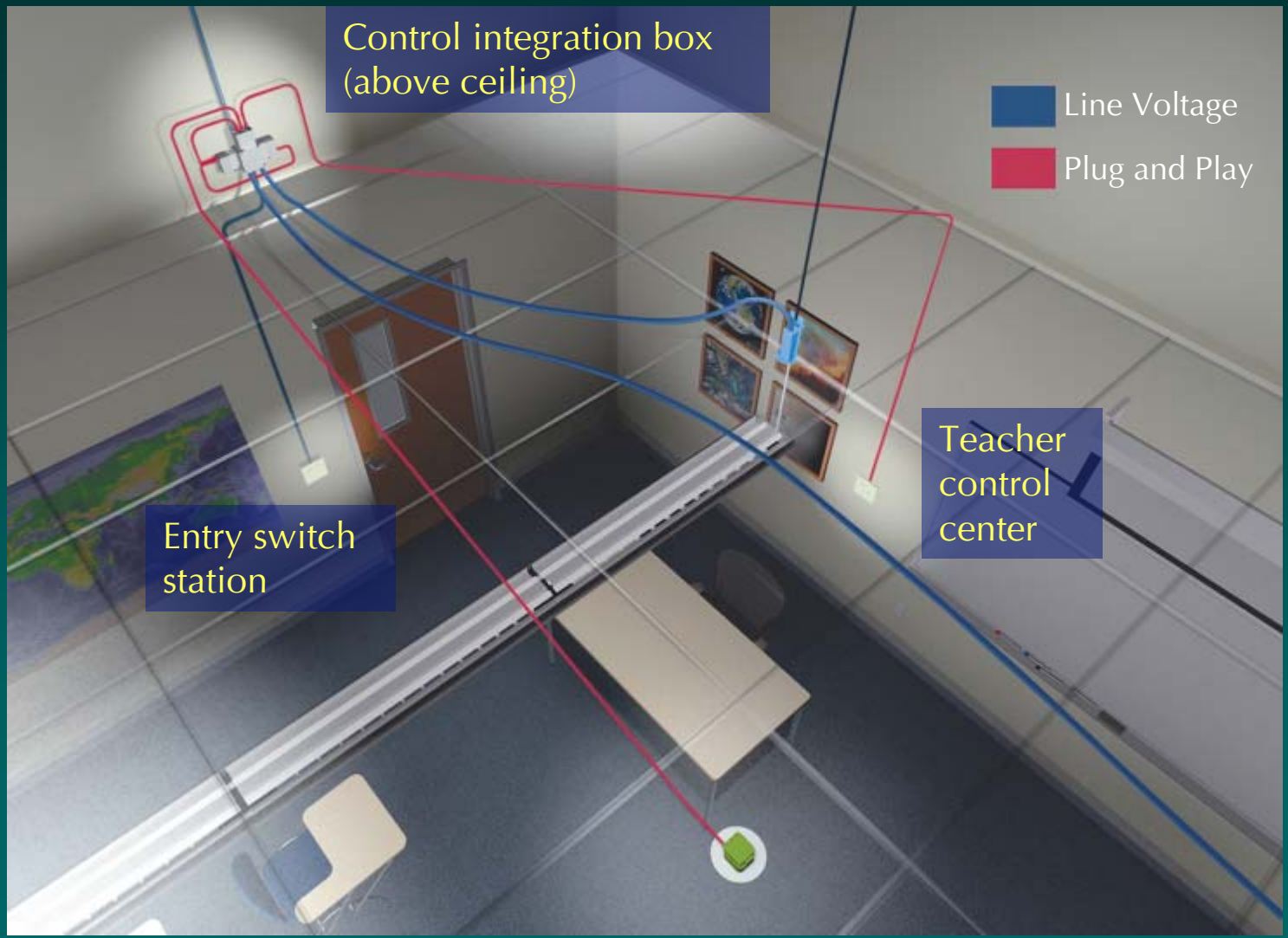


Control integration box -1 per classroom



All wall stations are low voltage

Plug and Play Wiring



Completing PIER: Field Activities

Commissioning and Start Up

- Plug and play eliminates wiring errors
- Commissioning includes
  - *Calibrate and set motion sensors*
  - *Calibrate and set daylight sensors*

Acceptance Testing

- Demonstrating full operation

User Education

- Teaching the teachers how to use the lighting systems and what they can (and can't) do

PIER Classroom System Performance

Parameter	***Criterion***	***PIER Performance – 2 Row "Good" System – 6 luminaires per row***	***PIER Performance – 2 Row "Better" System with Whiteboard luminaire – 5 luminaires per row***
Illumination throughout student seating area in general mode	30 fc Min (maintained)	59 fc Avg (31 fc Min in corner)	46.5 fc Avg (27 fc Min in Corner)
Board illumination in general mode.	10 fc min 4:1 or better	25.5 fc Avg 1.4 : 1	34 fc Avg 2 :1
Daylighting integration without dimming	at least 50% power reduction	Separate row switching minimum	Separate row switching minimum
A/V Mode illumination throughout student seating area	10 fc Avg (maintained)	22 fc Avg	18 fc Avg
Vertical illumination on screen in A/V Mode	8 fc max	8 fc Max	6 fc Max
Lighting Power Density (high efficiency lamps and ballasts)	0.96 w/sf or better	0.88 w/sf in General Mode 0.36 w/sf in A/V Mode	0.86 w/sf in General Mode 0.30 w/sf in A/V Mode
Meets Energy Codes	All	All	All

Summary of the PIER Classroom Lighting System Project

- ✓ An extremely efficient lighting system
- ✓ A lighting system compatible with front screen projected video and capable of multiple scenes
- ✓ A lighting system capable of simple or complex daylighting integration
- ✓ A plug and play control system capable of all necessary controls using either non-dimming or dimming technology
- ✓ A complete system designed to be reasonably cost competitive with ordinary classroom lighting systems
- ✓ A complete system that is easy to design, specify, install, commission, and use


Wrap Up
Any Questions?