

Better
Illumination
**FOR OUTDOOR
LIVING**



"A forum whereby our audience may review and evaluate their own performance and success as pertained to outdoor lighting."

Landscape Ontario – Landscape Lighting Conference 02/16/2012
Toronto, Canada
presents

TONIGHT'S FORECAST



Dark

CONCEPT . . .



- Attention to the need to light an otherwise darkened space.
- To make the space safe, secure and allow for physical and visual movement.
- Most important!
Be Comfortable for the User.



HISTORY OF LIGHT



From prehistoric campfires throwing shadows on a cave wall to festive torches, the creative use of light has pushed back the darkness and made the night a part of man's domain.

FIRE FOR LIGHT – (and food)

Fire-making and management appears about 10,000 years ago with Neolithic man. The challenge? Keeping the fire.



“Yog is our VP-in-charge of rubbing sticks together.”

Homer’s poem’s 3,000 years ago recount use of pine torches.



Torches coated with resinous pitch ... very flammable and very luminous when burned.

WOOD, OIL, WAX

Olive and sesame oils floated on water & terra cotta oil lamps made of stone, metal and shell.



In the early 17th century animal oils were obtained from whales.

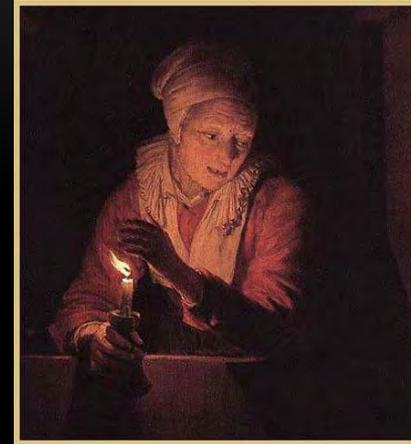
It was the fuel of choice for the wealthy.

Harpoons and whale oil lamps became popular.



WAX AND CANDLES

From about the sixteenth century onwards living standards improved greatly as evidenced by the increasing availability of candlesticks and candleholders and their appearance in middle class households.



In the early 1800's paraffin was discovered and "modern day" candles took the stage.



MATCHES

In 1827 the ends of sticks were coated with antimony sulfide, potassium, chlorate, gum and starch. Patented in 1844.

(Prior to invention of matches the use of tinder boxes containing flints, steel and tinder were commonplace).



GAS LIGHTING



Established in London in 1813, "coal gas" revolutionized lighting in urban areas.

THE ORIGINAL LIGHT BULB

was patented in 1880 by Thomas Edison



The Incandescent Light Bulb has enjoyed a pretty good run. It has been a reliable source of artificial light for well over a century.

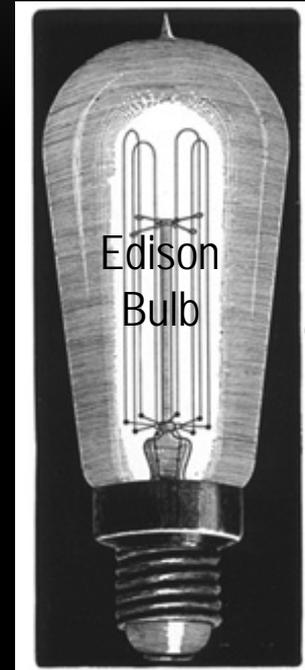
A 130 YEAR-OLD TECHNOLOGY

* SLATED PHASING OUT DATES *

* 2012 – 100 watt lamp

* 2013 – 75 watt lamp

* 2014 – 60 watt lamp

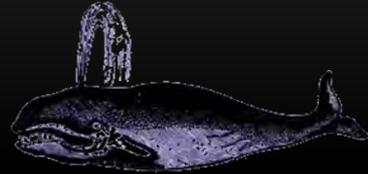


Going...going...almost gone!



Side note:

Conservation & The Blindness of Commerce ...



- 1780 – Whale populations were hunted into near extinction for oil to light factories and lubricate machines! The 1st time artificial lighting presented a threat to an environment.
- Demand for artificial illumination required 3 year voyages (to butcher) to secure greater volumes of whale oil!
- 1850 – Ironically, what saved the whale population was the discovery of “rock oil” or petroleum. It was far easier to obtain, produced cheap kerosene for lighting, and was a superior lubricant.
- 1880 – Invention of electric –powered light provided a superficial appearance of cleanliness as compared to the pollution associated with petroleum production.

Bottom-line – there is a need to reign in the negative impacts of industry and human impact
TODAY...

This brief walk through history celebrates the development and influence of light.

It is a rich mixture of ingenuity, persistence and technology that brings us to understanding the most challenging lighting technology of today . . .

SOLID-STATE LIGHTING

TODAY'S EXCITEMENT AND EXPECTATIONS



“I’ve always been at the right
place at the right time.

Of course, I steered myself there.”

- Bob Hope

American Entertainer, Patriot and Humanitarian

SSL – CHANGING THE WAY WE LIVE



“No other lighting technology offers as much potential to save energy and enhance the quality of our building environments, contributing to our (mutual) nation's energy and climate change solutions.”

- U.S. Department of Energy (DOE)

- Lower carbon emissions and new capital infrastructure associated with electricity generation; to decrease more than 10% by 2015.
 - Human visual experience enhanced through digital and independent control over the color, intensity, and spatial distribution of lights.
-

THE NEWEST BUZZWORD . . . LEDS

are solid state devices that directly convert electricity to light.

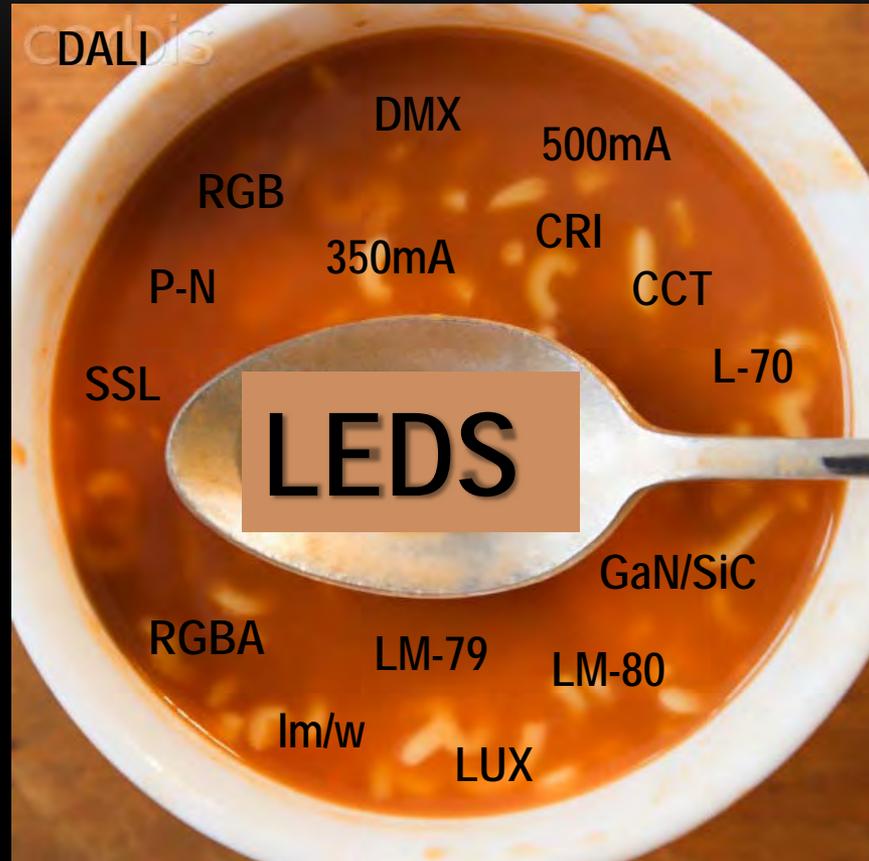


The human brain has evolved to connect warm yellowish light to relaxation and calm – think of a campfire dinner in a cave.

Conversely, we connect cool crisp light to alertness and activity – think hunting woolly mammoth in the mid-day sun. For our living spaces, we find the warm-colored light to be more inviting.

Energy efficiency and clean, renewable energy will mean stronger economies, cleaner environments, and greater energy independence for all.

LED Alphabet Soup

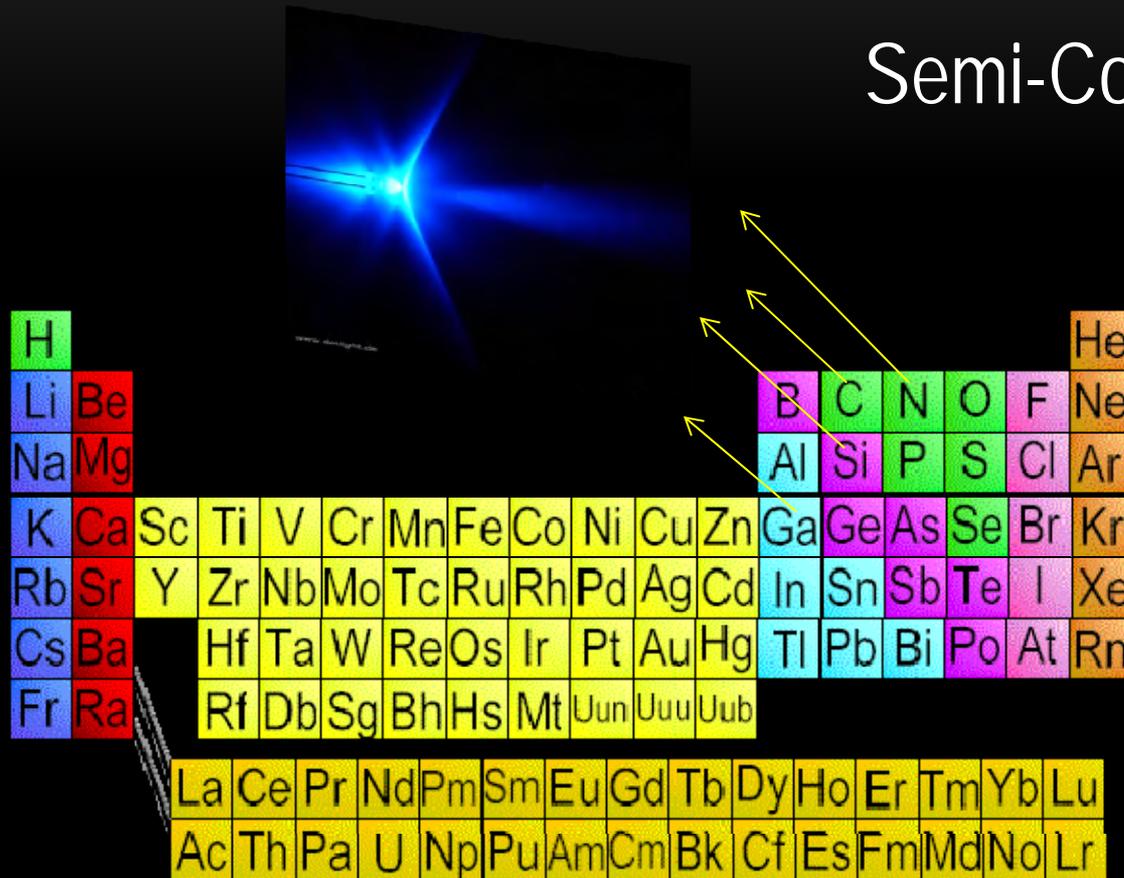


SSL – THE NEW LANGUAGE

- **SSL** – solid-state lighting; umbrella term for semiconductors used to convert electricity into light.
 - **LED** – light-emitting diode.
 - **CCT** – correlated color temperature; a measure of the color appearance of a white light source. CCT is measured on the Kelvin absolute temperature scale. White lighting products are most commonly available from 2700K (warm white) to 5000K (cool white).
 - **CRI** – color rendering index; a measure of how a light source renders colors of objects, compared to a “perfect” reference light source. CRI is given as a number from 0 to 100, with 100 being equivalent to the reference source.
 - **Lumen Maintenance** – the percentage of initial light output produced by a light source at some percentage of rated useful life (usually 100% for LED and 40% for source types characterized by sudden failure).
-

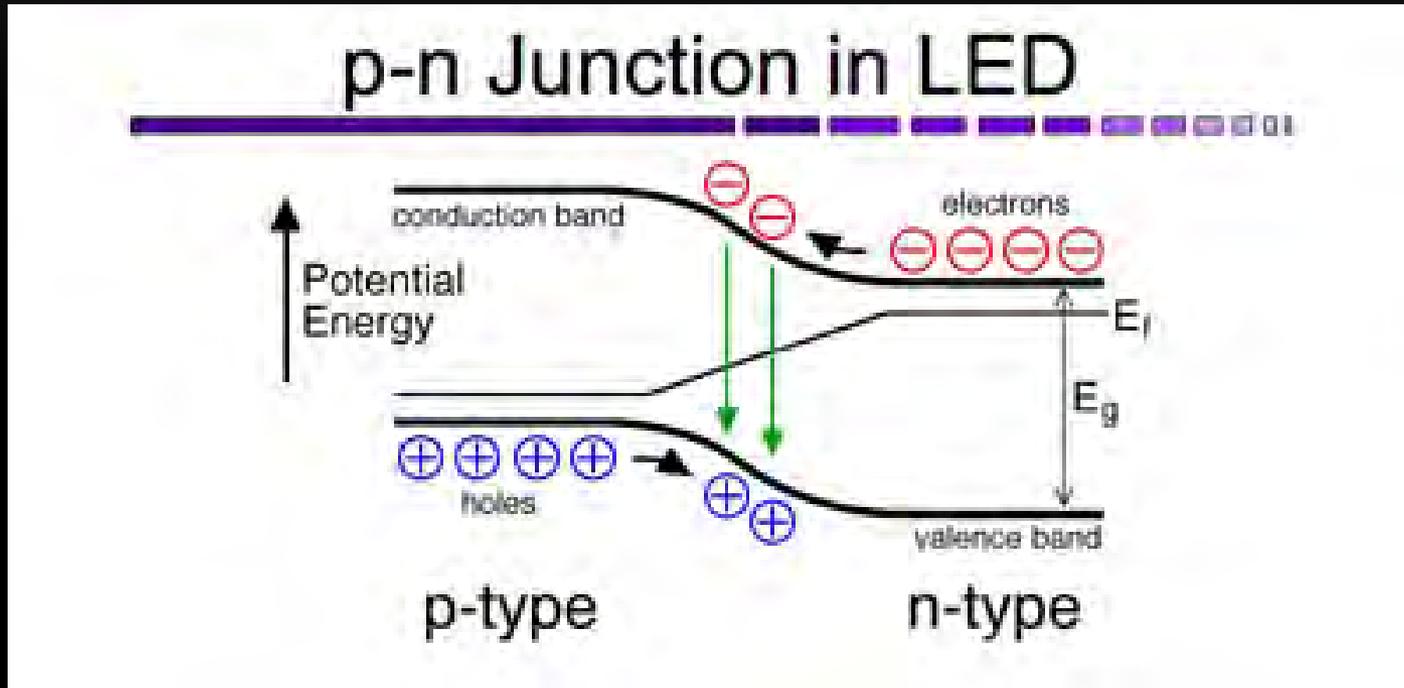
PERIODIC ELEMENTS

Semi-Conductors



Gallium, Silicon, Nitrogen, Carbon

p - n JUNCTION



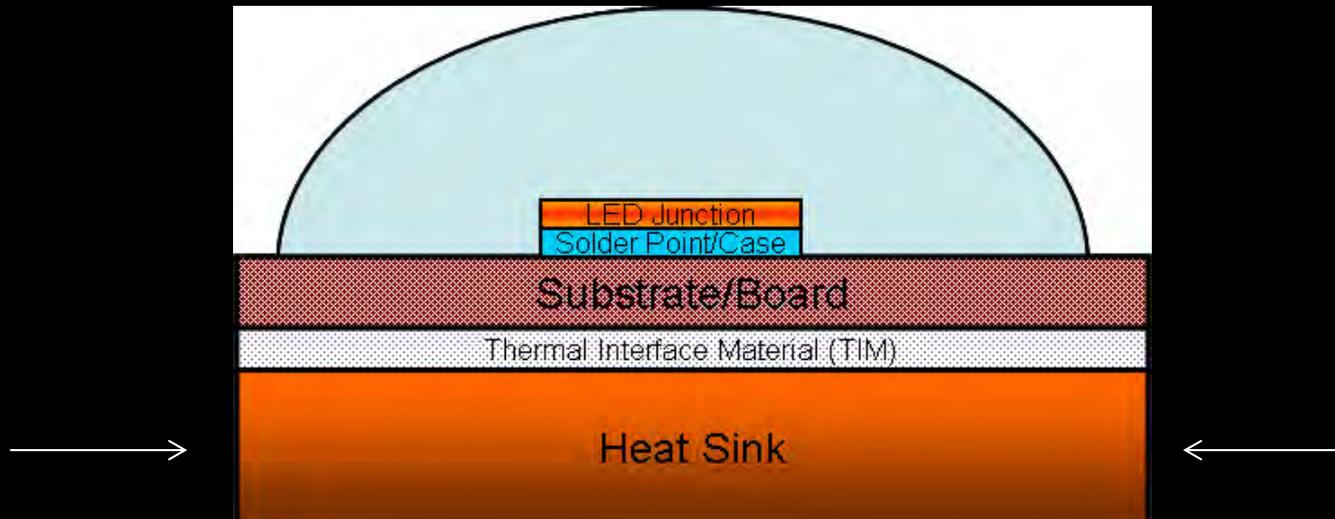
As a diode, an LED has a positive (p) anode and a negative (n) cathode that meet at a junction.

It is at this p-n junction where the work of converting electricity to light occurs.

THERMAL MANAGEMENT

Proper heat-extraction is required to create a reliable and efficient design.

- Color shift
- Lumen Output / Brightness
- Reliability
- Optical transmissions
- Driver circuit, current stability
- Mechanical connections stressed



WHY CHOOSE LEDS

- Excellent Color-rendering
- Cool to the touch – No infrared radiation (IR)
- Light Output – High Efficacies – Lumens per watt
- Energy-Saving – 10% less energy
- Up to 50,000 hours vs. CFL @ 10,000 hours
- Ease of integration into existing systems
- Ecological lighting solutions - No mercury (floures. HID's)
- Uncompromising direct replacement for MR-16 footprint
- Eco-friendly, long-lasting, directional, beautiful and bright
- No UV emissions – Materials, fabrics – Museum-friendly

Bottom-Line: LEDs far exceed the experiences and expectations of previous attempts.

" LIONS AND TIGERS AND LUMENS, OH MY!"



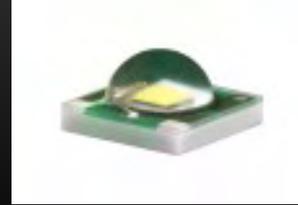
Watts vs. Lumens

- Input power is measured in watts.
- Light output is commonly measured in lumens. Total amt. of light given off by the source, e.g. measure of brightness.
- The amount of light falling on an object is measured in foot-candles.

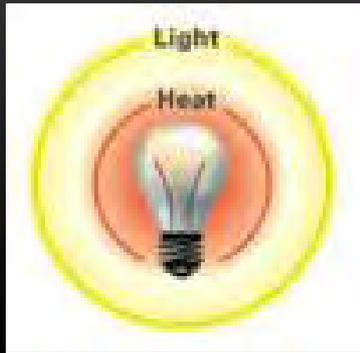
Key! The wattage is not directly related to the lumen output!

Key! LEDs are very efficacious light sources, meaning they generate more lm/w.

...more on Lumens



- Light output is commonly measured in *lumens* — a convolution of the radiated power and the sensitivity of the human eye.
 - The efficiency of lighting (luminous efficacy) is the light output (*lumens*) produced per unit of input electrical power (*Watts*) – or *lumens/Watt*.
 - A 60-Watt incandescent bulb produces about 850 lumens and 15 lm/w.
 - Today's LEDs are between 85 – 140 lm/w!
-



Incandescent bulbs create light by passing electricity through a metal filament until it glows white-hot. Unsurprisingly, this type of lighting produces little light in relation to power and heat.

Waste heat: 90 to 95%

Lumens per Watt: 16

Life: 750 to 2,000 hours



Compact fluorescent lights (CFLs) drive an electric current through a tube containing gases to produce ultraviolet light that is subsequently converted into visible light when it passes through a fluorescent coating on the inside of the tube.

Waste heat: 80%

Lumens per Watt: 100

Life: 5,000 hours



Light-emitting diodes (LEDs) use the movement of electrons through a nitride-based semiconductor to produce a blue glow. That light is typically passed through a yellow phosphor to produce white light.

Waste heat: 20% or less

Lumens per Watt: 100+ (300 theoretically possible)

Life: 50,000 hours

OLD



vs.

NEW



- Gives off **90%** of energy consumed in the form of heat.
- That leaves **only 10%** used to produce light.
- Avg. lifespan is 1100 hours.

- LEDs have a higher efficacy.
- Lifespans to 50,000 hours.

Standard incandescent
60 w. A-line lamp
to be discontinued in 2014.

Flag Pole Lighting – *Talk about high efficacy!*



Client's 35' flag pole displays an American Flag (8'x12') and a U.S. Marines Flag (6'x8').



Salute!

*Specifications: 6 watt – 4100K – 510 lm –
Narrow 10d. optics.*

(5 fixtures - 12vAC power supply).

- *Solution eliminates maintenance and an energy-savings of 970 watts!*

Inherent Problem: 'Self-cleaning' 40' Royal Palms wreaked havoc on lighting equipment.

IES LM-79



Approved Method for Electrical and Photometric Measurement of SSL Products.

Illuminating Engineering Society (IES) Standards and Photometric Measurements of Solid-State Lighting Products

Approved method describing procedures and precautions in performing reproducible measurements of LEDs:

- – total flux - lumens
- – electrical power – radiant flux - watts
- – efficacy (lm/watt)
- – chromaticity – CCT CRI

The Whole Fixture

IES LM-80



LM-80-08 Approved Method for Measuring Lumen Maintenance of LED Light Sources.
-50,000 hours operation with
-70% lumen maintenance.

Illuminating Engineering Society (IES) Standards and Photometric Measurements of Solid-State Lighting Products

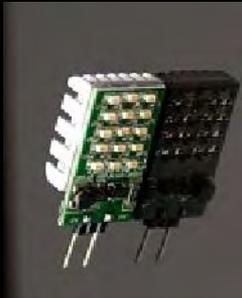
Note! LM-80 covers lumen maintenance measurement for LED packages, arrays and modules.

L70 is acceptable depreciation of LED over rated hours and shall not exceed 70%.
L-70 Lumen Depreciation – maintain 70% lumen output at end of life.

The LED Source

Common LED Retro-fit Types

Outdoor Applications



Bi -Pin



MR-16

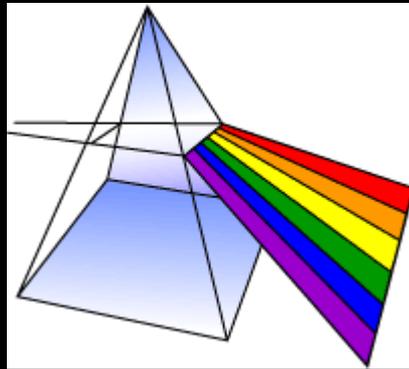


Wedge-base

The Visible Color Spectrum



White Light



Prism

IR -infrared

Red

Orange

Yellow

Green

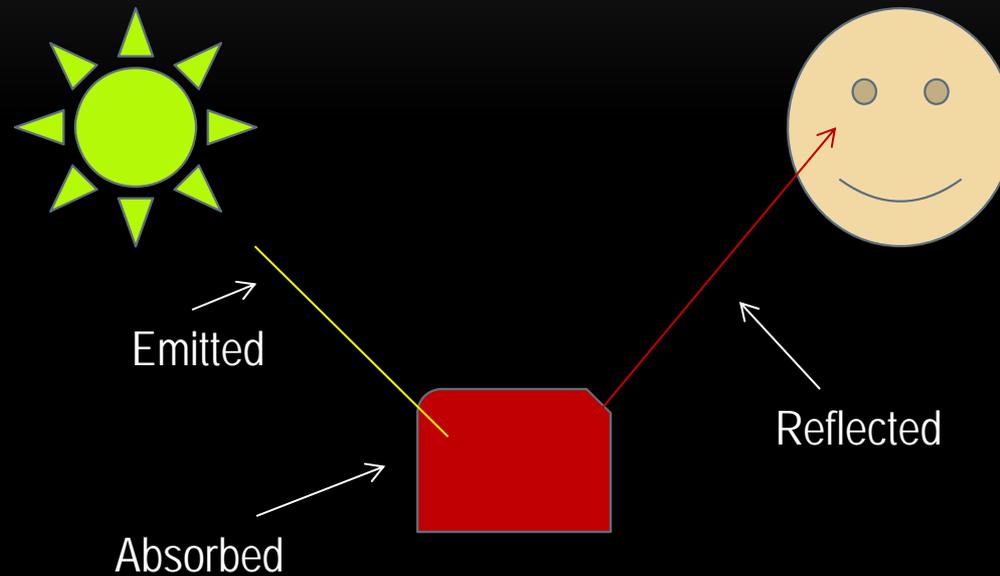
Blue

Purple

UV -ultraviolet

A ray of white light, when passed through a prism, refracts (bends) and separates its colors or wavelengths into the **visible spectrum**.

Color Perception



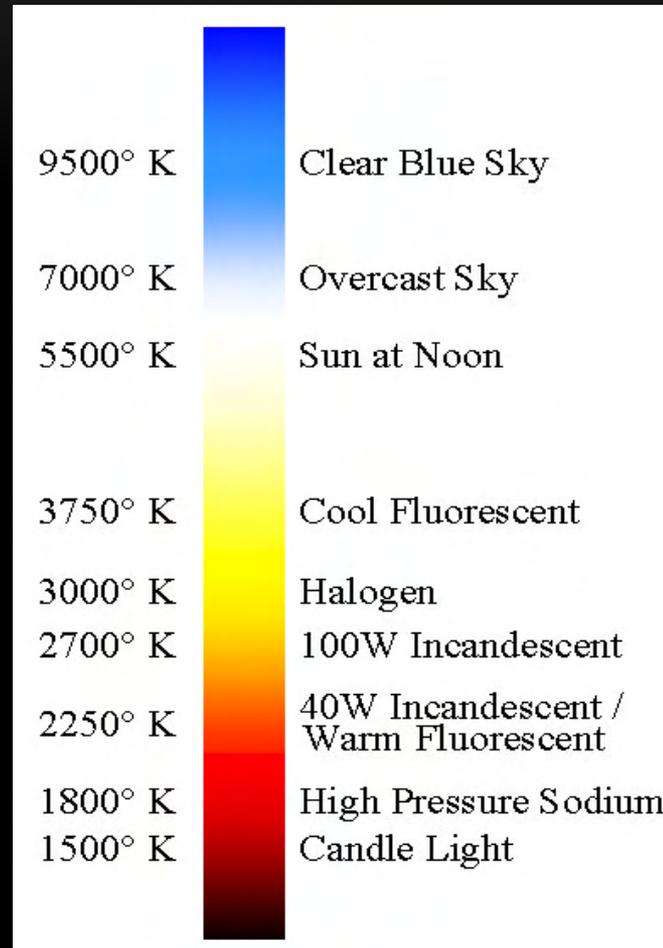
A ray of white light, when passed through a prism, refracts (bends) and separates its colors or wavelengths into the **visible spectrum**.



Kelvin Degrees - CCT of a Light Source



A candle is **1500K** Kelvin temperature.



Black Body Radiator Concept

- Imagine a piece of tungsten steel that changes color when heated.
- An object when heated sufficiently radiates light of a specific progression of colors.

Lower temperatures yield red, orange and yellow appearances. Higher temperatures yield bluish white appearances.

Outdoor Lighting Design

(typical)

Moonlighting
4100K

Up Lighting
3000K

Accent
2700K

Three color-temperatures help to develop lighting hierarchy within the scene.



Kelvin temperature of moonlight is 4100K.

KELVIN CONTRAST MAKES THE DIFFERENCE!

A recessed down light was retro-fitted with a **3500K** LED lamp. The front door is 'set apart' from the warm interior lighting and hierarchy is created.



Warm **2800K** incandescent sources emanate light through the home's transom windows.

PSYCHOLOGICAL IMPRESSION OF COLOR

Warm Colors

Yellow

Orange

Red

Cool Colors

Violet

Blue

Green

Key! In order to see color in an object it must be emitted from the light source.

Color adds a certain psychology to a space.

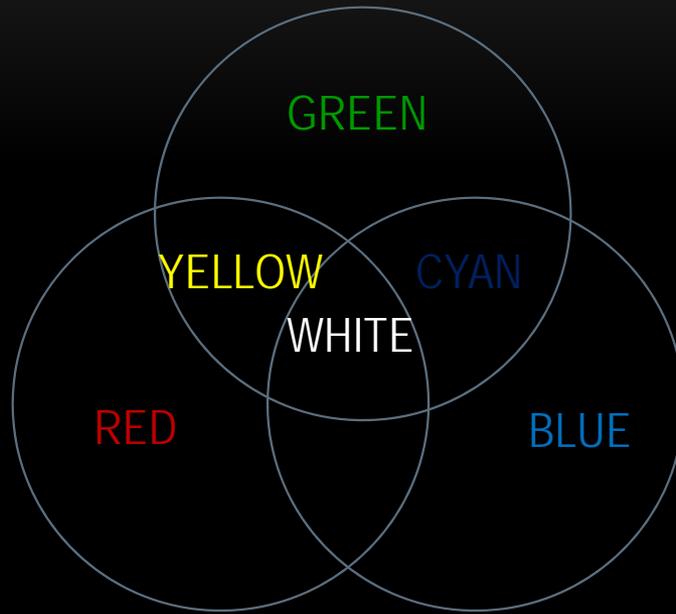
COLOR IS ...



- **Symbolic** - e.g. the Wizard of Oz, Dorothy's **red** shoes
- **Pragmatic** - e.g. kids at the zoo with same chartreuse shirt
- **Behavioral** – e.g. set the mood, candles evoke emotion, romantic, etc.

Color is emotionally appealing !

ADDITIVE MIXTURES OF LIGHT



Primaries of blue, green, and red result in White light when mixed together.



CRI – COLOR-RENDERING INDEX



Simply put, it is method to compare how different light sources with the same CCT reproduce 8 pastel colors to a reference source, which is a Black-body source for below 5,000K. Theoretically, the higher the CRI rating the better.

e.g. navy blue car under a low / or high-pressure sodium fixture

CRI – Color Rendering Index



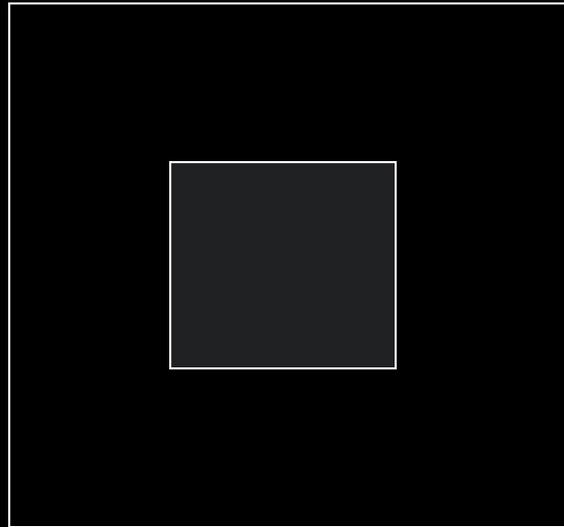
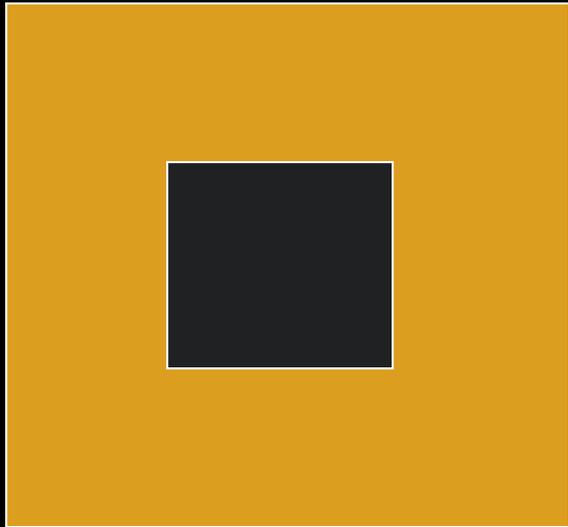
Color rendering, expressed as a rating on the **Color Rendering Index (CRI)**, from 0-100, describes how a light source makes the color of an object appear to human eyes and, how well subtle variations in color shades are revealed. The higher the CRI rating, the better its color rendering ability.



Trust Your Eyes!

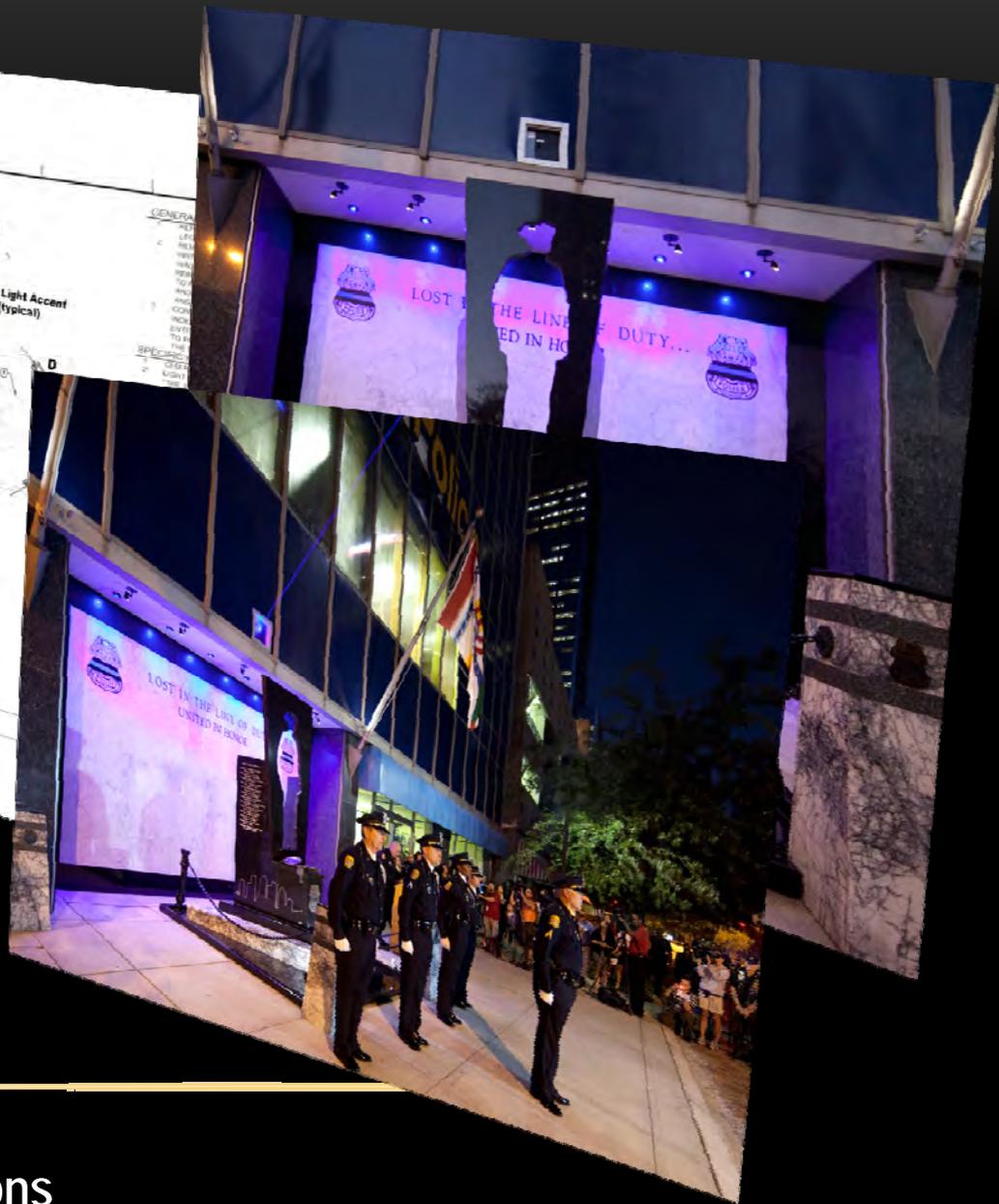
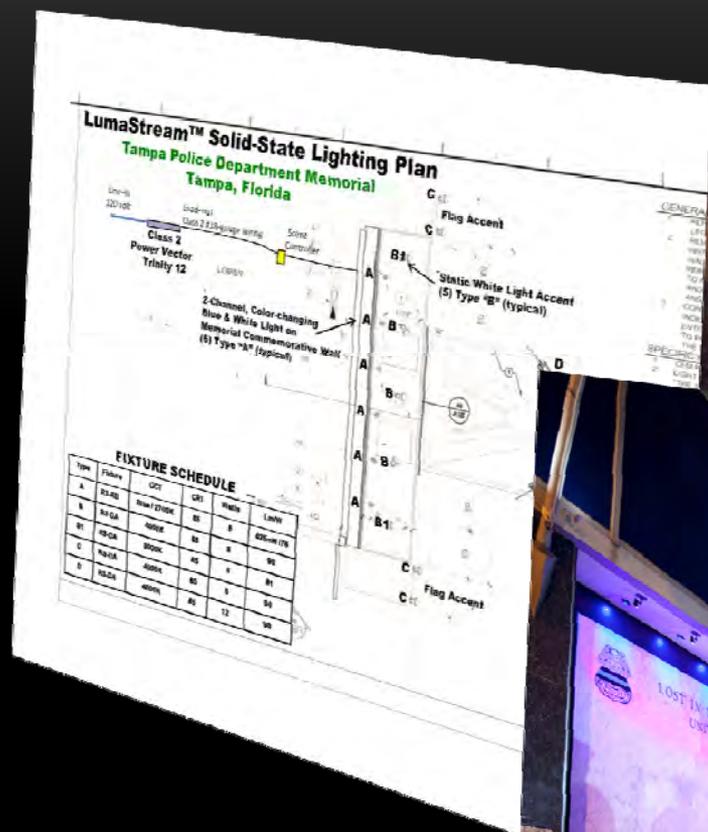
Color rendering expresses how colors appear under a given light source.

The Surround



Is the gray box on the right lighter than the one on the left?

Most observers would say 'yes' as the box on the right has a greater contrast.



Municipal
LED Lighting Applications



Architecture - Pure saturated color.



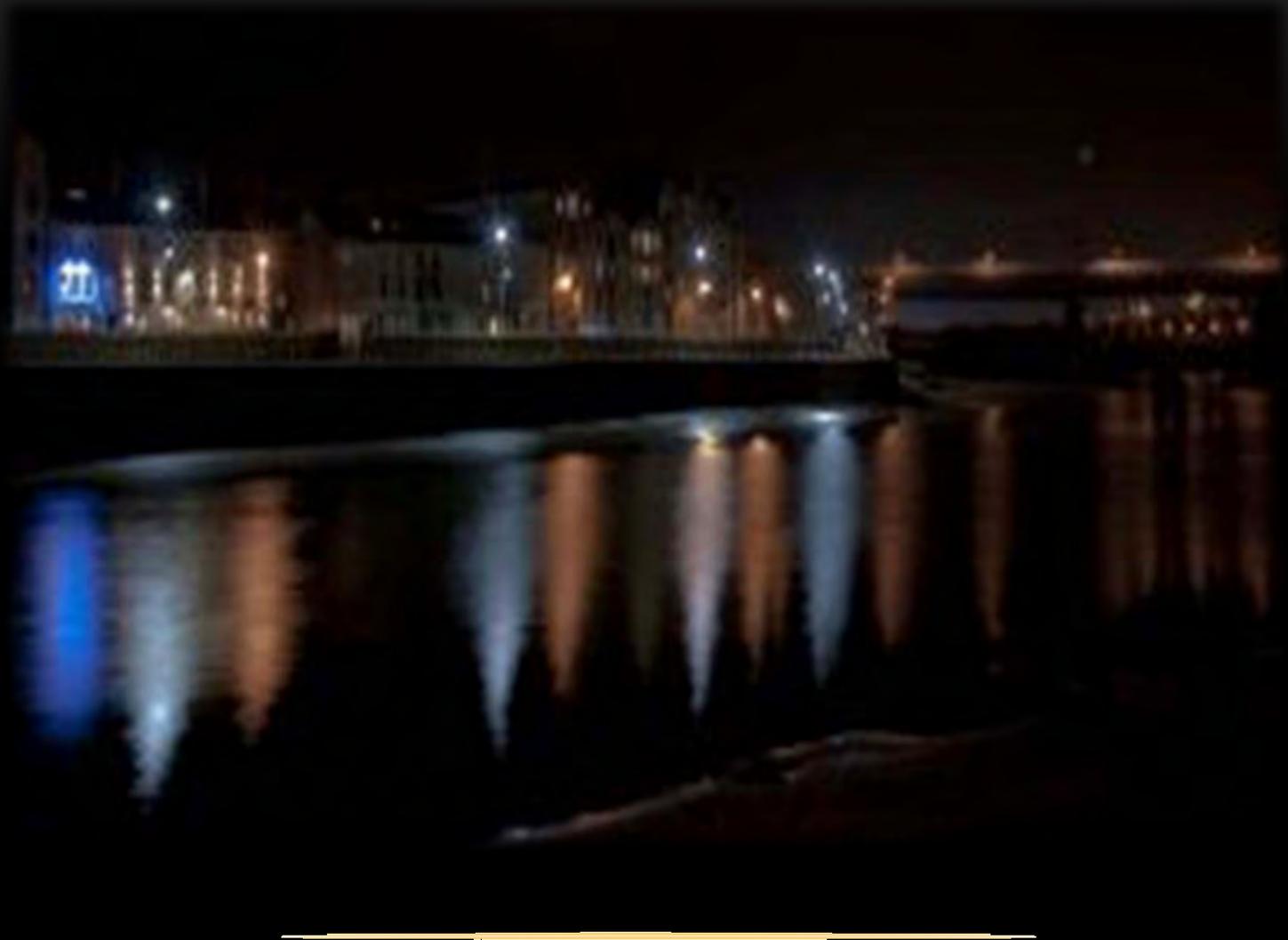
Public Art - Dynamic Color Options



The lighting lends a public but still somewhat private, elegant atmosphere. Note; the warm color tends to dominate while cool colors tend to recede.



A 'vista' technique is created with lighting that leads to a visual destination. Note the warm color temperature of the lamps.



Use of color can be very effective when designing around water and waterscapes.



An effective use of color portrays a coherent yet subtle difference to the architecture.



LEDS ~ A PANACEA?

Lighting decision-making is based on:

- Goals
- Needs of clients
- Aesthetic considerations
- Quality of illumination realized
- Minimizing energy use and environmental impact.

Intrusion of SSL is poised to effect change within the Outdoor Lighting Industry.

If you're waiting to jump in, the water's warm, Now.

LIGHTING SUPPORTS

(FOUNDATIONAL)

- The architectural vision
 - Complements form
 - Creates visual hierarchies
 - Directs the eyes
 - Transforms spaces
 - Provides drama
 - Assists way-finding
 - Creates the ambiance
-

GOOD QUALITY LIGHTING

(FOUNDATIONAL)

- Enables people to read,
- Locate,
- Identify,
- Navigate, and
- Perform well in their environment.

Lighting enables us to interact with each other and the world around us.

The Eye - Process of Adaptation

(Foundational)

3 Operating States:

Photopic Vision - uses cone receptors; Daytime vision

Scotopic Vision - uses rod receptors; Nighttime vision

Mesopic Vision - uses both rods and cones; Dawn & Dusk

e.g. Curtains & rods and cones in the bedroom...

Cues from "Mother Nature"

Nighttime illumination is . . .

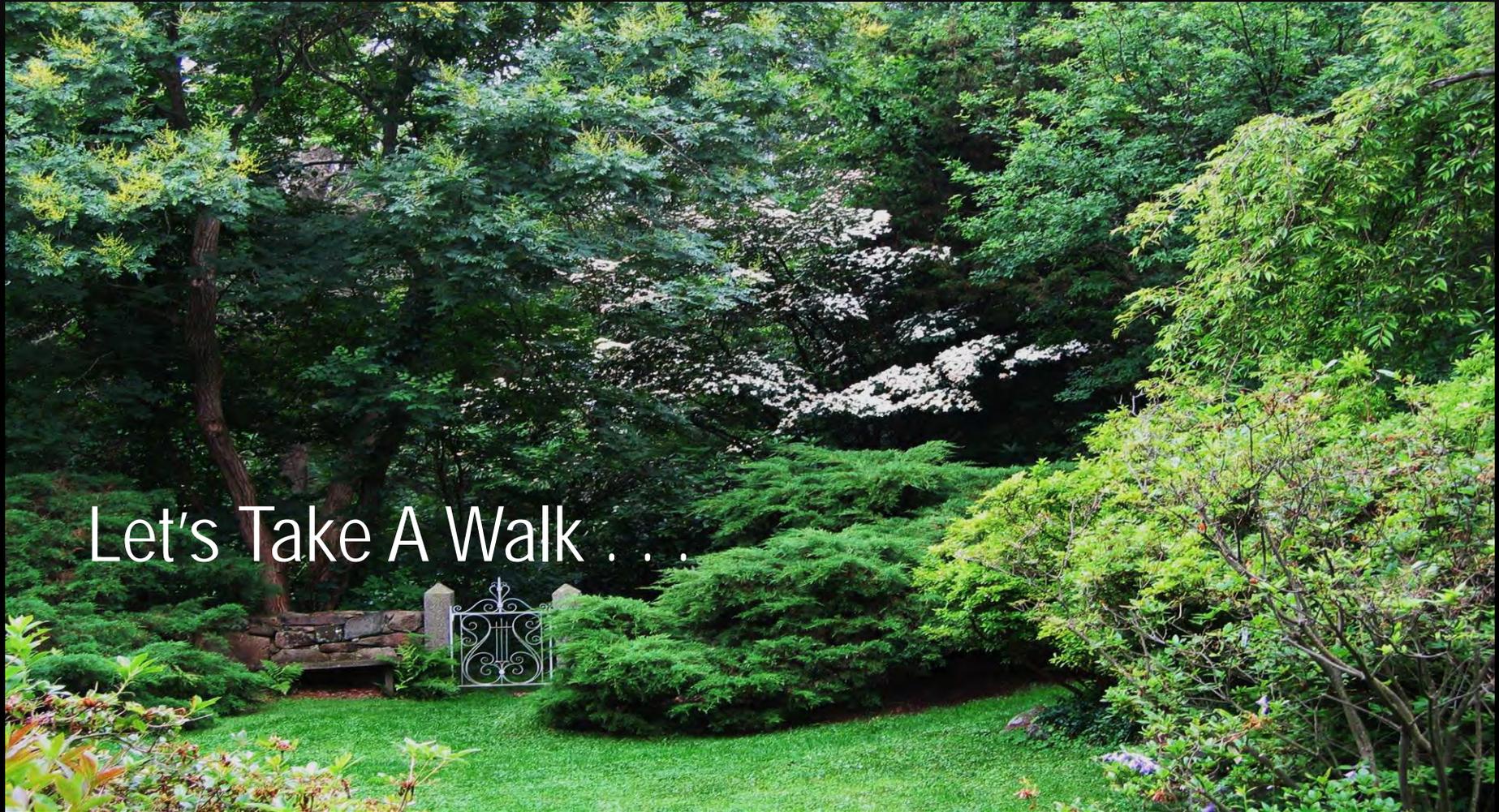
- An evening space made available to enjoy,
- An evening space made safe,
- An evening space made secure.
- Nighttime illumination is to be within nature's darkness.
- Nighttime illumination is to have a "romance with nature".





"Good lighting makes the adjustment easier on the eyes when going between places with differing levels of brightness." – e.g. 'adaptation'.

What better way to design outdoor lighting than to observe Mother Nature at her best?



Let's Take A Walk . . .



An early morning sunrise, details are missing...colors are muted.



Early a.m. shadows are long, details begin to emerge.



A morning setting comes alive with color and detail.



A high sun creates near vertical shadows at mid-day.



Real beauty in nature is revealed during an afternoon stroll.



- This setting portrays “fill lighting” to the right and in the background.
- Nature lends cues to what an evening space can look like.
- Note! The dappled sunlight on hostas plant material to the left.



- When creating depth in a scene, use high color temperature lamps at background and low color lamps in fore-ground.
- This enhances the illusion of the distance beyond.
- Can you picture a moonlit stroll down the lane?

Note the daytime shadows, suggest specifying 4100K.

Also, note high light levels pull the eye through in background .

A good sunny day can reveal a moonlighting opportunity!



A four o'clock sun creates a random mural of shadows on a garden wall.



"Mother Nature at her best!"

Illusion of depth is created behind the water through 'mirror lighting.'



The day is waning, colors are mellowing and details disappear.

An evening setting is in silhouette.



Sunlight defines the shapes of objects and plant materials.



-
- Light coming from one direction shows textures; defines shapes.
 - Daytime reveals the shape of a cross and a steeple.

Sunlight from one direction creates a natural “halo” effect to a row of pine trees.





Backlighting in Nature.





Light from a carefully positioned tree-mount fixture creates a 'natural' mural of shadows to the home's gable.

The Definition of Light

- *Light is a form of energy similar to radio signals and x/ray.*
 - *Light is also particles called photons which travel in streams and waves (much as the same manner as water).*
 - *The human eye detects intensities, contrasts, wave-lengths (NM) and the patterns they form.*
 - *Our brains model the information into Objects.*
-

Facts of Light

Facts of Light

- Light travels in straight lines.
 - Any light over and above to see clearly and comfortably is *glare*.
 - The older we get, the more light we need.
 - The more difficult the task, the higher the light level needed.
 - Light is either reflected or absorbed.
-

What Is Light?



In human terms light is visually evaluated radiant energy.

What is lighting?

Lighting is the application of light. Lighting is a 100% collaborative medium.

A successful collaboration must be founded on a clear understanding with the client.

"Cutting to the chase" . . . To SELL 'Light' we must understand it!



Lighting For People

Lighting For People



Concept: Attention to the need to light an otherwise darkened space; to make the space safe, secure, allow for physical and visual movement; and, most important, Be Comfortable for the user.

Lighting For People

Nighttime illumination is . . .

- An evening space made available to enjoy,
- An evening space made safe,
- An evening space made secure.
- Nighttime illumination is to be within nature's darkness.
- Nighttime illumination is to have a "romance with nature".



Lighting For People



- Human vision is enabled as much by modeling of shape from highlight and shadow, as it is from general illuminance values.
 - Sometimes we should consider what we shouldn't light.
 - Application of light or the lack of it can be a most effective way of enhancing the human experience of the space.
-

Lighting For People *

* Client participation can never be overemphasized. It's mandatory.



A talented person set the mood here, not the fixtures.
Too often, too early in the design process, client
discussions turn to fixtures..

Lighting For People

- WHY LIGHT...Good lighting is defined at the beginning of each project with each client.
- You must write it down for each and every job you do. You can't look it up on the Internet.



Lighting For People



Outdoor lighting design requires an understanding of nature's systems and user criteria. Considerations in developing a design conclusion are . . .



Lighting For People



Inventory the Space

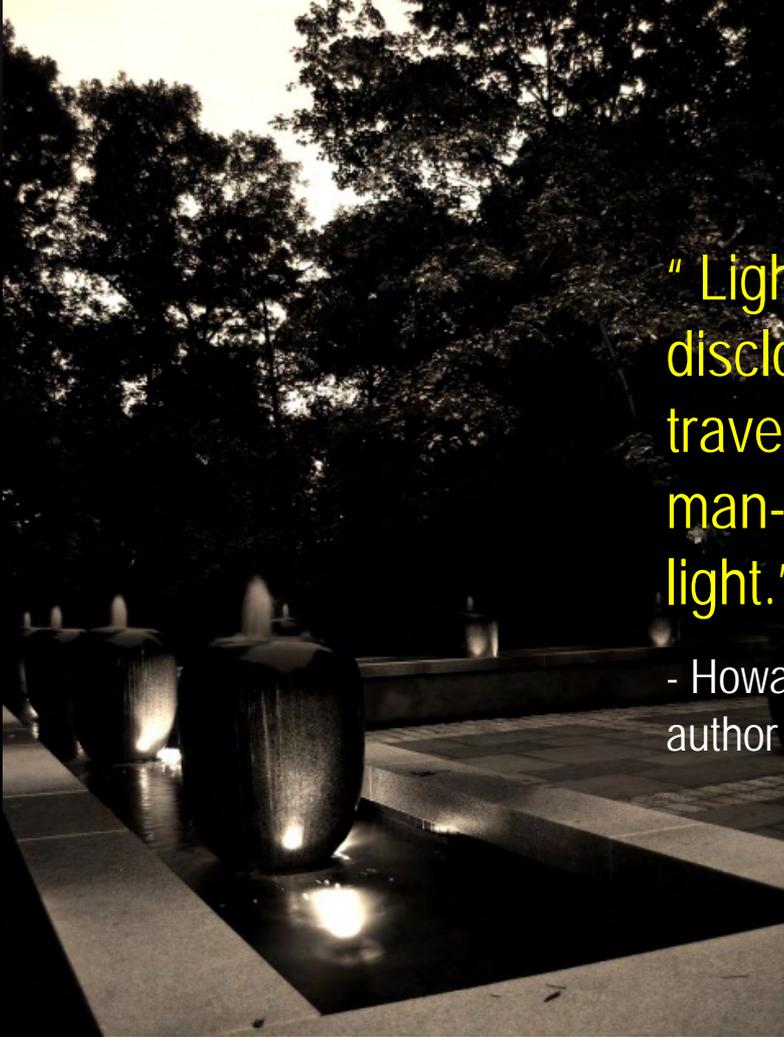
- Note the boundary
- Note the division of space; the sequence and destination
- Note the posture of the space; the focus and attention



THE Three People Activities for Lighting the Nighttime



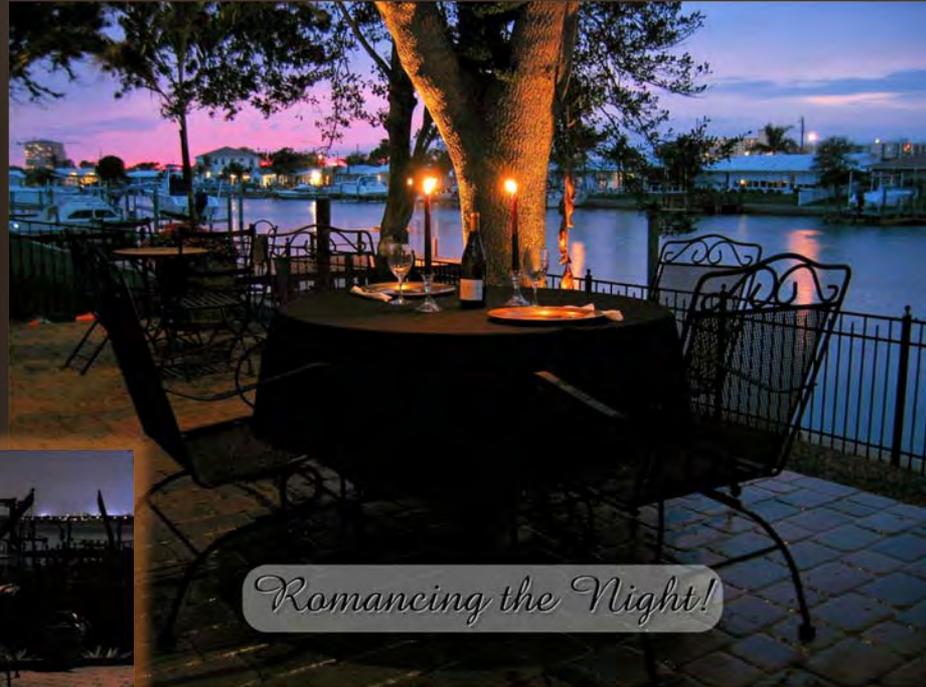
Lighting For People



" Light is a revealer, a shaper, a discloser. Light is time's swiftest traveler. It is hard to conceive of a man-made space that does not use light."

- Howard Brandston, LC Internationally recognized author and lecturer.

Lighting For People



Good lighting not only makes the space look good, it makes the people look good.

Lighting For People



Illumination is the sincerest form of flattery.



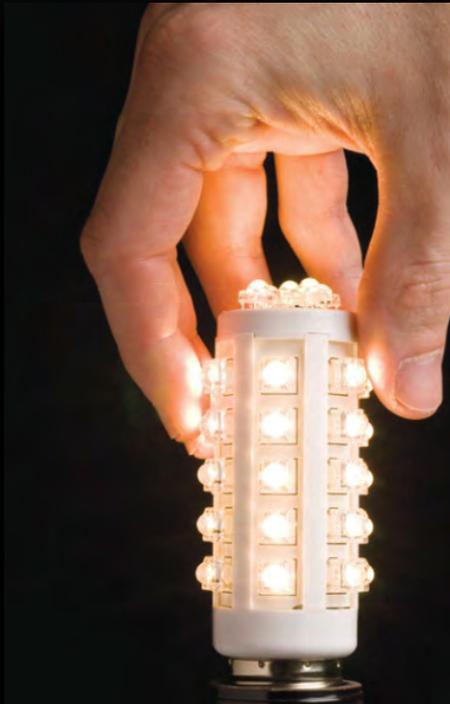
"Let the evening begin"

761 816 6400



"Put it on sunset cruise"

Lighting For People



- Lighting is critical to the emotional impact of a space.
- The factors of light levels, visual contrast and glare aspects decide the draw-in factor to an evening space.



Lighting For People



“Lighting is a woman’s silent partner”

Lighting For People



When women look great, men spend money.

Lighting For People

"Look to the body first, then the aesthetics."

A photograph of a group of people gathered around a campfire at night. The scene is illuminated by the warm glow of the fire, which is the central light source. Several people are visible, some sitting on chairs and others standing. In the background, there is a building with a wooden structure, possibly a cabin or a house, partially lit. The overall atmosphere is cozy and social.

Most lighting designs get caught up in the
"architecture."

But, it's the people that are important.

Lighting For People

– The word ' Because'



- "You need this because..."
 - "You should consider this because..."
 - "I can show you...and, by implementing this plan..."
 - "You need to use this plan because..."
 - "Mrs. Jones, you've made a good decision because..."
 - This technique was chosen because it preserves the 'Money Shot'...
-

Better Illumination for OUTDOOR LIVING



Savvy, Strength, Statement & Sophistication

Lighting For People



Energy efficiency and clean, renewable energy will mean stronger economies, cleaner environments, and greater energy independence for all.



Thank You.

I wish to express sincere thanks and appreciation to the following list of lighting authors & lighting professionals for their contributions, relevant lighting information and commitment to the cause.

Presenter: Doug Alderman, LC, IES

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