Designers Lighting Forum

What's the deal with healthy/circadian/human centric/WELL lighting? And how does it impact design?

Kassandra Gonzales, Lesa Lorusso PhD, Dorothy Underwood

March 17, 2020

Kassandra Gonzales
Lighting Design Specialist, RAB Lighting

Kassandra works at RAB Lighting as a lighting design specialist. She holds an MS in Lighting from Rensselaer Polytechnic Institute, as well as a BS in Interior Design from Texas State University in San Marcos, TX. After graduation, Kassandra became a research specialist for the Light and Health program at the LRC. While working there, she developed circadian lighting designs for several settings that included offices, hospitals, and residential facilities for older adults. She also conducted research into the effects of light on human health and well-being. She is an associate member of the Illuminating Engineering Society and serves on the Aged and Partially Sighted Lighting Committee. She has presented on circadian lighting for the Patricia DiMaggio Memorial Fund in New York, in a lecture titled, “Designing with Circadian Stimulus.” She has also presented for the Ohio IES section in Columbus, Ohio on healthcare lighting. She is a recipient of the IESNYC Thesis Prize in 2015 and presented her thesis at the Building Energy Exchange, titled, “Lighting Patterns for Senior Care.”

Dorothy Underwood
Associate, KGM Architectural Lighting

Dorothy is an Associate at KGM Architectural Lighting, where she manages a variety of projects, from sports arenas to high end residential, including key projects such as the new NFL stadium in Los Angeles, and the award-winning Ballroom Renovation at the New York Botanical Gardens. She holds an MS in Architectural Sciences with a Concentration in Lighting, as well as a B.Arch from Rensselaer Polytechnic Institute in Troy, NY. Dorothy worked in a variety of design positions before becoming a lighting designer, including interning at architecture firms, and working as a lighting applications specialist. These experiences have helped to strengthen her understanding of not just lighting, but the surrounding professions as well. Dorothy holds LC and LEED AP BD+C certifications and is an Associate member of IALD. She previously presented a seminar on circadian lighting at LEDucation 2019 titled “The Design Implications of Circadian Lighting.”

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Lesa Lorusso
Healthcare Director of Research & Innovation, Gresham Smith

Lesa is a firm-wide resource at Gresham Smith, strengthening healthcare planning and design through research and innovation. She collaborates with the healthcare team to facilitate human-centered design and development and implementation of research strategy and scalable tools for knowledge sharing among healthcare planners and designers. She implements design thinking strategies throughout the healthcare practice and advise the Gresham Smith team on evaluative methodologies regarding healthcare facilities. Key roles involve identifying opportunities for EBD research and leading strategic implementation of research projects and developing external collaborative partnerships.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Learning Objectives

At the end of the this course, participants will be able to:

1. Discuss the science behind circadian rhythms and human health
2. Understand the various current metrics and standards for circadian lighting
3. Understand the impacts that circadian lighting has on design and implementation of projects

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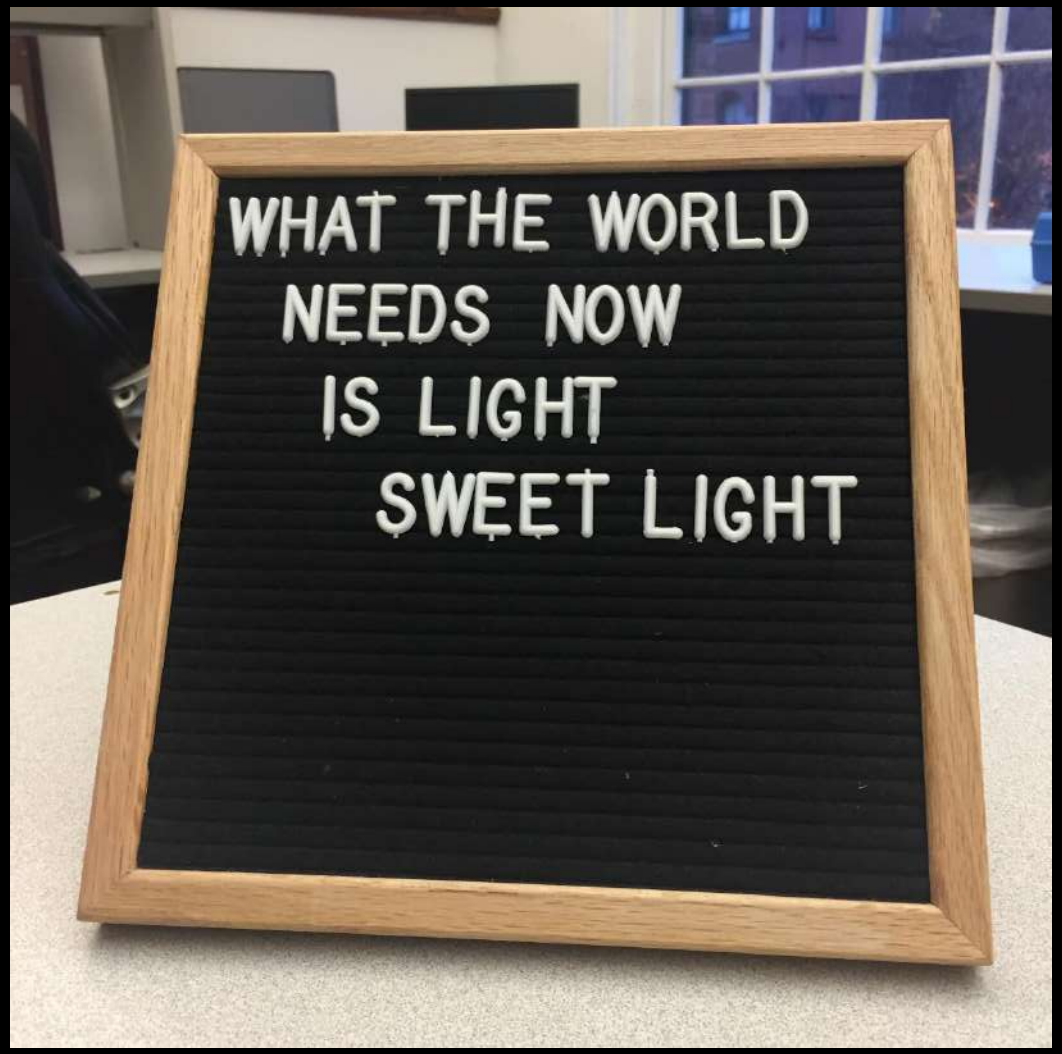

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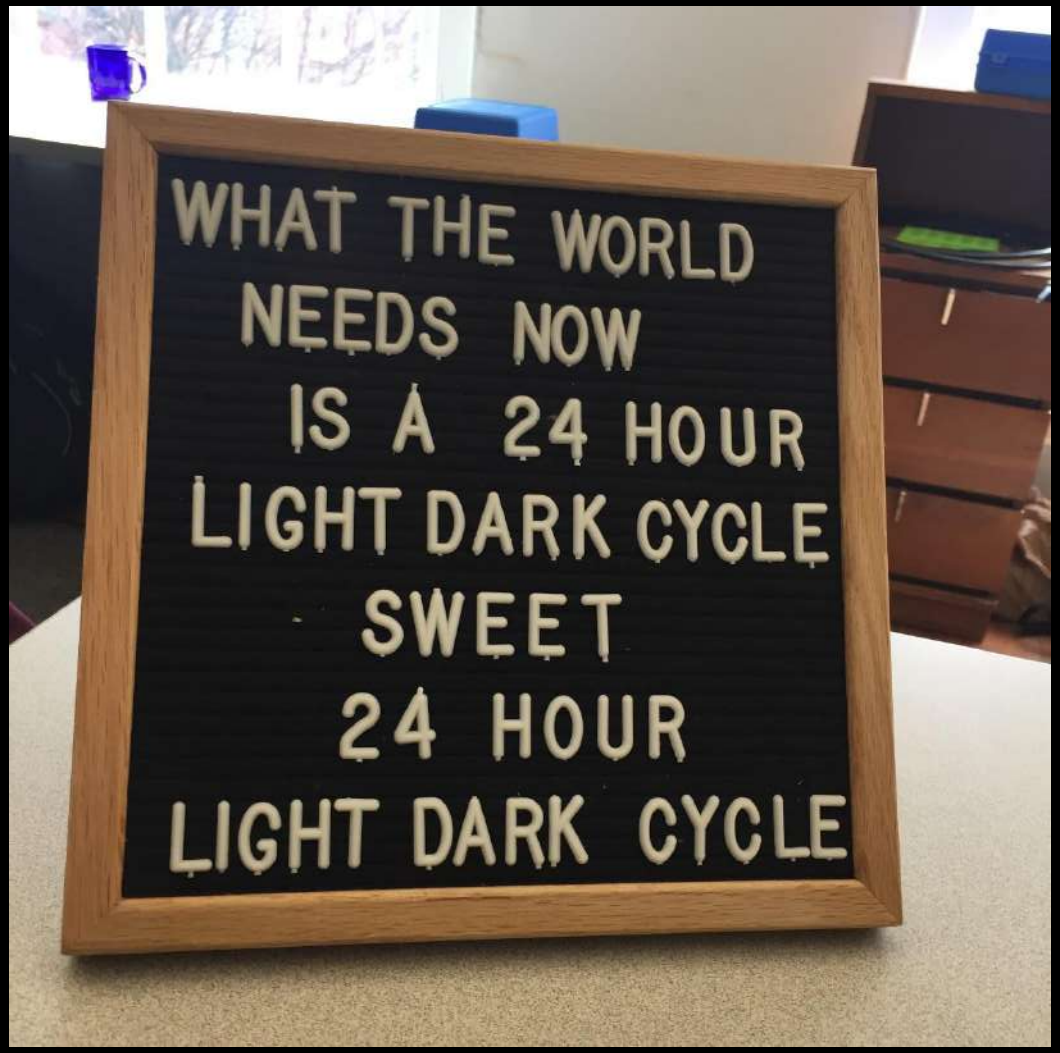
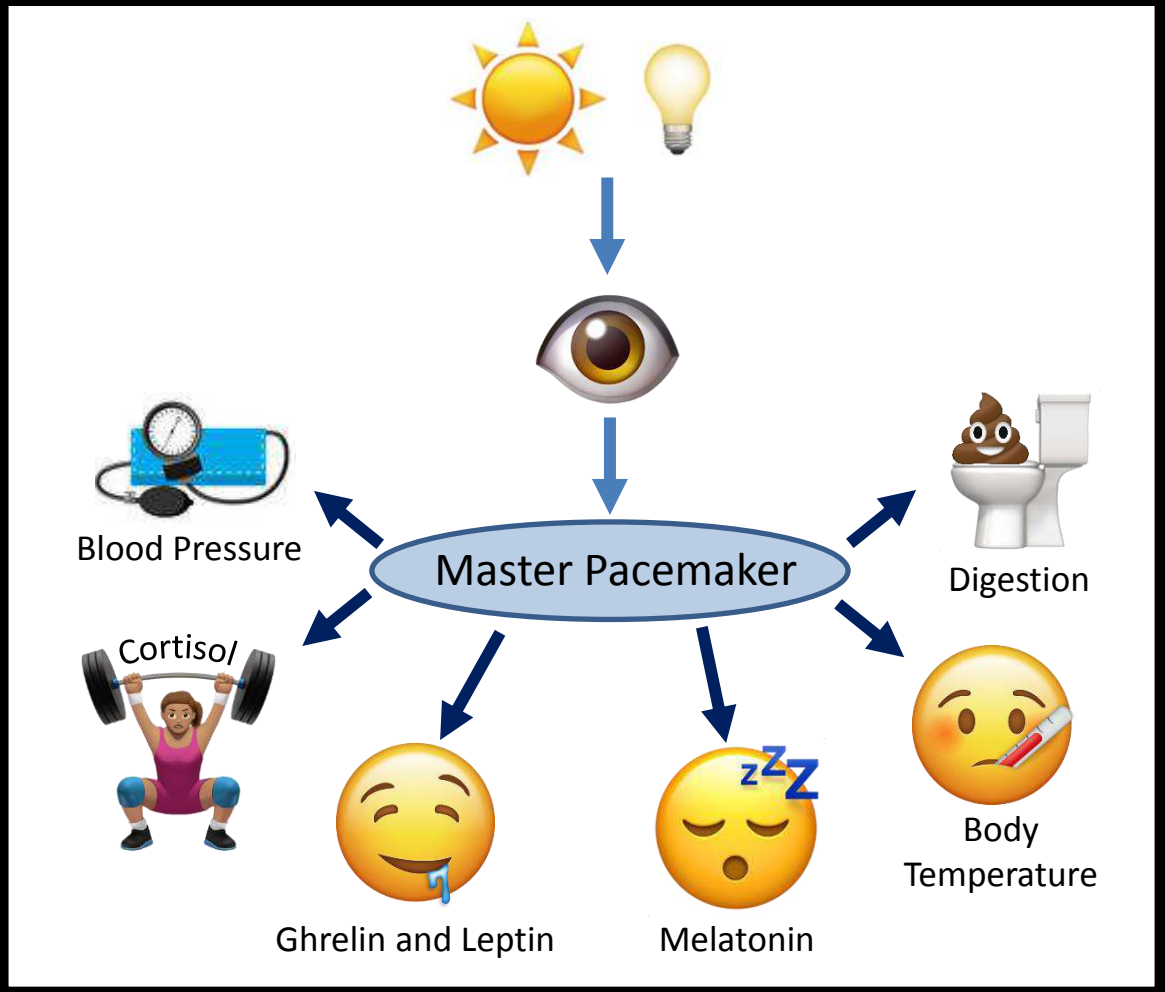

WHAT THE WORLD
NEEDS NOW
IS A 24 HOUR
LIGHT DARK CYCLE
SWEET
24 HOUR
LIGHT DARK CYCLE

Circadian rhythms

- Circadian means around (*circa*) a day (*dies*).
- Circadian rhythms are biological daily rhythms that repeat themselves approximately every 24 hours.
  - Ultradian is less than 24 hours
  - Infradian is greater than 24 hours
- Almost all behavioral and physiological parameters exhibit circadian rhythms, including:
  - **Sleep/wake cycle**
  - **Hormone production**
  - **Body temperature**
  - **Heart rate**
  - **Blood pressure**
  - **Gene expression**



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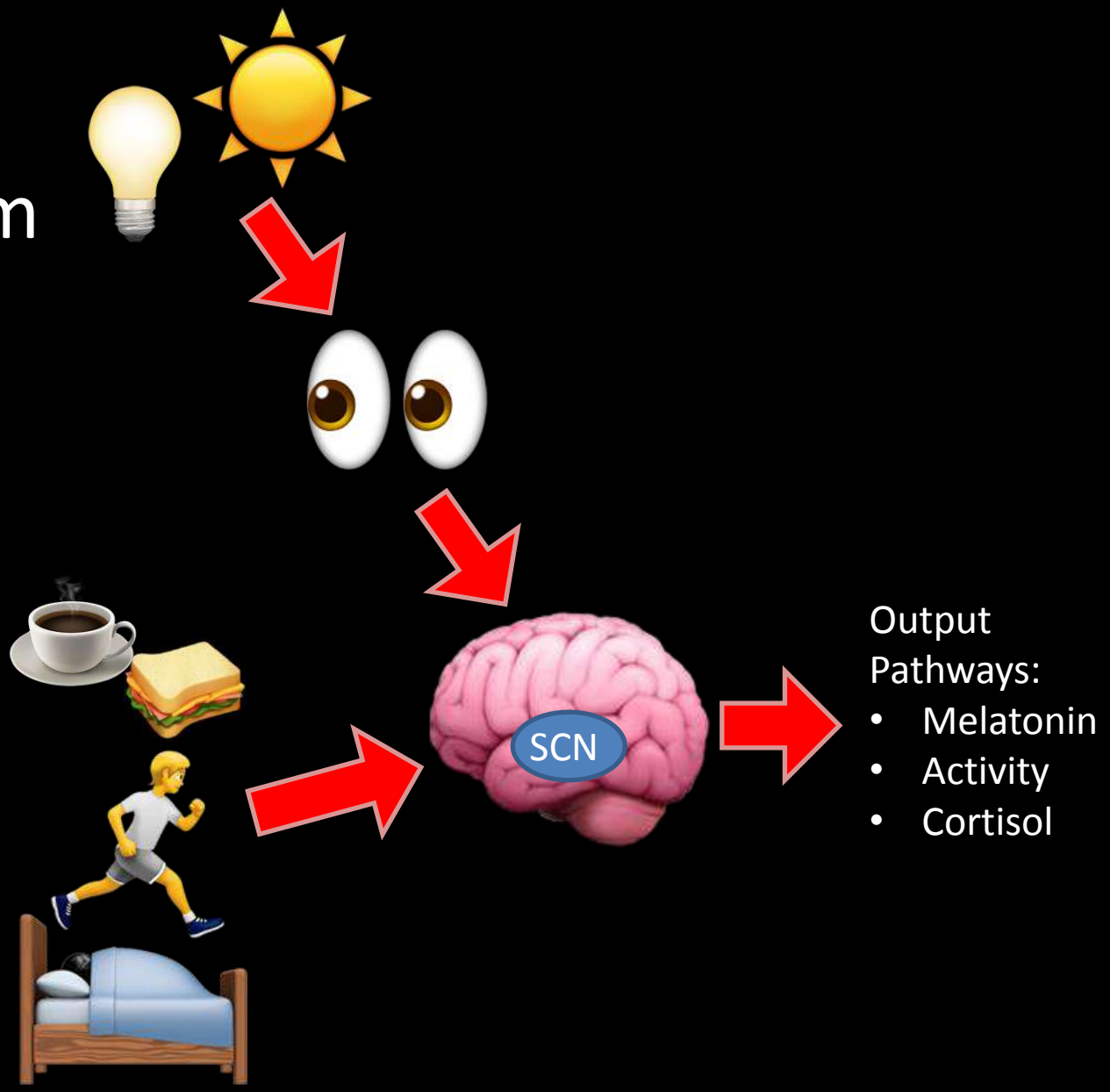
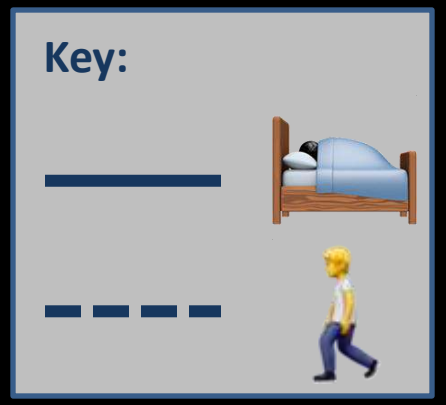
Circadian Timing System

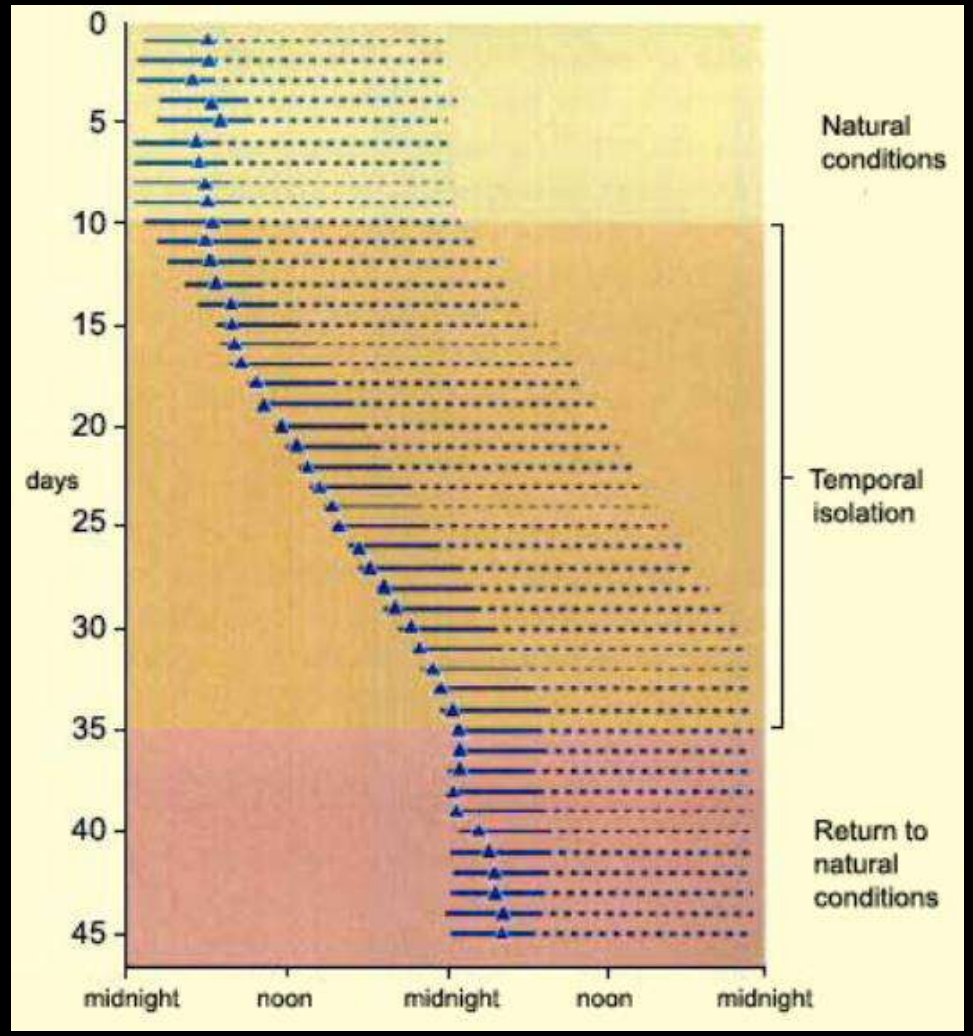
- Neural system that generates and regulates circadian rhythms.
- There are 3 components:
  - Input pathways, which provide photic and non-photic signals to the master pacemaker
  - Master pacemaker located in the suprachiasmatic nucleus (SCN) – located in the pineal gland in your brain
  - Output pathways, which organize behavior and regulate biological functions



Light as an Entraining Agent

- Light is the circadian system's most powerful environmental cue
- Tracking rest–activity patterns shows this effect
- Without regular light stimulus to systematically shift their daily activity, humans and animals are said to be "free-running"

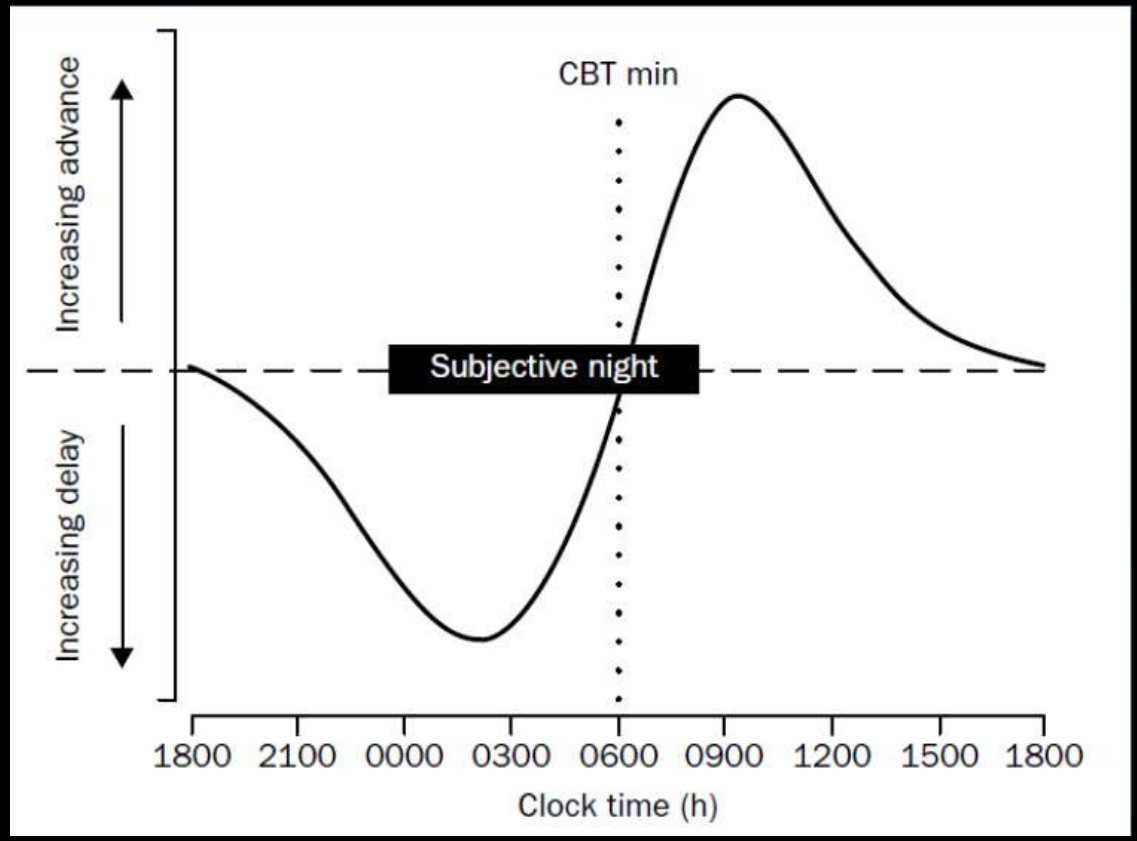




http://thebrain.mcgill.ca/flash/a/a_11/a_11_p/a_11_p_hor/a_11_p_hor.html
Adapted from Dement, 1976

Timing of Light and Phase Shifting

- The timing of a light stimulus determines how it will shift circadian phase
- For humans, light early in the day advances circadian phase, while light later in the day delays it
- The magnitude of a phase shift is also determined by the timing of the light stimulus

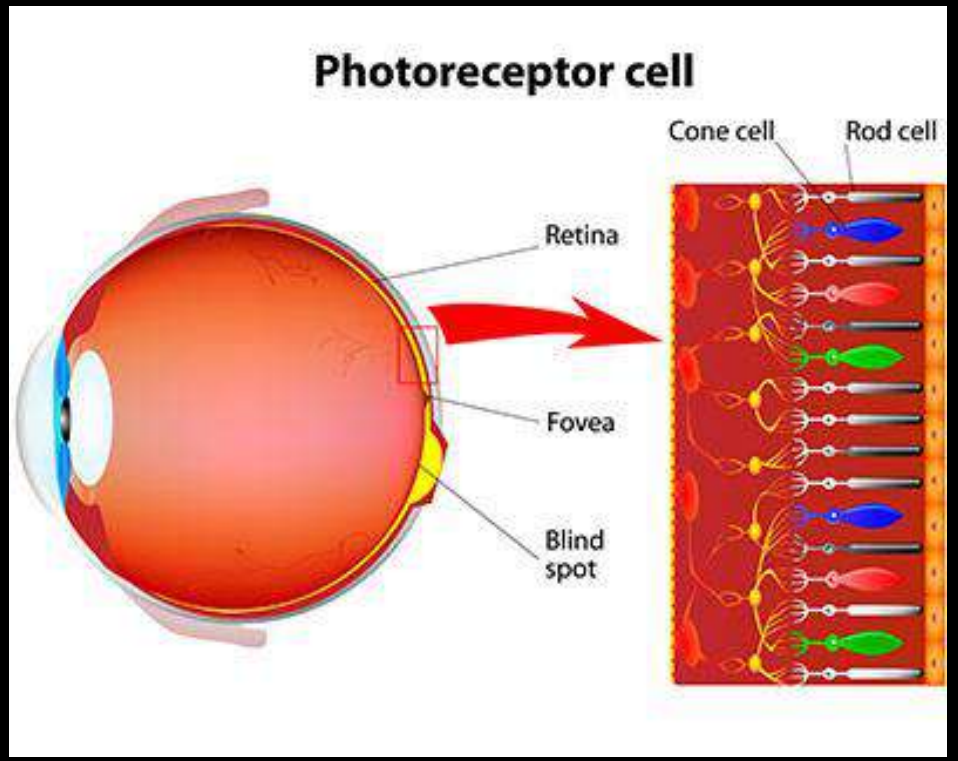


Rajaratnam S, Arendt J. Health in a 24-h Society. The Lancet. 2001; 358(9286):999-1005.

Circadian Phototransduction

Photic information is transmitted by the human eye's 5 photoreceptors:

- Rods
- Short-wavelength cones
- Medium-wavelength cones
- Long-wavelength cones
- ipRGCs (intrinsically photosensitive retinal ganglion cells)



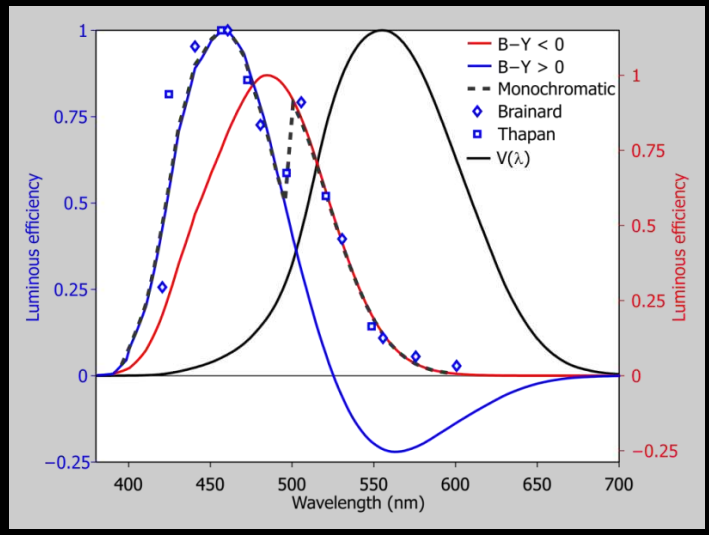
https://www.aao.org/eye-health/anatomy/parts-of-eye

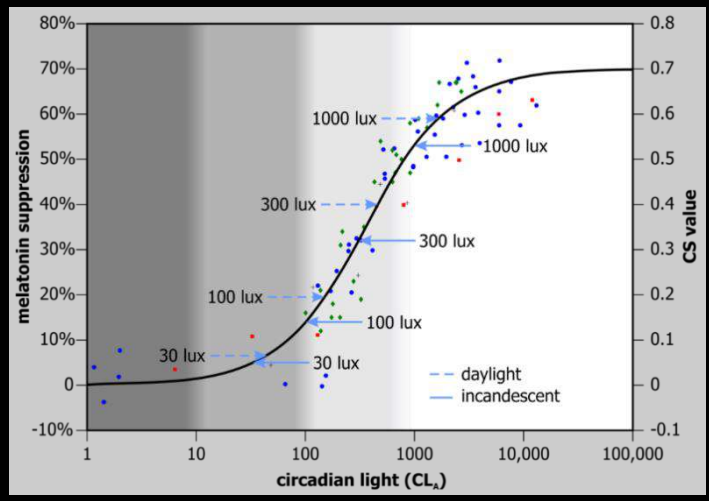
How light may impact our health, mood, and wellbeing

- Light with the appropriate characteristics can:
- Reduce symptoms of seasonal affective disorder
- Increase sleep efficiency of older adults including those with Alzheimer's disease
- Improve circadian entrainment of premature infants
- Increase alertness and wellbeing of night-shift workers
- Decrease in depression ,better sleep quality, and more energy for office workers

Circadian Stimulus (CS)

- Predicts melatonin suppression over a 1 hour period using illuminance at the eye and the spectral distribution of the source.
- CS uses a single biomarker of the circadian system plotted using data from subjects.
- Targets:
  - CS of 0.3 + will suppress melatonin
  - CS of 0.1 or less does not suppress melatonin



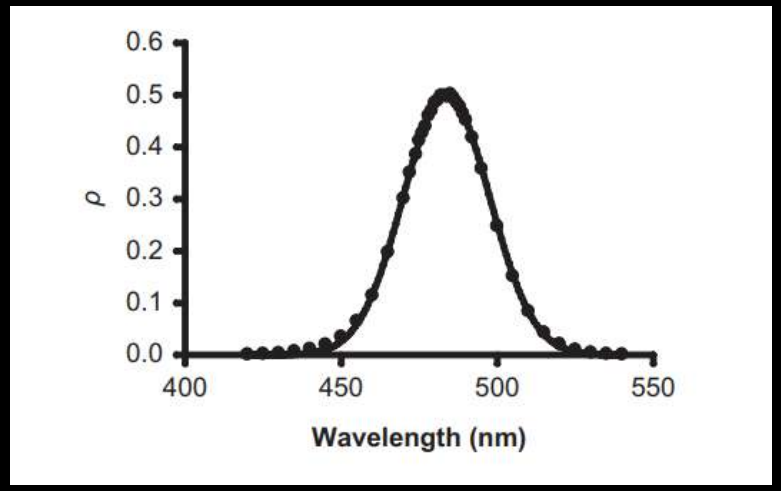


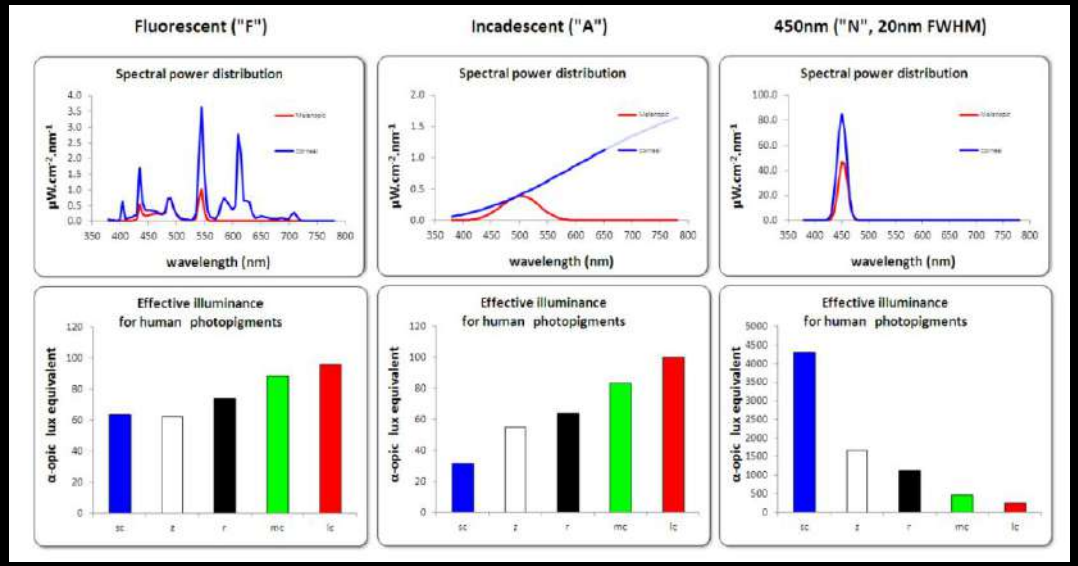
Rea MS, Figueiro MG, Bullough JD, Bierman A. A model of phototransduction by the human circadian system. Brain Research Rev, 2005; 50(2):213-228

Rea MS, Figueiro MG, Bierman A, Hamner R. Modeling the spectral sensitivity of the human circadian system. Light Res Tech, 2012; 44(4):386-396

Equivalent Melanopic Lux (EML)

- Predicts the response of the iPRGC to a light stimulus using illuminance at the eye and the spectral distribution of the source.
- This is what the WELL standard uses
  - The WELL calculator takes the SPD of a source and assigns it a melanopic ratio
  - You take that ratio and multiply it by the amount of photopic illuminance you get at the eye and you have equivalent melanopic lux
  - WELL requires 200 equivalent melanopic lux measured at 4’ aff from 9AM to 1PM for every day of the year at 75% or more of work stations (Part 1: Melanopic Light Intensity for Work Areas)





Al Enezi et al (2011) J Biol Rhythms 26(4) 314-323. http://jbr.sagepub.com/content/26/4/314.long

Lucas, R., Peirson, S., Berson, D., Brown, T., Cooper, H., Czeisler, C., Figueiro, M., Gamlin, P., Lockley, S., O'Hagan, J., Price, L., Provencio, I., Skene, D. and Brainard, G. (2013). Irradiance Toolbox User Guide. [online] Personalpages.manchester.ac.uk. Available at: https://personalpages.manchester.ac.uk/staff/robert.lucas/Lucas%20et%20al%202014%20suppl%20text.pdf [Accessed 30 Aug. 2019].

Standard.wellcertified.com. (2019). Circadian lighting design | WELL Standard. [online] Available at: https://standard.wellcertified.com/light/circadian-lighting-design [Accessed 30 Aug. 2019].

Why can’t we be friends?

- The big clash between the two metrics has to do with what photoreceptors they think participate with the circadian system.
  - CS uses all 5 photoreceptors
  - EML uses only the melanopsin response
- The use of all photoreceptors causes a sub-additive response, causing a shift in response when using the CS metric.
  - Macular Pigment Optical Density (MPOD)

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"An important note of caution here is that it is not always clear whether lighting design should aim to maximize or minimize non-visual responses. In many ways, light can be considered a drug, having the potential for both beneficial and deleterious effects. These conflicting effects can occur concurrently, and in a single individual and context… Balancing the desirable and undesirable impacts of light or darkness requires careful, informed consideration of the context and of the myriad effects of light on physiology, perception, and cognition."

Lucas et al., "Measuring and Using Light in the Melanopsin Age." Trends in Neuroscience, Jan 2014.

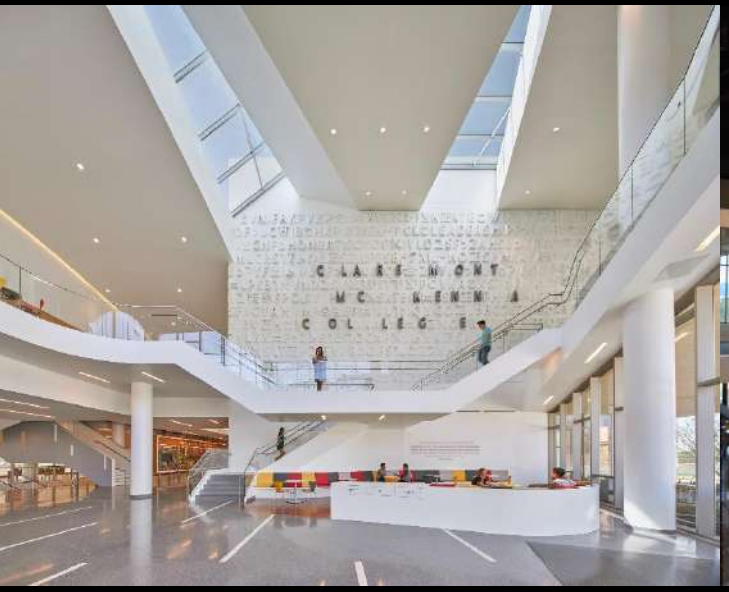
Client’s Needs

Client's Needs: Building Use Type




Client's Needs: Age of Occupants

Client's Needs: Aesthetic



Architectural Finishes





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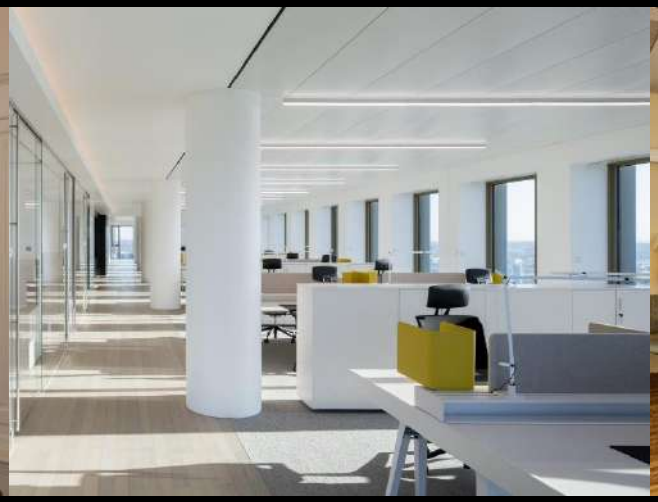
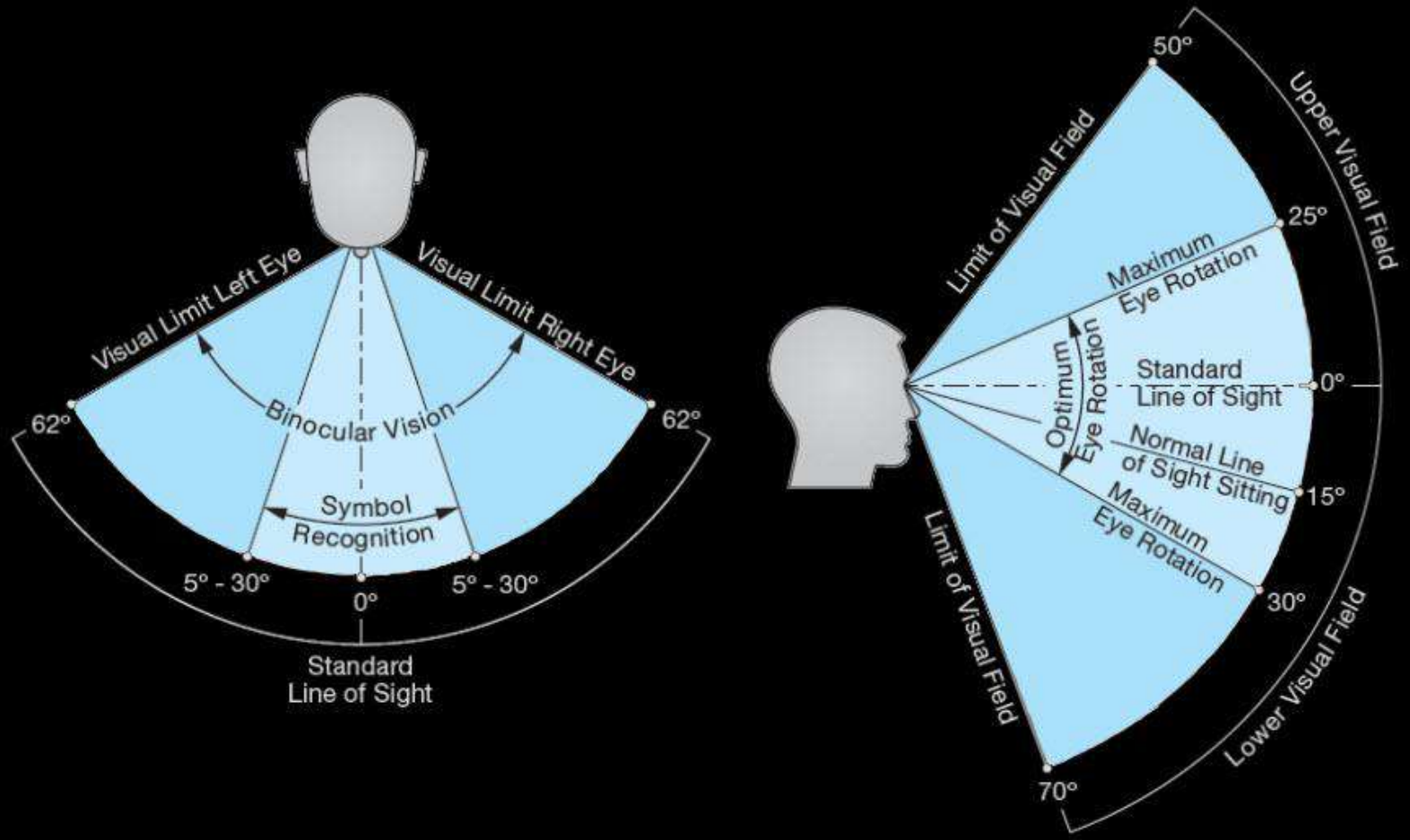
Architectural Finishes

Use of Light

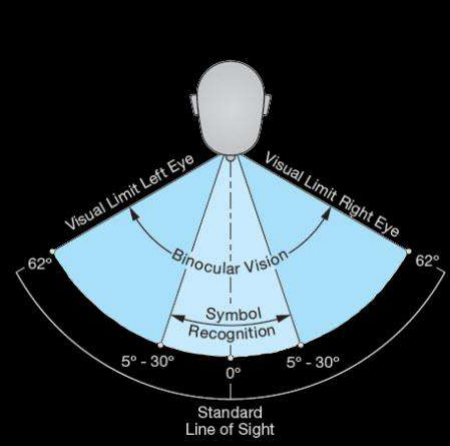
Delivery of Light: Circadian Morning

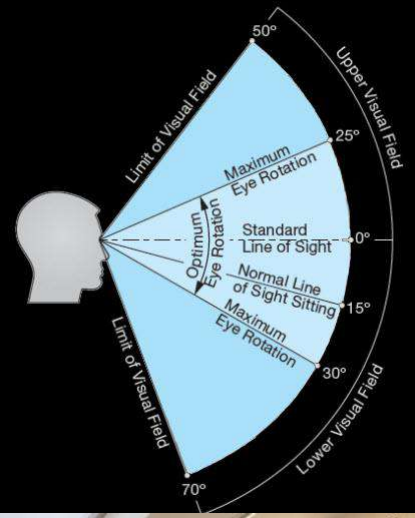




Delivery of Light: Circadian Morning





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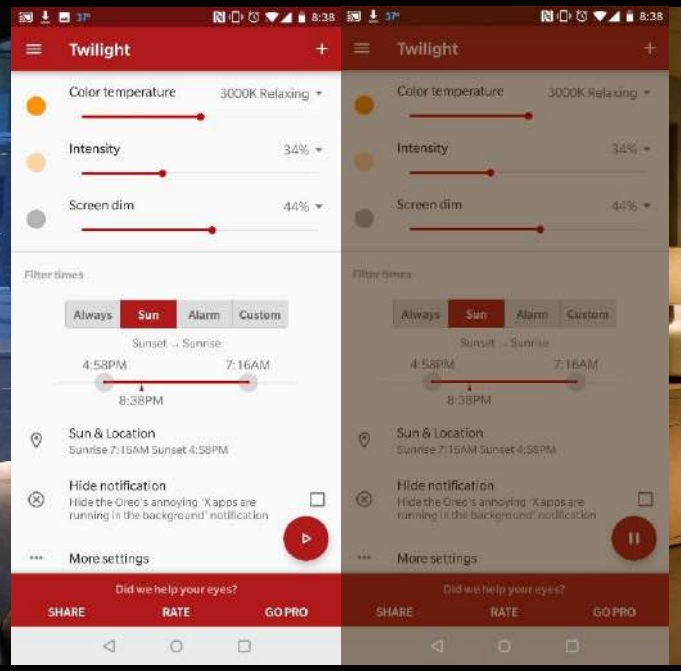
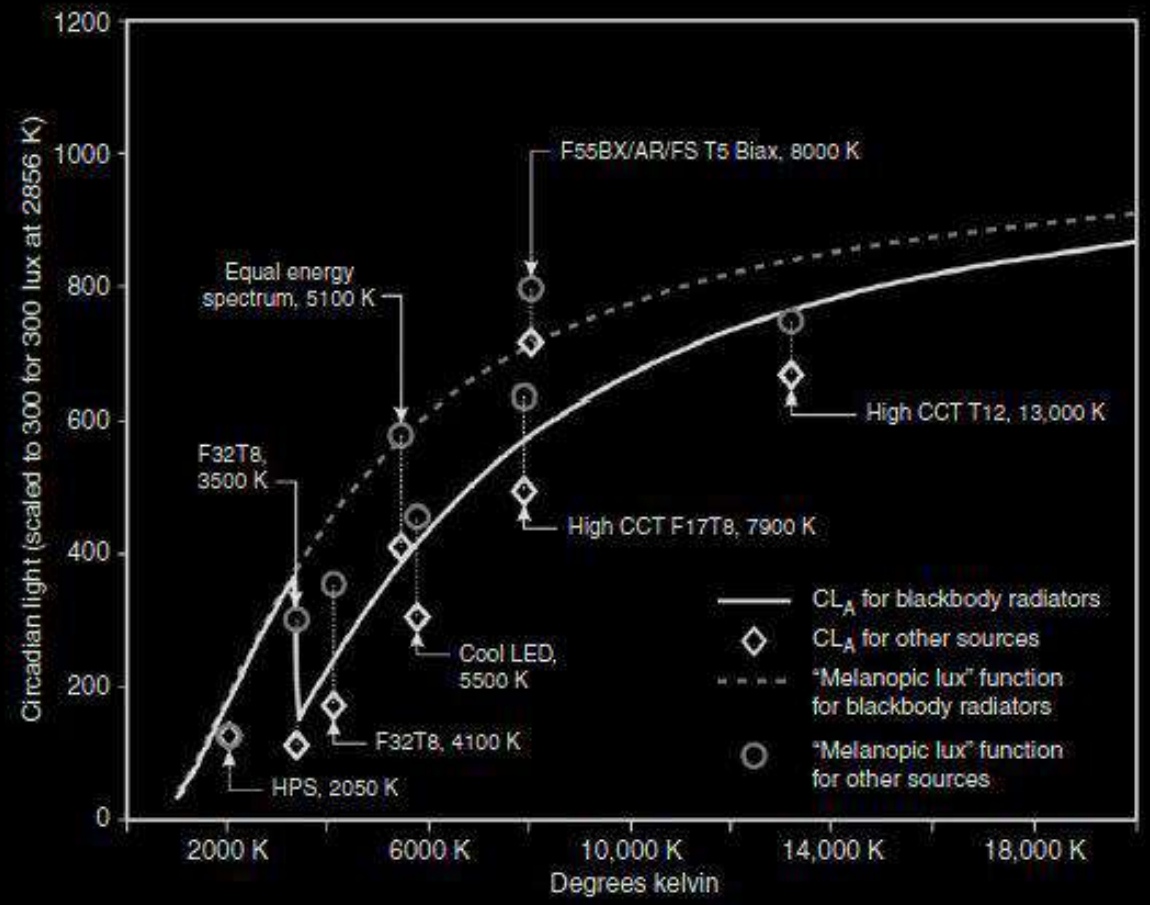
Removal of Light: Circadian Evening



Removal of Light: Circadian Night

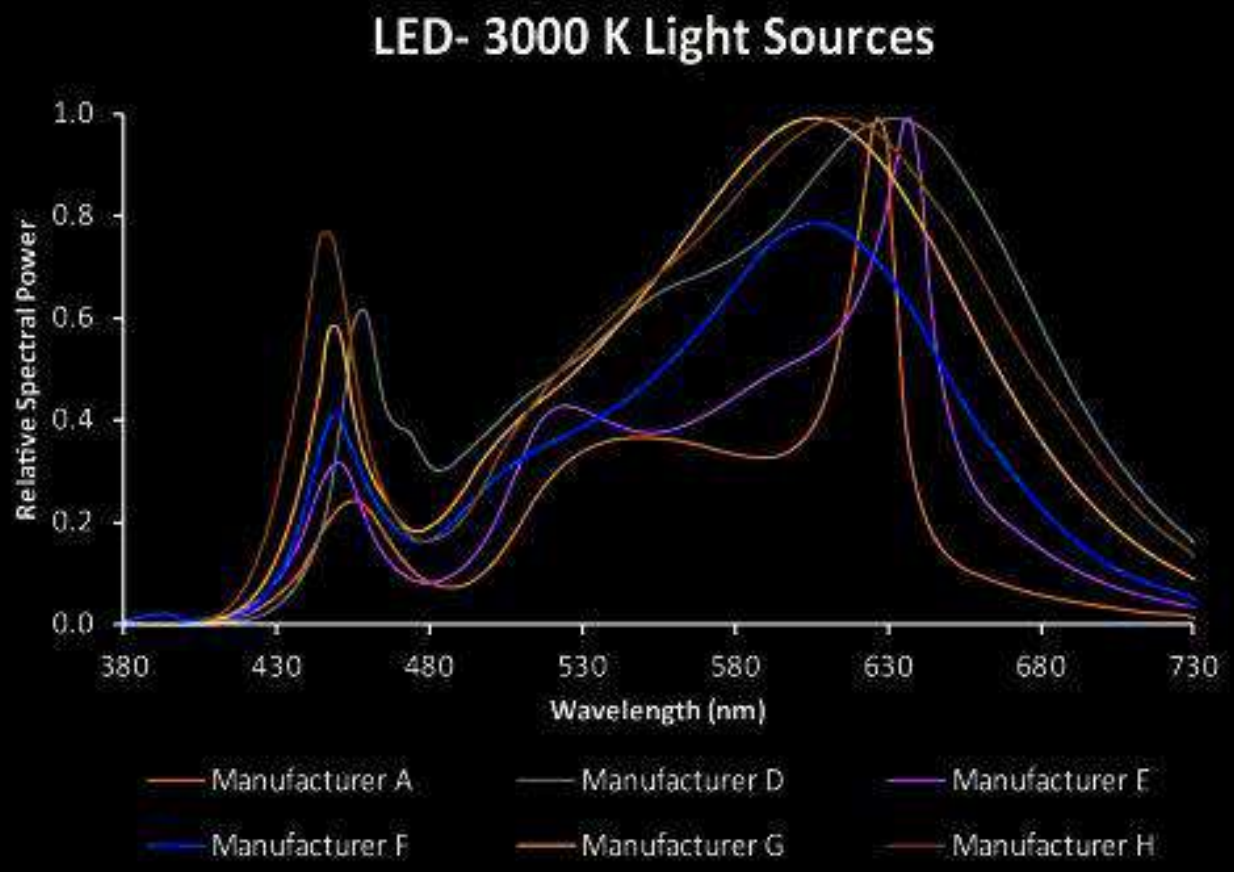
Benefits of Single Spectrum Light

CCT and SPD of White Light



Rea, MS and MG Figueiro, "Light as a Circadian Stimulus for Architectural Lighting." Lighting Res. Technol. 2018; 50: 503

CCT and SPD of White Light



Circadian Stimulus (CS) at the Eye

Horizontal Illuminance (lux)	Manufacturer					
	A	D	E	F	G	H
300	0.23	0.26	0.24	0.24	0.23	0.12
325	0.25	0.27	0.25	0.25	0.25	0.13
350	0.26	0.29	0.26	0.27	0.26	0.14
375	0.27	**0.30**	0.28	0.28	0.27	0.14
400	0.29	**0.31**	0.29	0.29	0.28	0.15
425	**0.30**	**0.33**	**0.30**	**0.30**	**0.30**	0.16
450	**0.31**	**0.34**	**0.31**	**0.31**	**0.31**	0.17
475	**0.32**	**0.35**	**0.32**	**0.32**	**0.32**	0.18
500	**0.33**	**0.36**	**0.33**	**0.33**	**0.33**	0.19

Values in **BOLD** meet or exceed the recommended CS of 0.3 or higher.

Lighting Research Center, "Circadian Stimulus Look-Up Charts – Direct/Indirect." p5.
https://www.lrc.rpi.edu/programs/lightHealth/index.asp

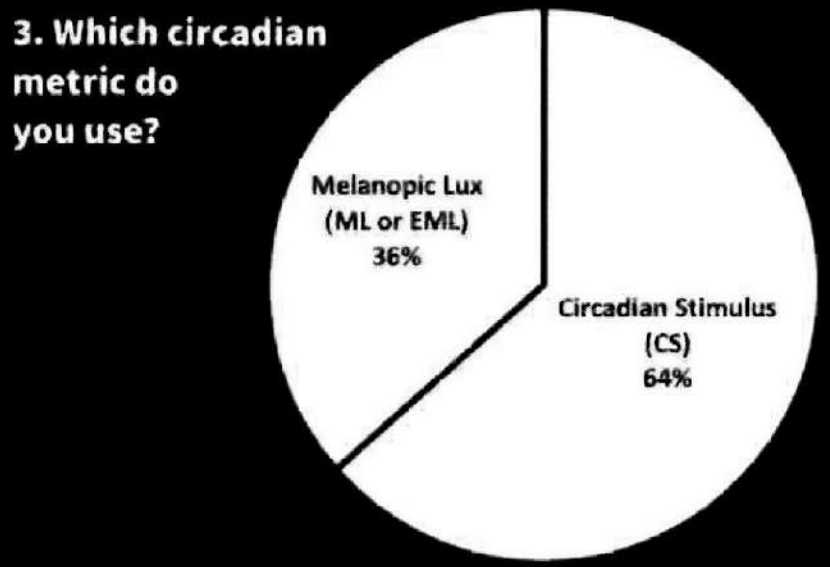
Projects

Residential Lobby

NY Office

Process for Calculations

- Identify most used position(s) for occupants
- Calculate vertical illuminance for each position in AGi
  - Separately calculate each light source for each position, as each source has a different SPD
- Input SPD info for each light source and vertical illuminace of each light source into CS and EML excel calculators for each position
- Add CS of each source to get total impact
- Add EML of each source to get total impact



Lesniak, Natalia and Ed Clark, “Putting it Into Practice: Circadian Survey.” LD+A Oct 2018, p45

Residential Lobby: Design Considerations

- Occupants of all ages
- Classical aesthetic
- Light stone finishes
- Restore stained glass skylight
- Make the space feel like it is exposed to sunlight
- Historic preservation
- Make the space feel bright and welcoming
- Did NOT consider daylight, as the space is shaded by surrounding high rises for the majority of the day

Residential Lobby

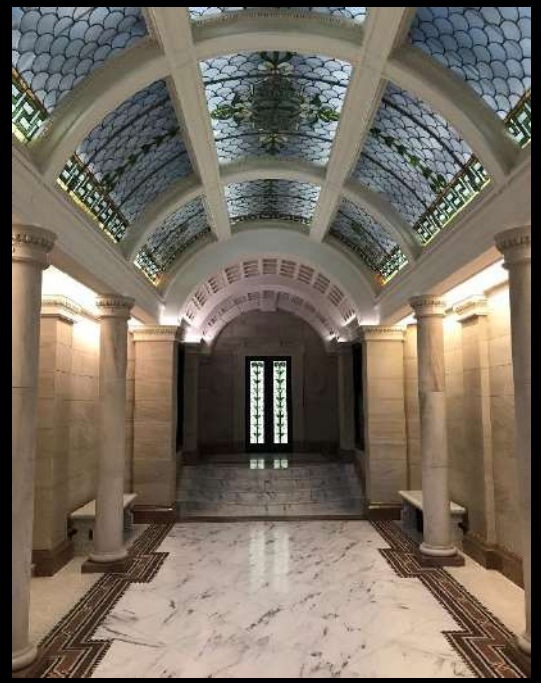
Before Renovation

Concept Rendering

Residential Lobby: After Renovation

"Sunrise"

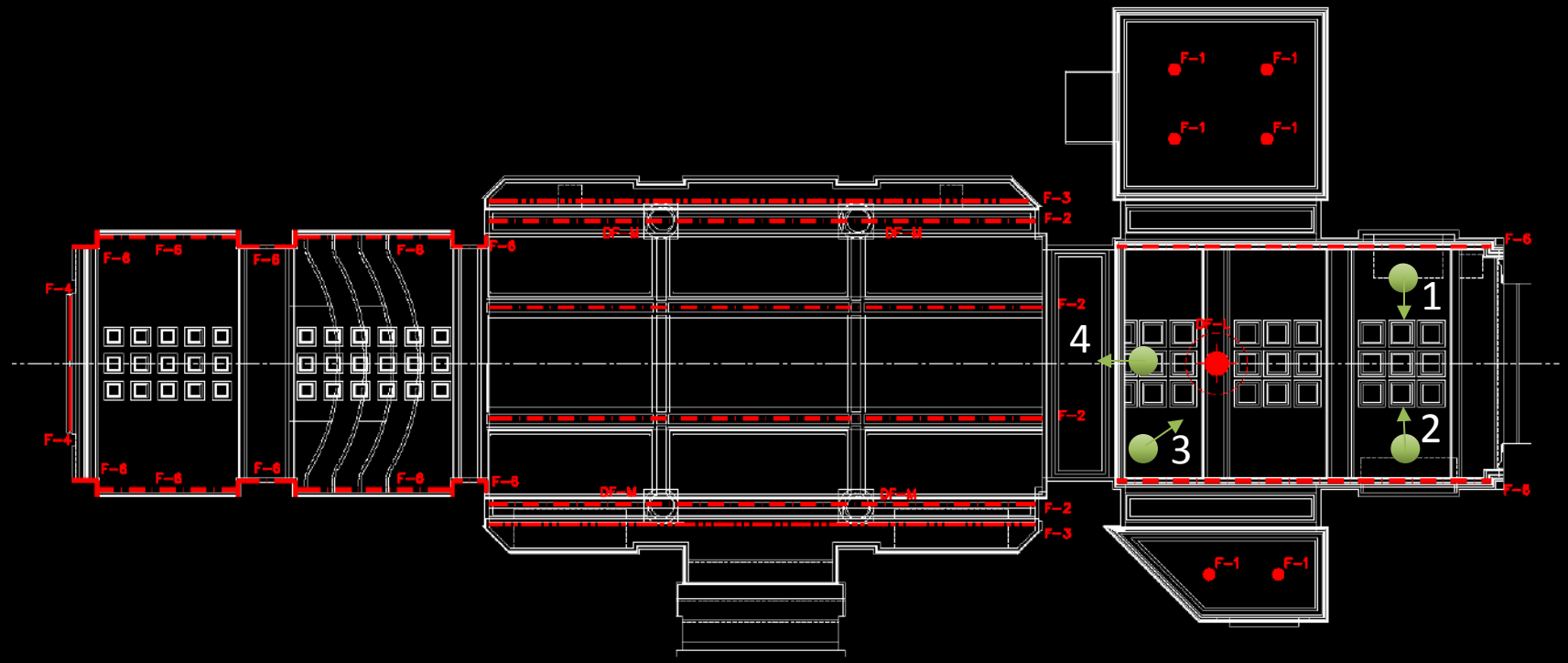
"Morning"



"Afternoon"

"Sunset"

Residential Lobby



Residential Lobby

RESIDENTIAL LOBBY CIRCADIAN VALUES																	
			DOORMAN POSITION 1				DOORMAN POSITION 2				DOORMAN POSITION 3				DOORMAN POSITION 4			
			HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE
WARM SCENE	F-1	2700K	5.4	5.21	0.006	2.52164	5.4	5.09	0.006	2.46356	6.4	6.99	0.008	3.38316	6.4	2.75	0.003	1.331
	F-2	2700K	13.2	8.31	0.009	3.74781	13.4	8.73	0.009	3.93723	56.9	11.28	0.012	5.08728	59.7	106.74	0.124	48.13974
	F-3	2700K	1.8	1.72	0.002	0.78432	1.9	1.72	0.002	0.78432	4.8	2.44	0.002	1.11264	4.8	9.69	0.011	4.41864
	F-6	2700K	14.05	11.73	0.013	5.34888	14.1	12.42	0.014	5.66352	12	11.77	0.013	5.36712	12.9	2.72	0.003	1.24032
	TOTAL		35.15	27.47	0.03	12.40265	35.4	28.56	0.031	12.84863	80.9	33.1	0.035	14.9502	84.7	122.62	0.141	55.1297
MEDIUM SCENE	F-1	2700K	5.4	5.21	0.006	2.52164	5.4	5.09	0.006	2.46356	6.4	6.99	0.008	3.38316	6.4	2.75	0.003	1.331
	F-2	4000K	15.5	9.7	0.007	6.0819	15.6	10.2	0.007	6.3954	66.9	13.17	0.01	8.25759	70.1	125.53	0.102	78.70731
	F-3	2700K	1.8	1.72	0.002	0.78432	1.9	1.72	0.002	0.78432	4.8	2.44	0.002	1.11264	4.8	9.69	0.011	4.41864
	F-6	~4000K	33.2	27.78	0.031	21.22392	33.3	29.41	0.033	22.46924	28.4	27.86	0.031	21.28504	30.7	6.47	0.006	4.94308
	TOTAL		56.85	45.08	0.046	30.61178	57.15	47.22	0.048	32.11252	107.7	51.33	0.051	34.03843	113.2	145.89	0.122	89.40003
COOL SCENE	F-1	2700K	5.4	5.21	0.006	2.52164	5.4	5.09	0.006	2.46356	6.4	6.99	0.008	3.38316	6.4	2.75	0.003	1.331
	F-2	6500K	18.7	11.68	0.019	9.64768	18.9	12.29	0.022	10.15154	80.8	15.88	0.027	13.11688	84.7	151.4	0.228	125.0564
	F-3	2700K	1.8	1.72	0.002	0.78432	1.9	1.72	0.002	0.78432	4.8	2.44	0.002	1.11264	4.8	9.69	0.011	4.41864
	F-6	6500K	18.7	15.63	0.028	15.19236	18.75	16.55	0.029	16.0866	16	15.68	0.028	15.24096	17.3	3.63	0.006	3.52836
	TOTAL		45.6	35.02	0.055	28.146	45.9	36.55	0.059	29.48602	109.4	42	0.065	32.85364	114.5	169.02	0.248	134.3344

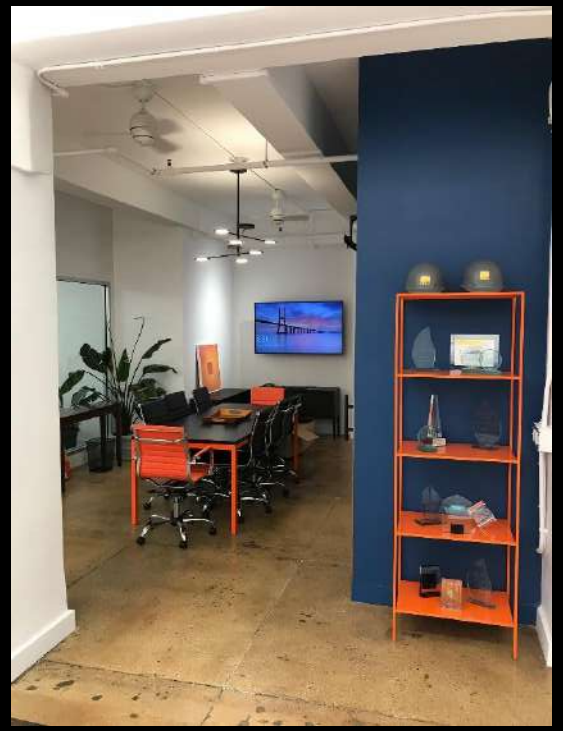
KEY			
HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE
<50	<30	<0.3	<150
50-150	30-75	>0.3	150-240
>150	>75		>240

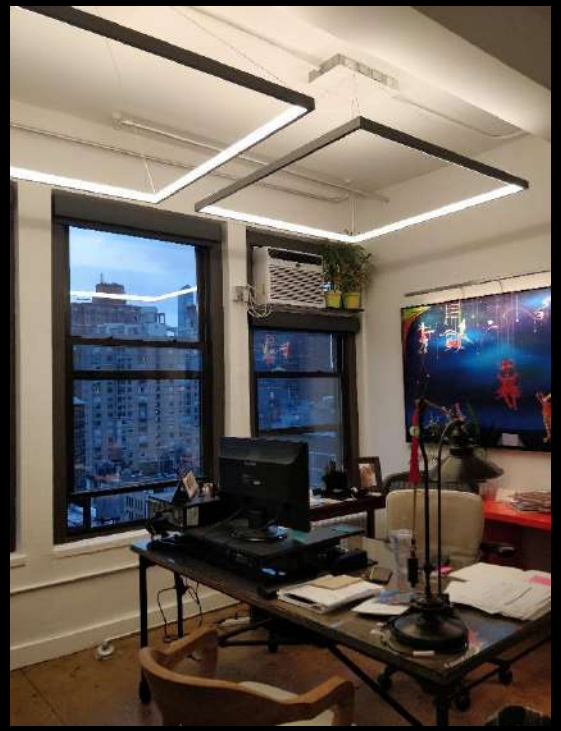
NY Office: Client's Needs

- Occupants all working adults, roughly ages 20-65
- Clean, contemporary design
- Light colored finishes with lots of art
- "Showroom" for clients
- Balance high levels of sunlight coming from windows
- Low budget
- DID consider daylight using CIE D65
- DID NOT consider computer monitors or other screens

NY Office: Shell Space

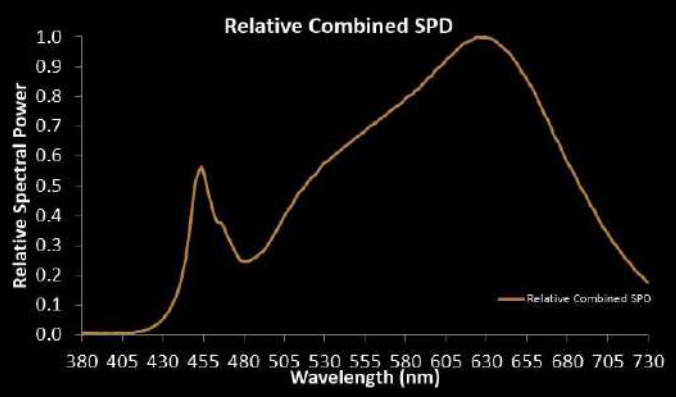
NY Office





NY Office

F-1 AT 3000K



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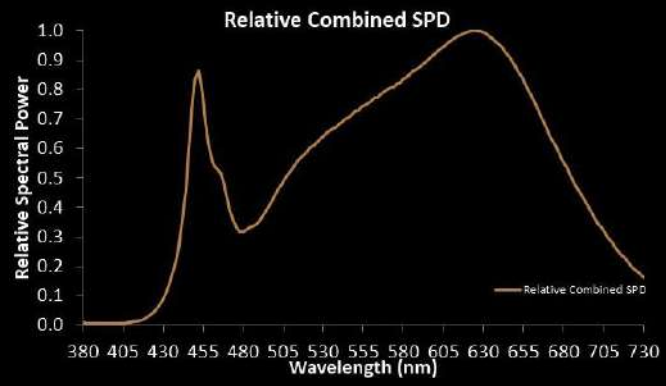

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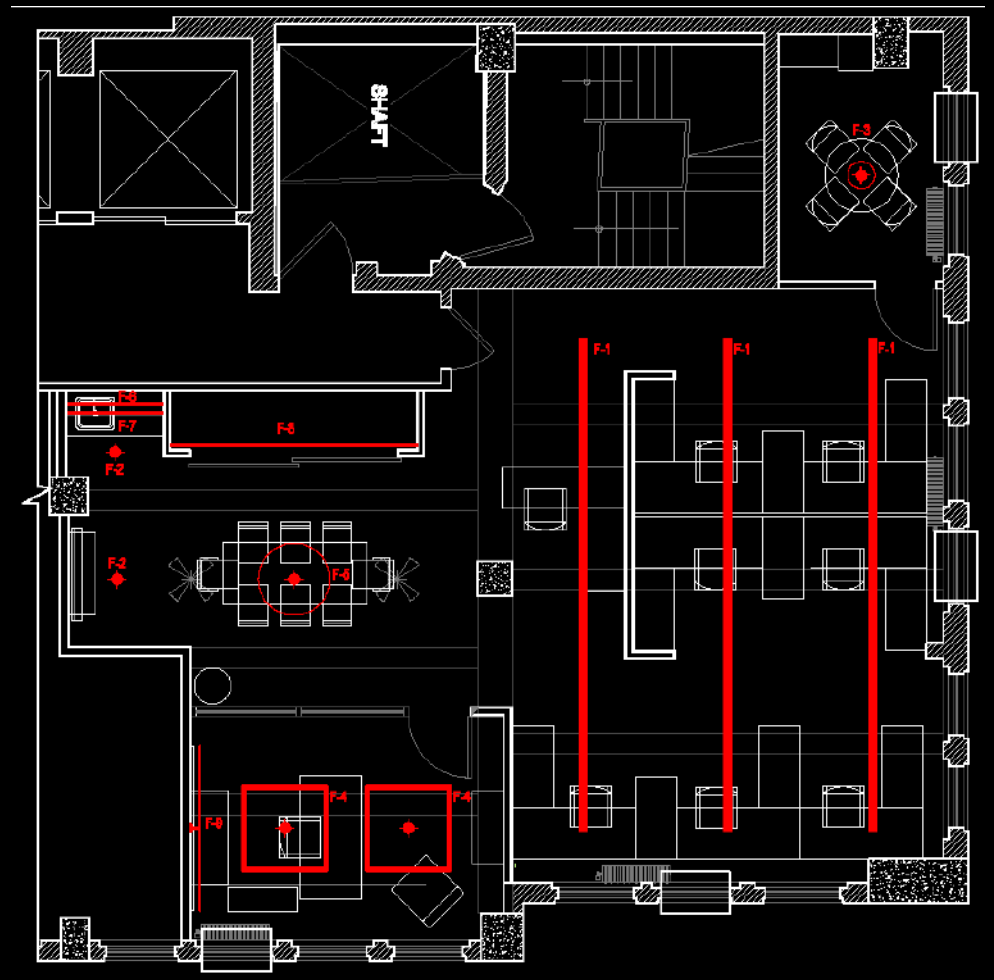
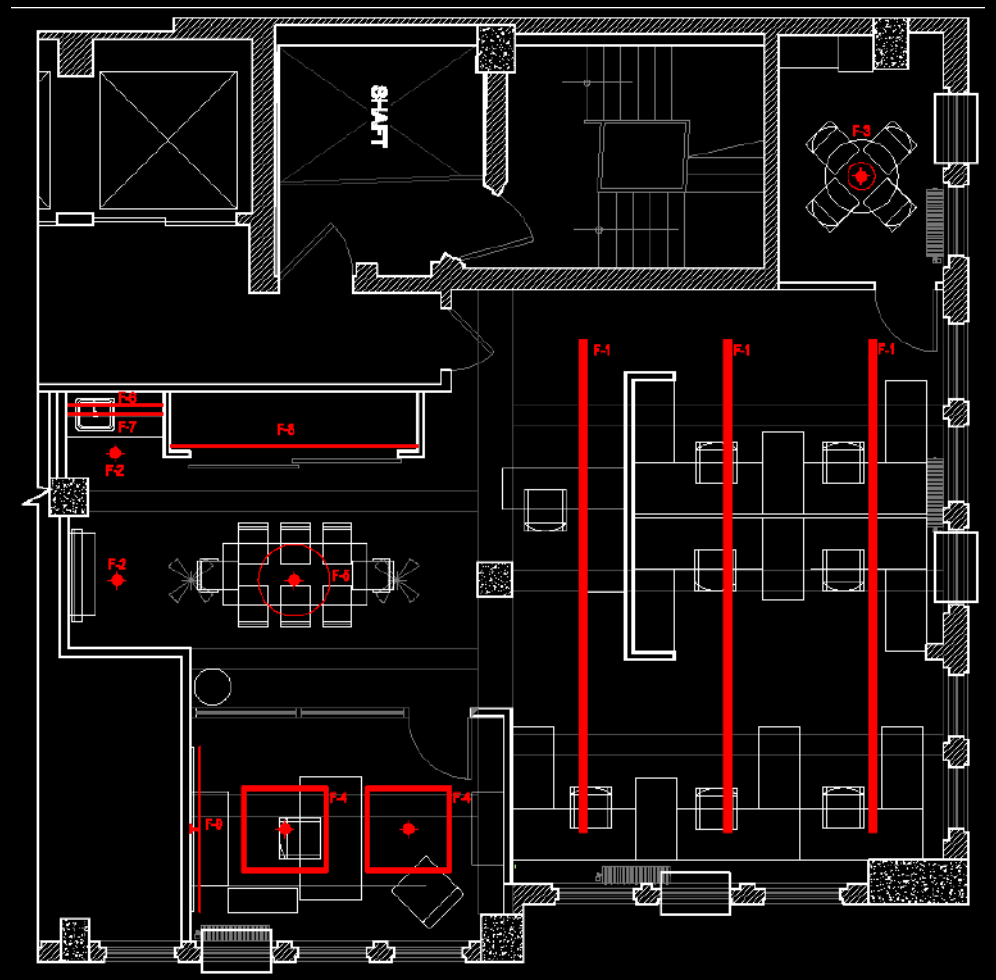


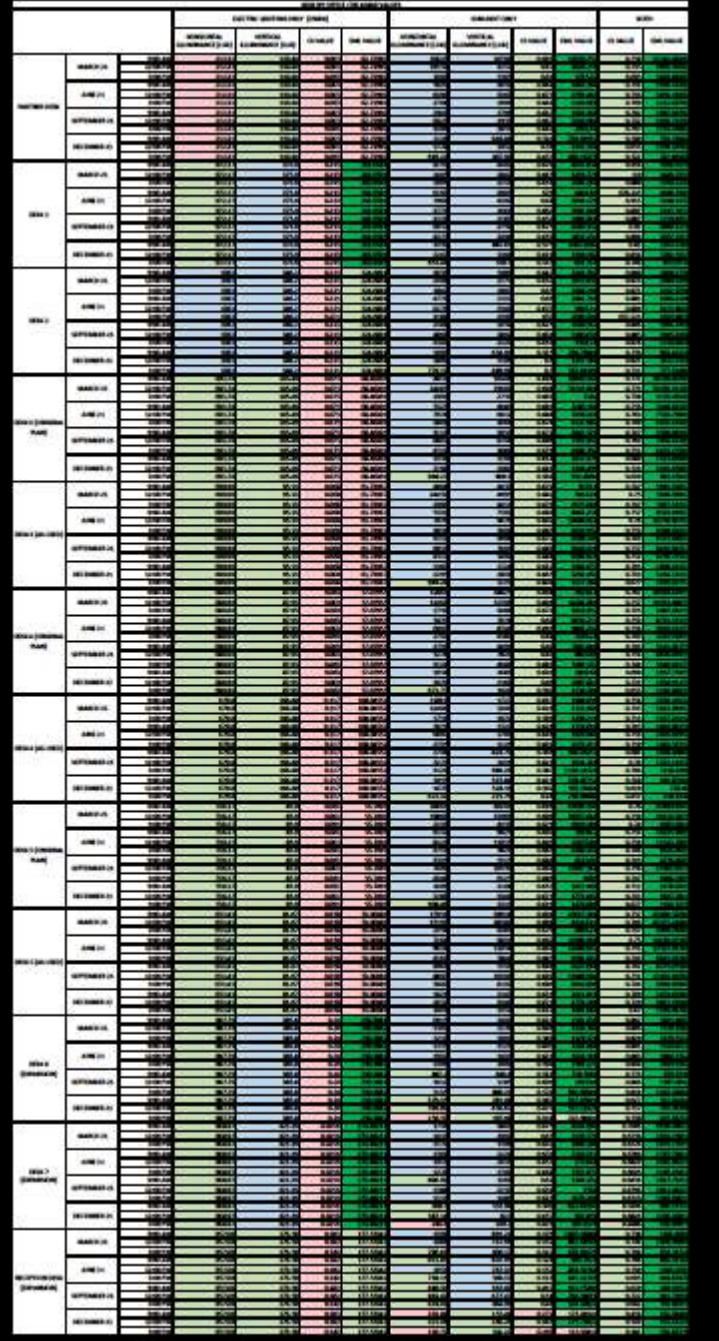
KGM NY OFFICE CIRCADIAN VALUES								
	ELECTRIC LIGHTING ONLY (3500K)				ELECTRIC LIGHTING ONLY (3500K)			
	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE
PARTNER DESK	212.31	110.44	0.153	61.18376	212.31	110.44	0.065	62.72992
DESK 1	972.17	375.9	0.364	208.2486	972.17	375.9	0.235	243.9591
DESK 2	1032	346.2	0.348	191.7948	1032	346.2	0.221	224.6838
DESK 3 (ORIGINAL	691.74	105.49	0.147	58.44146	691.74	105.49	0.075	68.46301
DESK 4 (ORIGINAL	680.93	87.95	0.125	48.7243	680.93	87.95	0.063	57.07955
DESK 5 (ORIGINAL	736.17	85.9	0.123	47.5886	736.17	85.9	0.061	55.7491
DESK 6	987.79	385.8	0.369	213.7332	987.79	385.8	0.24	250.3842
DESK 7	968.97	421.39	0.386	233.45006	968.97	421.39	0.0256	273.48211
RECEPTION DESK	957.08	273.58	0.303	151.56332	957.08	273.58	0.182	177.55342

KEY			
HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE
< 300	< 50	<0.3	< 150
300-1000	50-300	>0.3	150-240
>1000	>300		>240

NY Office



KEY			
HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE
< 300	< 50	<0.3	< 150
300-1000	50-300	>0.3	150-240
>1000	>300		>240



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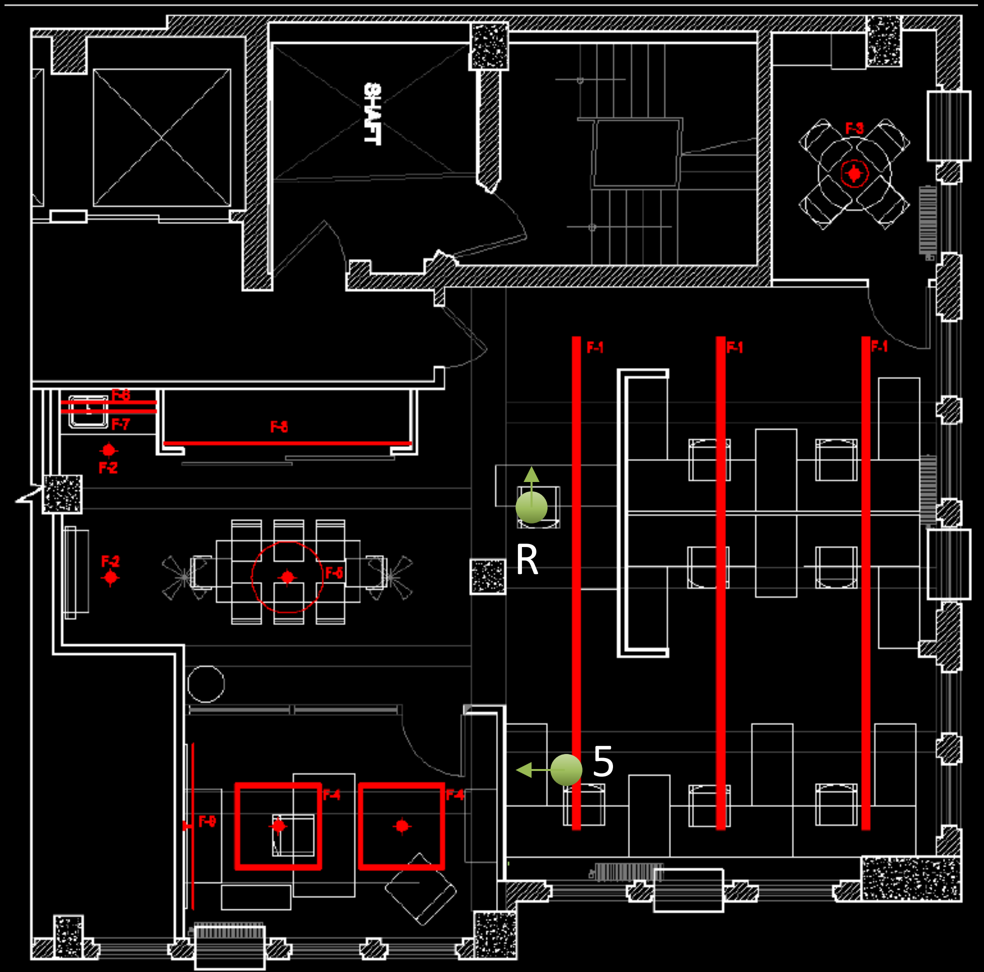

NY OFFICE CIRCADIAN VALUES

			ELECTRIC LIGHTING ONLY				SUNLIGHT ONLY				BOTH	
			HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	HORIZONTAL ILLUMINANCE (LUX)	VERTICAL ILLUMINANCE (LUX)	CS VALUE	EML VALUE	CS VALUE	EML VALUE
DESK 5 (ORIGINAL PLAN)	MARCH 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	JUNE 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	SEPTEMBER 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DESK 5 [illegible]	MARCH 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	JUNE 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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RECEPTION DESK (EXPANSION)	MARCH 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	JUNE 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		12:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		3:00 PM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	SEPTEMBER 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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	DECEMBER 21	9:00 AM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Daylight zone in a typical windowed space, defined here as penetrating into the space a distance of 2 times the window height. Image courtesy of CLTC.

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>1000	>300		>240

AIA

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Patient Experience

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Client Goals

Tallahassee Memorial Healthcare: TMH Tower

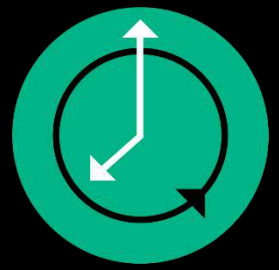
- Patient-Family Centered Design with Connectivity to Nature
- New hospital entrance that makes a visible statement
- Clear wayfinding from existing hospital to new and Convenient parking
- Flexible design that accommodates future growth
- Supportive work environment for staff that is environmentally sustainable.
- Financially responsible, innovative solutions based on evidence-based design.
- Maintain ongoing operations without diminishing quality of service.

- Off-Stage Design
  - 24 bed racetrack configuration
  - 3 Team centers in core dedicated to each 8 bed pod
  - Family lounge located directly off public elevators at West end with amenities

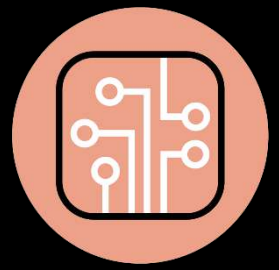
- 6 Design Drivers Influencing Design
  - Patient Safety
  - Quality + Efficiency
  - Technology
  - Adaptability/Resiliency
  - Healthy, Sustainable Buildings
  - Human Experience

TMH ICU
Design Drivers

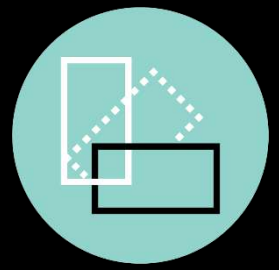
Patient Safety



Quality + Efficiency



Integration of Technology



Adaptability/ Resiliency

Healthy, Sustainable Buildings

Human Experience

Research Opportunities

Driver	Design Solutions	Outcomes
	Clear Caregiver safety zones	Med Errors
	Distributed support spaces	
	Visibility	
	Central staff corridor	Noise,
	Limited staff travel distance	Staff PFEC Burnout
	Dedicated staff team rooms	
	Collaboration	
	Glass enclosed nurse station	
	Dedicated PT pathways	PT Satisfactior
	Noise/Visibility	
	Noise Reduction Strategies	PFEC
	Privacy Adaptable Rooms	PFEC
	Daylight and Vistas in Rms	Sleep Quality
	PT Choice and Control	
	Positive Distraction	
	Family Presence in Rooms	

**PFEC=Patient, Family Engaged Care, National Academy*

Hypothesis:

The built environment will positively impact expected outcomes reducing sensory stress for patients, their families and staff in the ICU.

Study dates: May 2018 - May 2020

Collection Period 1

- Pt/Family paper survey
- Staff paper/online survey
- Staff DThinking session
- TMH Data pulls
- Noise/EML light levels
- Space Syntax Analysis

Collection Period 2

- Pt/Family paper survey
- Staff paper/online survey
- Staff DThinking session
- TMH Data pulls
- Noise/EML light levels

Collection Period 3

- Pt/Family paper survey
- Staff paper/online survey
- Staff DThinking session
- TMH Data pulls

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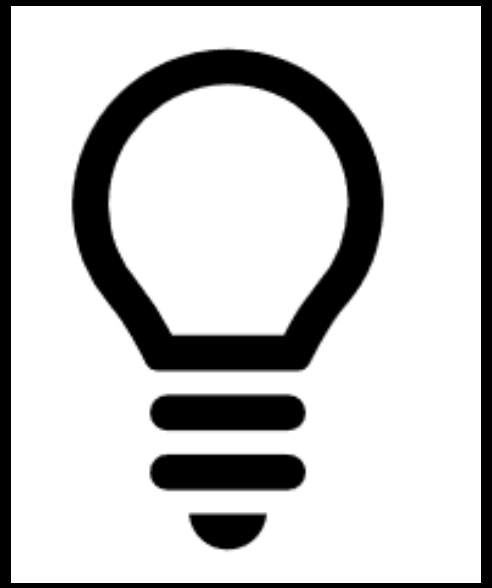

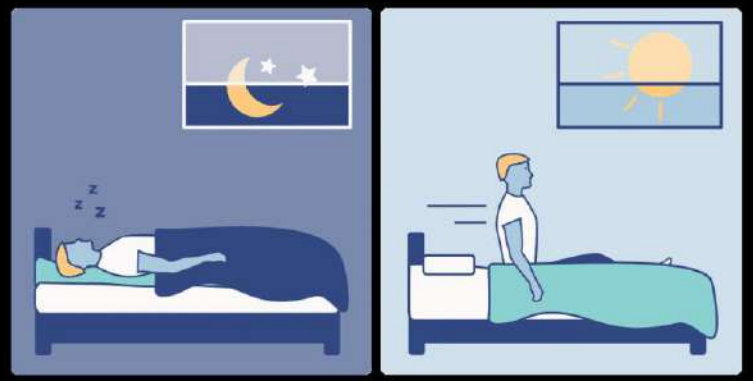

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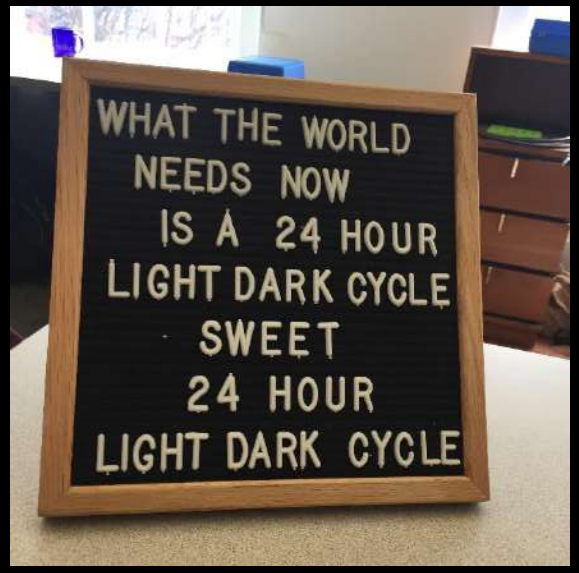
What this means for designers:



- Lighting affects more than just your vision
- Think about layers of light
- Tunable lighting does not mean circadian lighting
- Timing matters
- Occupant education is important for the success of circadian lighting design

This concludes The American Institute of Architects Continuing Education Systems Course

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