

Designers Lighting Forum

Lighting to Support a
Healthy Circadian Rhythm

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Learning Objectives

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

1. Have a basic understanding of the impacts of artificial lighting on human's circadian rhythm.
2. Analyze the interior environment's impact on human health relating to artificial light exposure.
3. Apply lighting techniques to support the balance of human's circadian rhythm.
4. Apply basic knowledge of application techniques of various LED CCT's and illuminance levels to support a healthy circadian rhythm.

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Professor

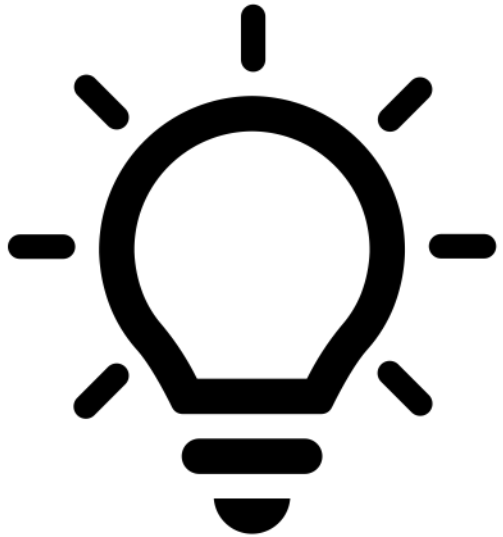
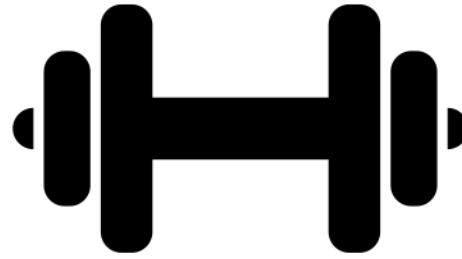
Registered Interior Designer

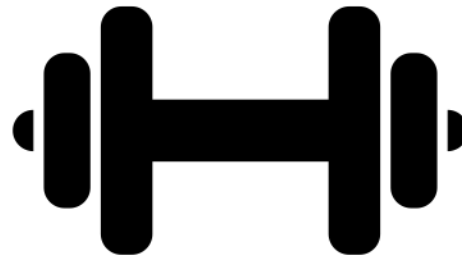
Entrepreneur

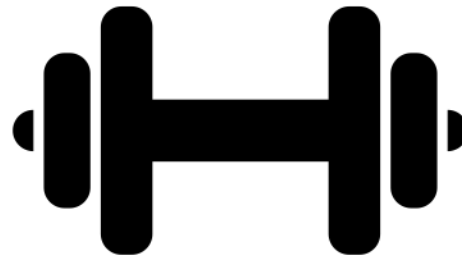
Health & Wellness Advocate

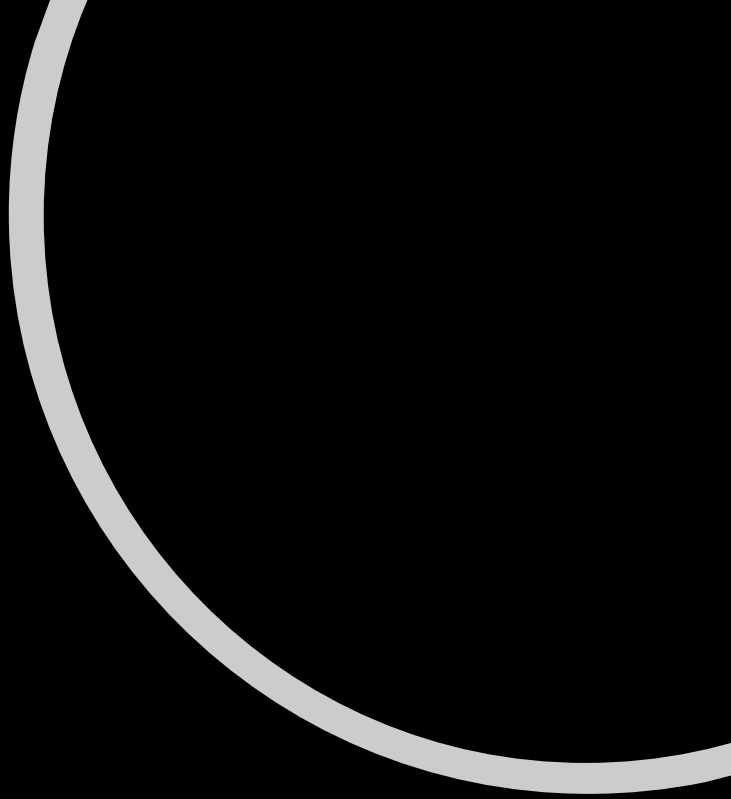
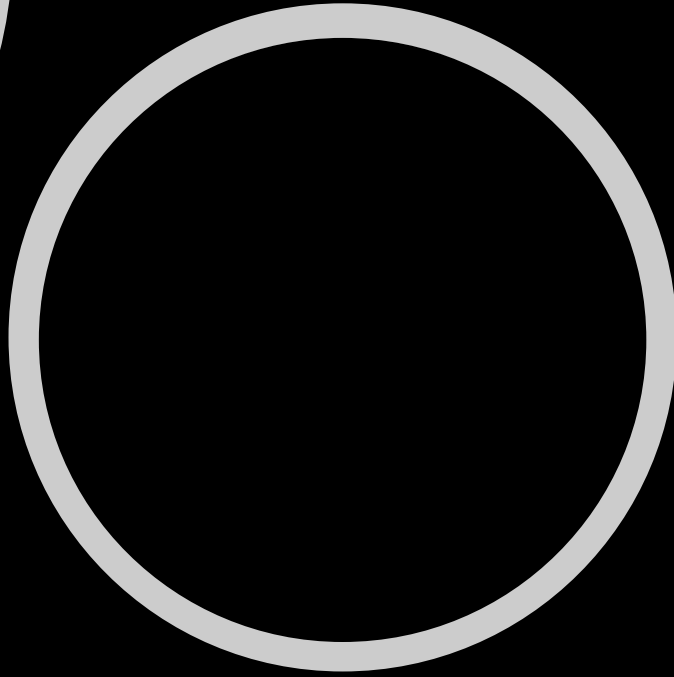


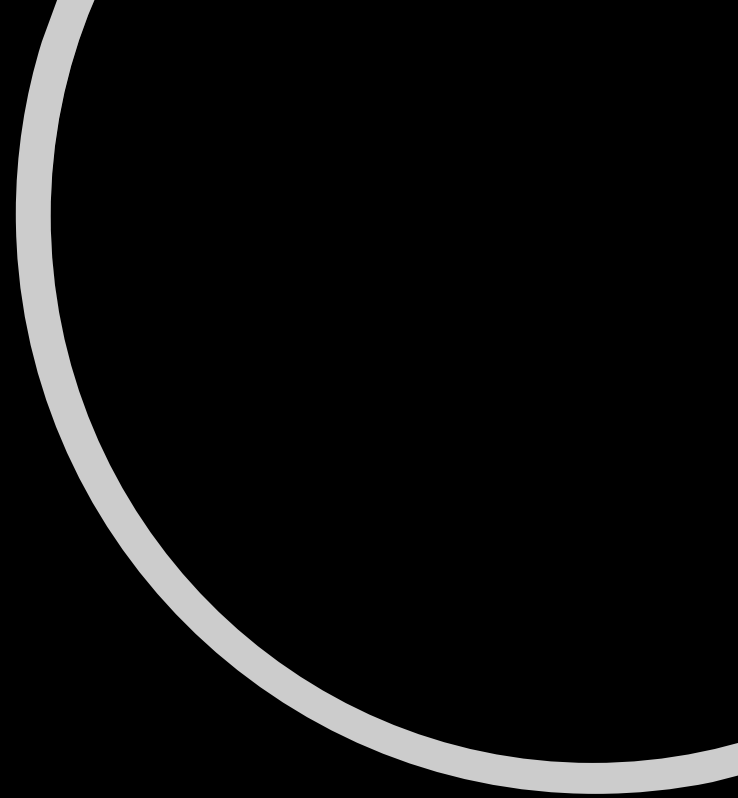
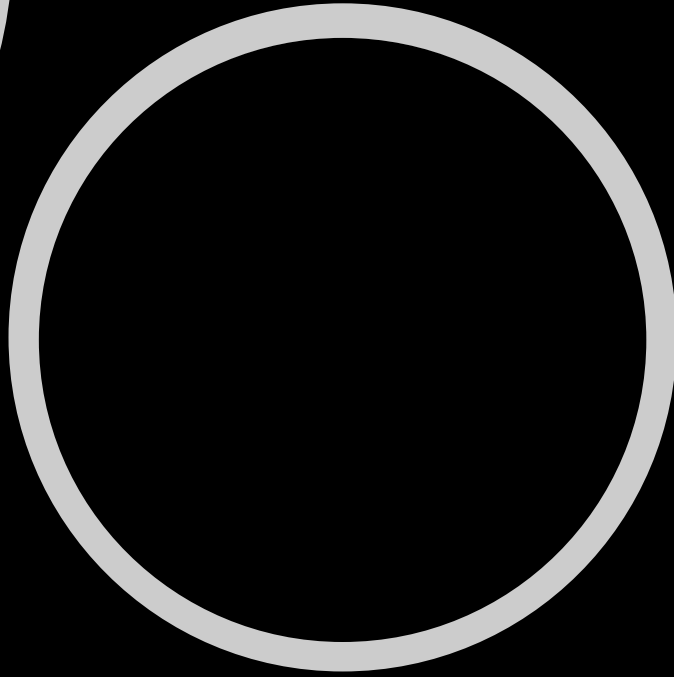






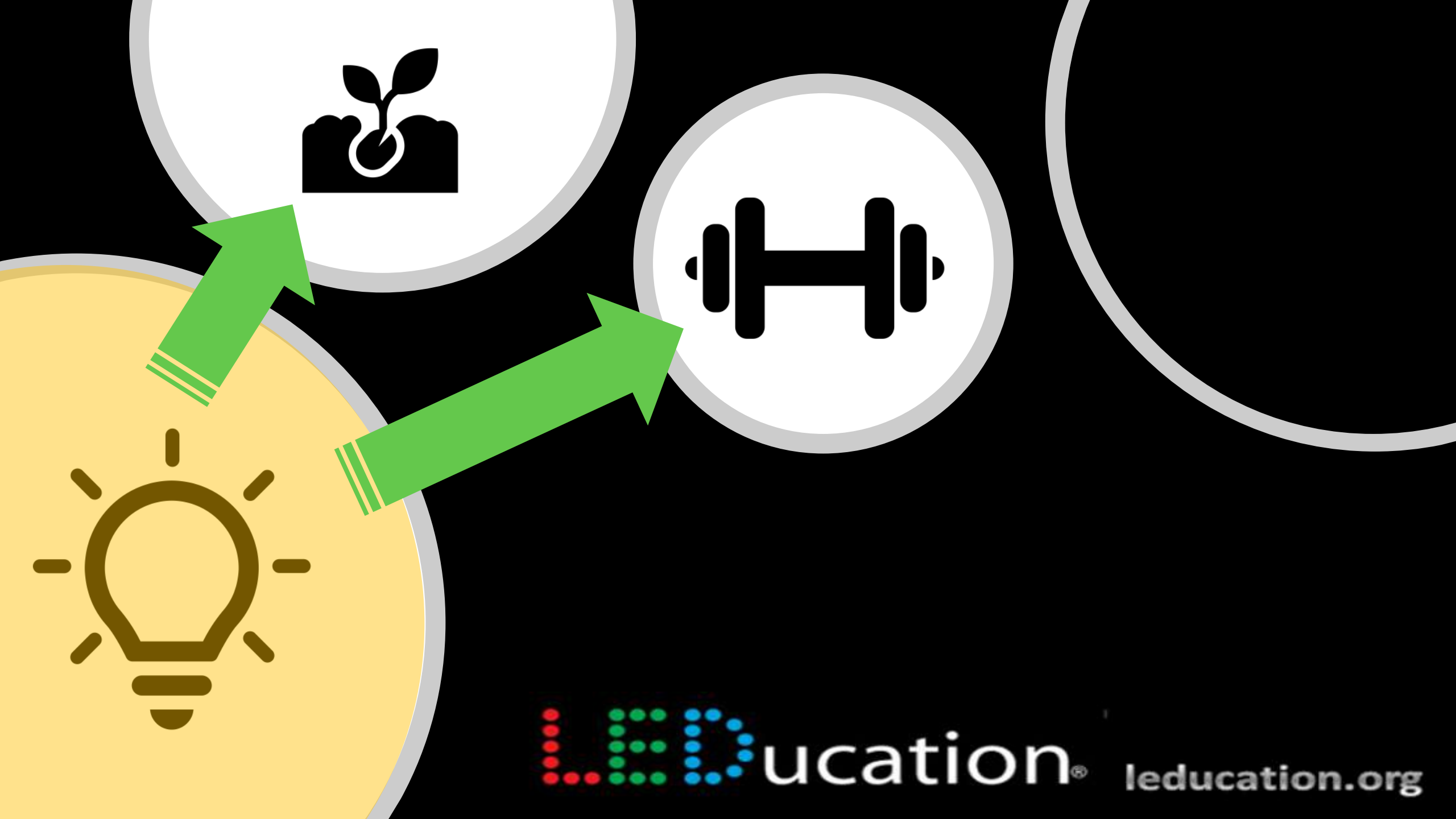


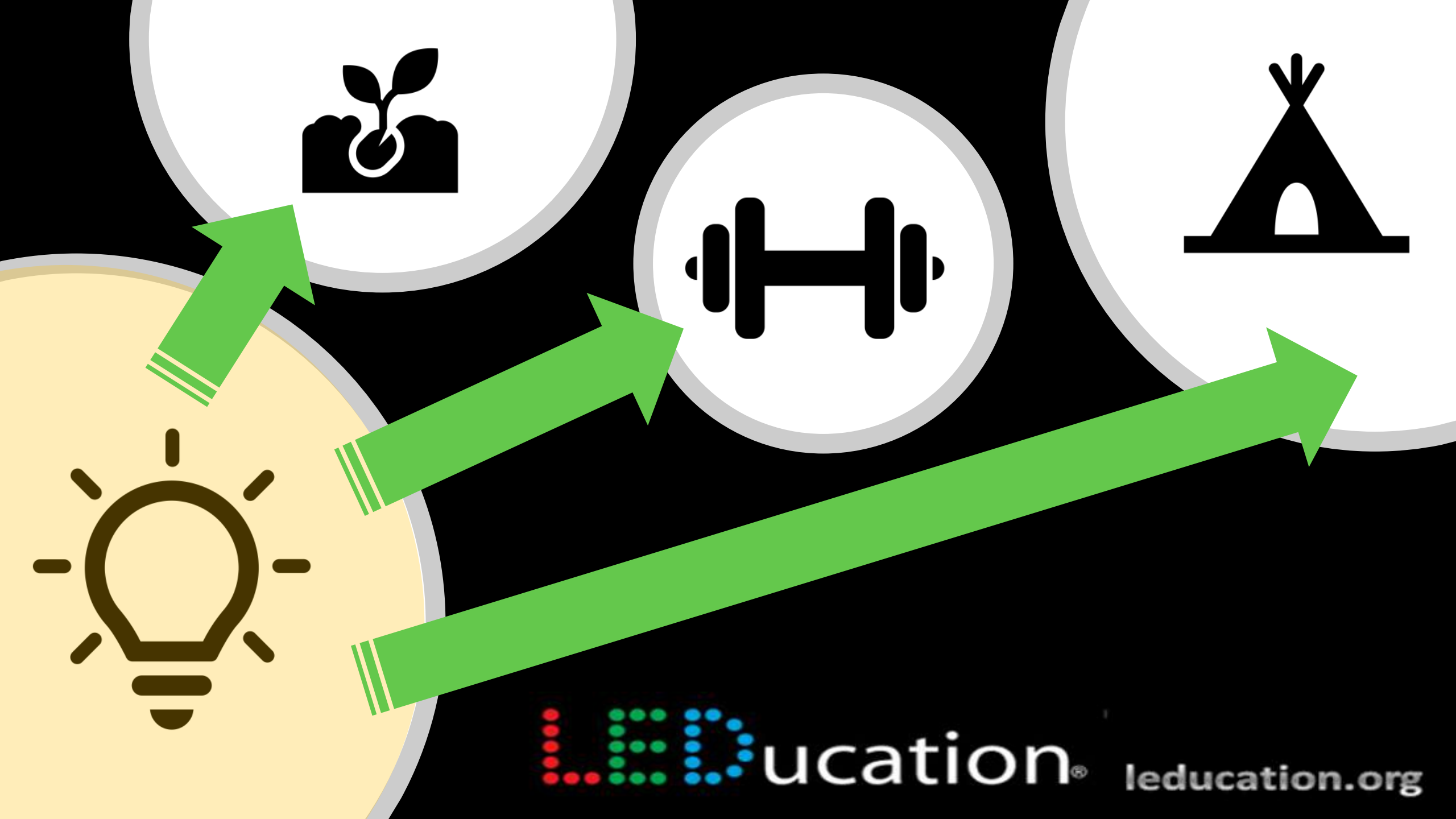


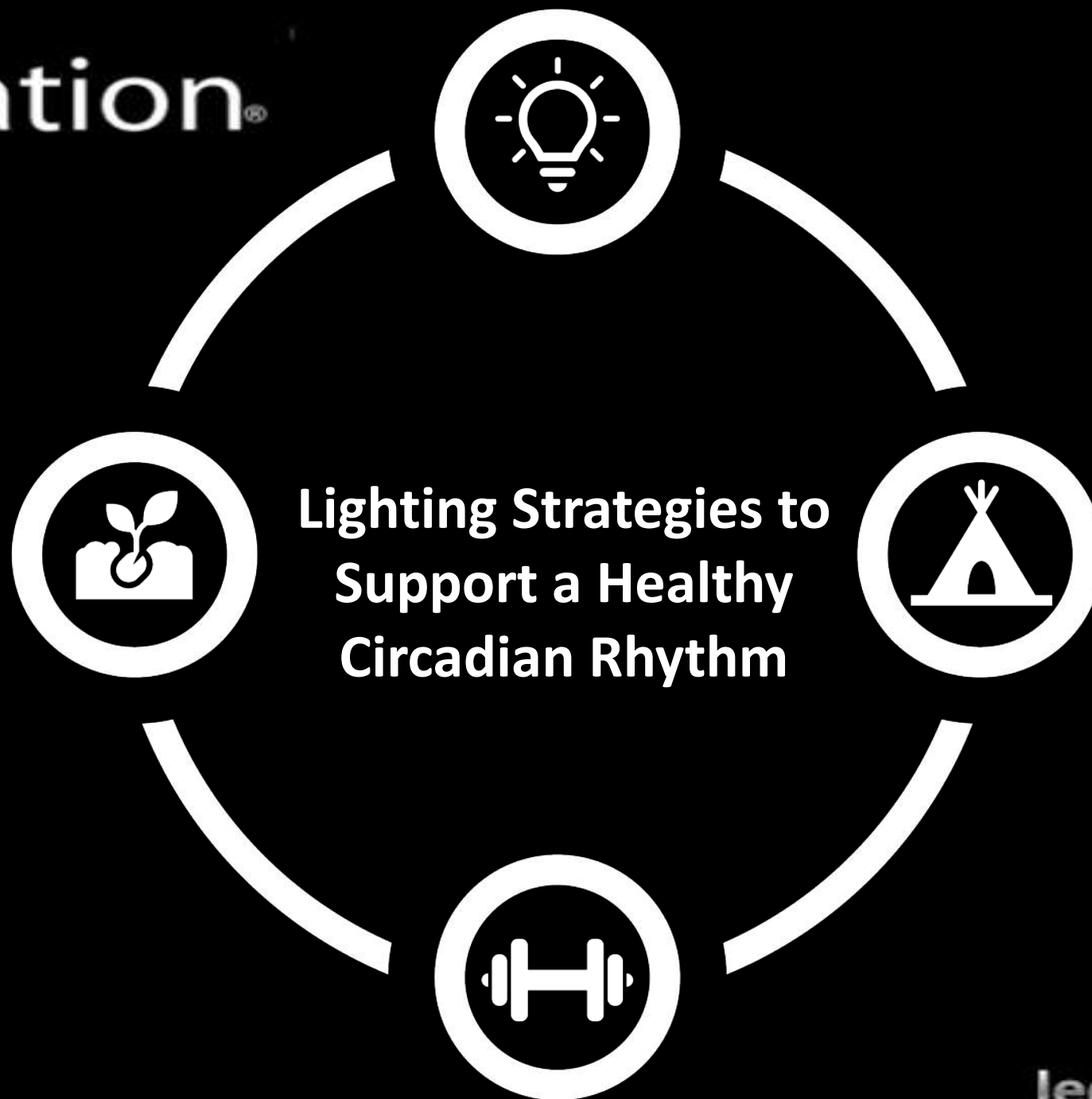


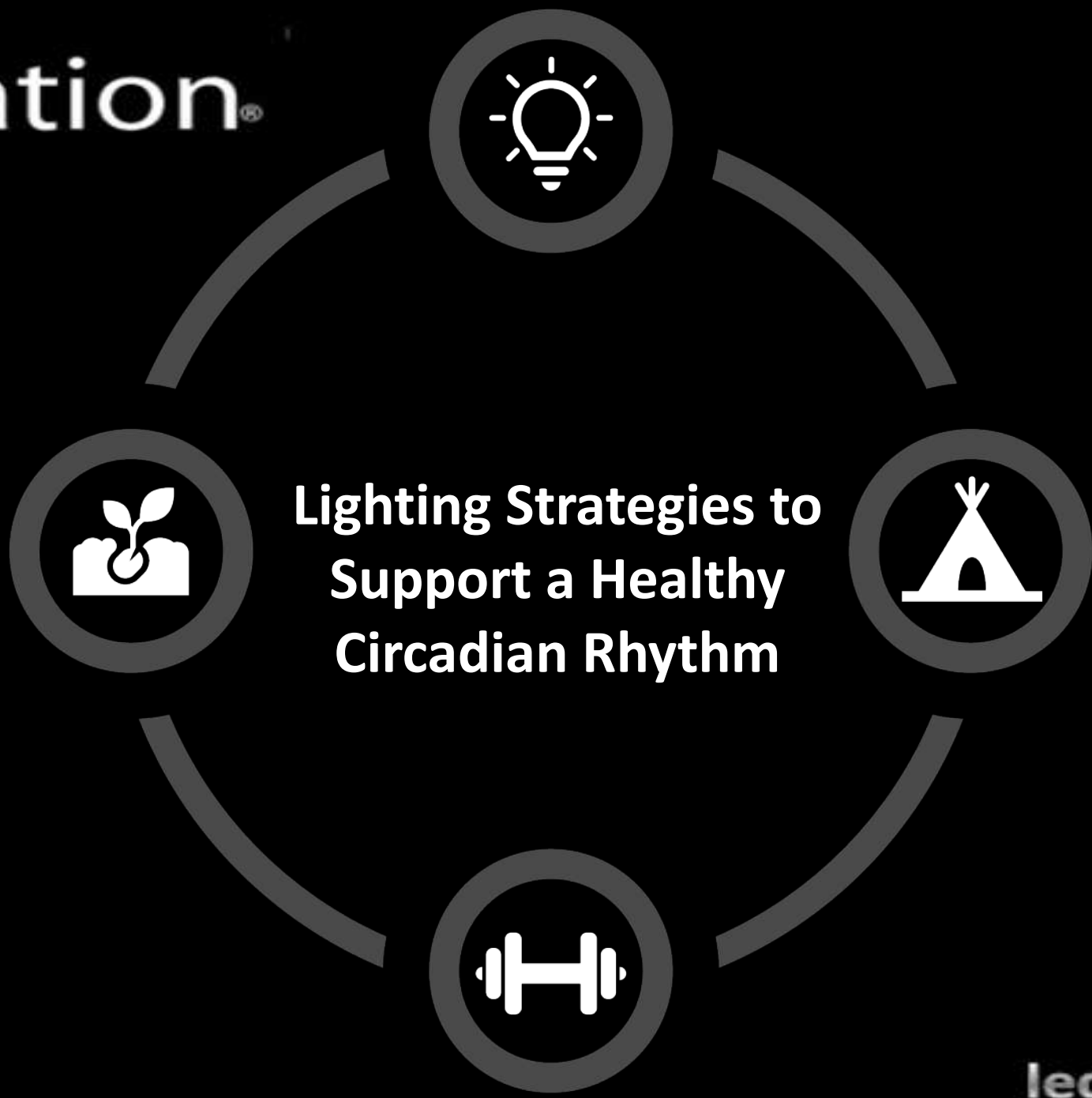
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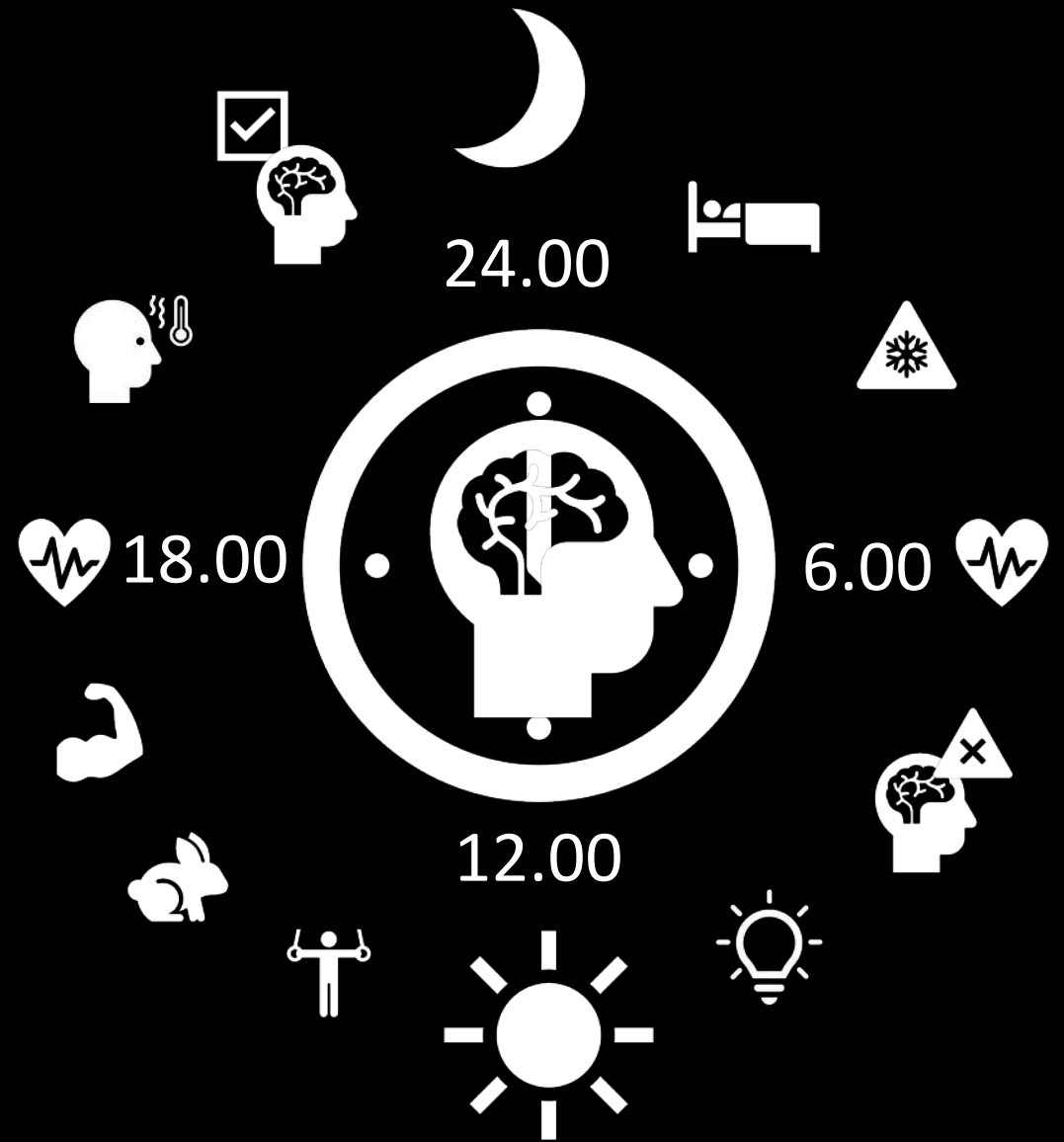






Circadian Rhythm

- sleep /wake cycle
- Circadian rhythm signals various biological functions
- Internal clock
- Regulates hormone health
- Melatonin production/suppression
- Cortisol production/suppression



Circadian Rhythm & Light – Light is the missing link to Health



- intrinsically photosensitive retinal ganglion cells (ipRGCs)
- Project to brain areas to entrain the Circadian Rhythm
- Regulate body temperature, hormone production
- Responsible for alertness, sleep regulation & cognitive function

Ancestral times

- Body's in tune with darkness/daylight
- Wake naturally with the sun
- Daylight active
- Day ends when sun sets
- Evenings are dark, telling our bodies to prepare for sleep
- No artificial light
- Complete darkness while sleeping



Present times – What has changed?

- Invention of artificial light
- Evolution has not kept up to technological advancement
- 93% of time spent indoors
- Reduced daylight exposure
- Increased exposure to artificial light & screens
- Shortening of days & lengthening of nights
- Brighter nights suppress melatonin production
- no absence of light



Consequences

- Increased links to depression
- Decreased cognitive function
- Obesity
- Cancer
- Sleep disorders
- Mood, anxiety & energy shifts



Other Factors

- Retina sensitivity changes throughout the day
- Low during the day
- High at night
- Our Circadian Rhythm has a difficult time synchronizing with such a reduced amount of light
- Why our body clocks get later and later



Our Biology & Behaviour



- Optimal timing based on each individual
- Repair process
- Observe patterns on non-work days

Our Biology & Behaviour



- Social jet-leg (living against your body clock)
- Using an alarm clock
- ***Sleep is the single most important factor of our wake time***

Our Behaviour

- COVID pandemic – forced change
- showed people could still be productive and perform work
- No commute time
- Spend time outdoors at the end of the day, instead of the beginning

Our Behaviour & Our Age

Gen Z & Millennials, Youth

- Tech companies leading with offering flex hours
- School age students start school before their natural wake time
- Teens fall asleep later
- Higher screen exposure in the evenings, and often late at night
- Causing sleep disruption, and further suppressed melatonin

Our Behaviour & Our Age

Baby Boomers

- Aging population, aging eye
- Thickening & yellowing of the lens
- Adults over 60 require two times the light exposure
- Requiring more sleep and recovery time
- Adults in assisted living care spend more than the population who's average is 93% time indoors

What can we do to improve our health through light exposure?

What are we doing the rest of the day?



Lighting Strategies to Support a Healthy Circadian Rhythm

- 1. Alignment of Internal Clock**
- 2. Spectral Content**
- 3. Distribution & Location & Intensity**
- 4. Duration (amount & time of day)**



Lighting Strategies to Support a Healthy Circadian Rhythm

1. Alignment of Internal Clock

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Daytime Practices

Emulate back to natural state

- blue enriched light exposure during day time
- Design the lighting scheme to match the user's age/demographic combined with flexible work time – can reduce alarm use, social jet-let
- Increase exposure of light, natural or artificial

1. Alignment of Internal Clock

Daytime Practices

Emulate back to natural state

1. Alignment of Internal Clock

Evening Practices

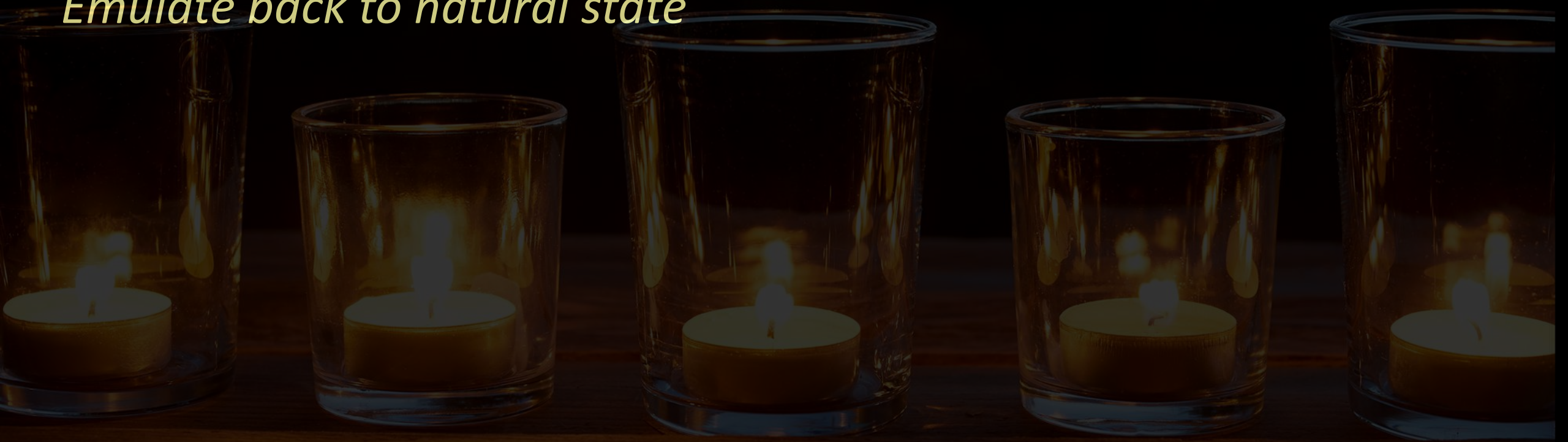
Emulate back to natural state

- lamps, computers, screens (remove blue part of spectrum after sunset)
- Adjust CCT of lighting to a warmer tone, emphasizing the red & orange hues
- Continue to mimic natural pattern and timing of the sun (light/darkness)

1. Alignment of Internal Clock

Evening Practices

Emulate back to natural state





Lighting Strategies to Support a Healthy Circadian Rhythm

2. Spectral Content

2. Spectral Content

- The exposure time of day
- Duration
- Wavelengths
- Spectral content in white light is not equal.

2. Spectral Content

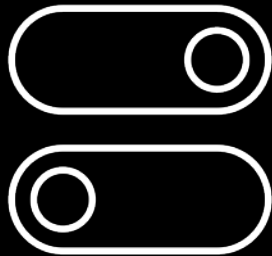
- Not all white light is equal
- To understand the effectiveness of a light source we need to measure and evaluate the spectral power distribution (SPD), not just the CCT

2. Spectral Content



- ipRGCs are most sensitive to the short blue wavelengths of light
- irregular SPDs can indicate overemphasized or underemphasized colours.
- Color consistency through consistent manufacturer

2. Spectral Content



- Use lamps with tunable CCT
- Tunable white luminaires can have LEDs emitted at least two CCTs
- Adjustability for occupants
- Create lighting schemes for different times of the day



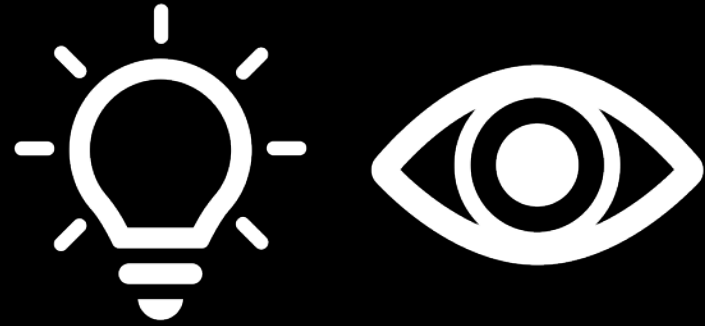
Lighting Strategies to Support a Healthy Circadian Rhythm

3. Distribution & Location & Intensity

3. Distribution /Location/ Intensity

Recommended Practices

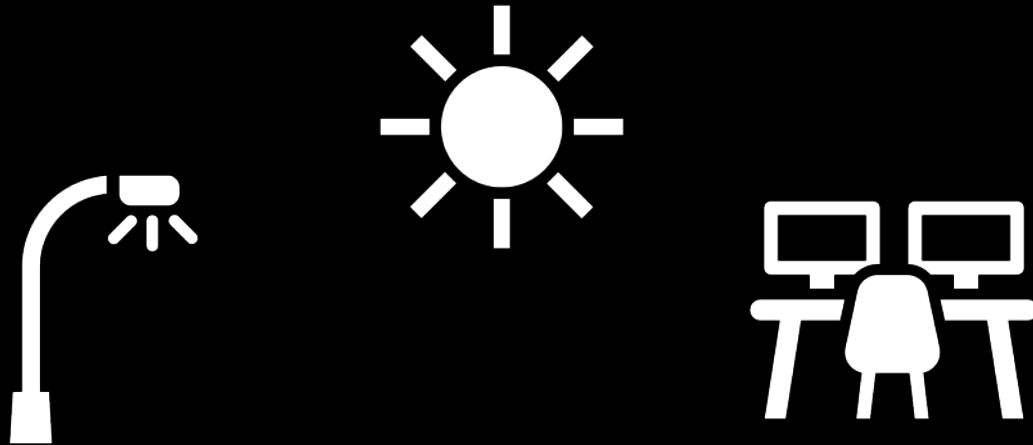
- Human centered focus to consider lighting for human health
- Not just illumination for visual tasks (horizontal plane)
- Stimulus at the EYE, not at the work surface



3. Distribution /Location/ Intensity

Daytime

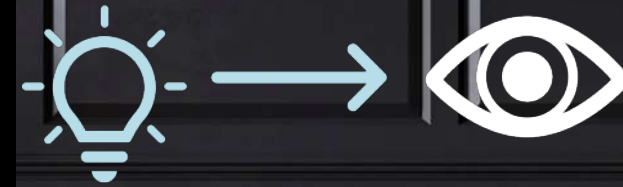
- Treat the domestic work space with lighting that mimics the daytime sky
- Use luminaires that are adjustable and will not cause glare



3. Distribution /Location/ Intensity

Daytime

- Place luminaires near the peripheral level
- Use integrated lighting to reduce glare
- Use luminaires to create diffused, indirect light



3. Distribution /Location/ Intensity

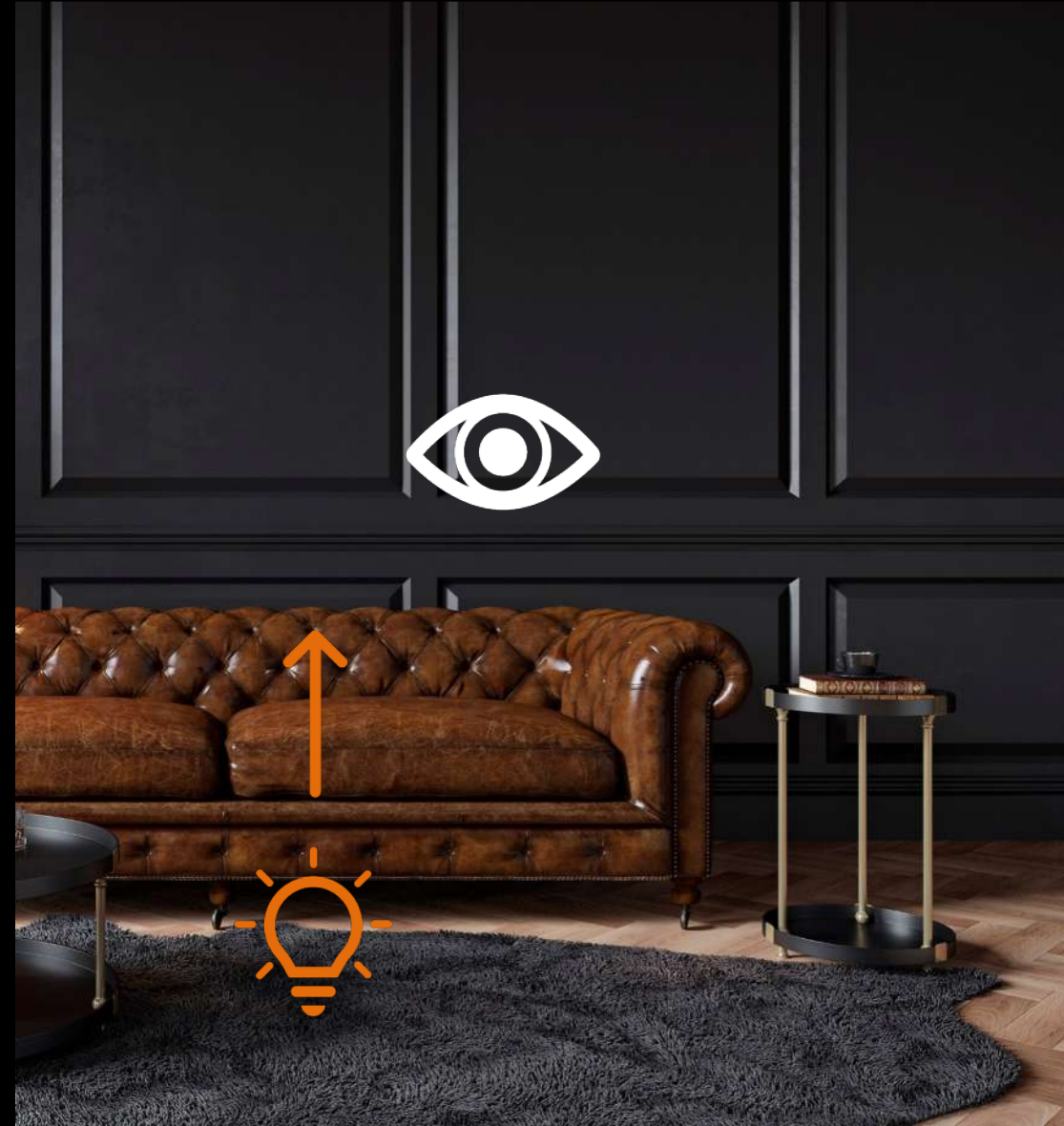
Other Factors

- Consider material finishes and sheen level, include contrasting colours
- Change lighting schemes based on the space and the activity

3. Distribution /Location/ Intensity

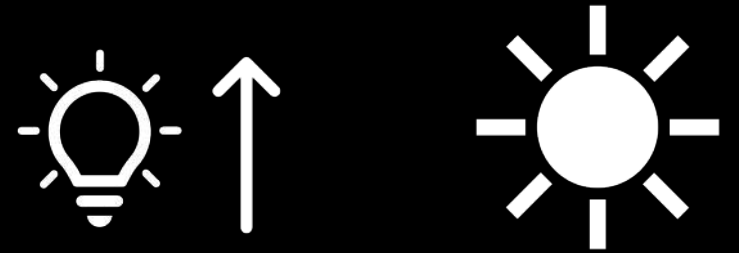
Evening & Nighttime

- place luminaires below peripheral levels, such as floor level
- Provide dimmers and ensure luminaires are producing diffused, indirect light
- Motion sensors that dim on and off, especially during the night at floor level



3. Distribution /Location/ Intensity

- Intensity is too dim in indoor settings
- Work with manufacturers to establish illumination levels that will support the Circadian Rhythm, not just visual tasks
- Increase illumination levels during daytime hours, decrease levels in the evenings
- 1000-2500lux can be impactful



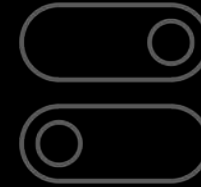
3. Distribution /Location/ Intensity

- Remove as much light as possible
- Reduce intensity
- Remove light sources from eye level
- Place luminaires with dimmers at floor level



3. Distribution /Location/ Intensity

- Ensure no excess light reaches the interior of the space



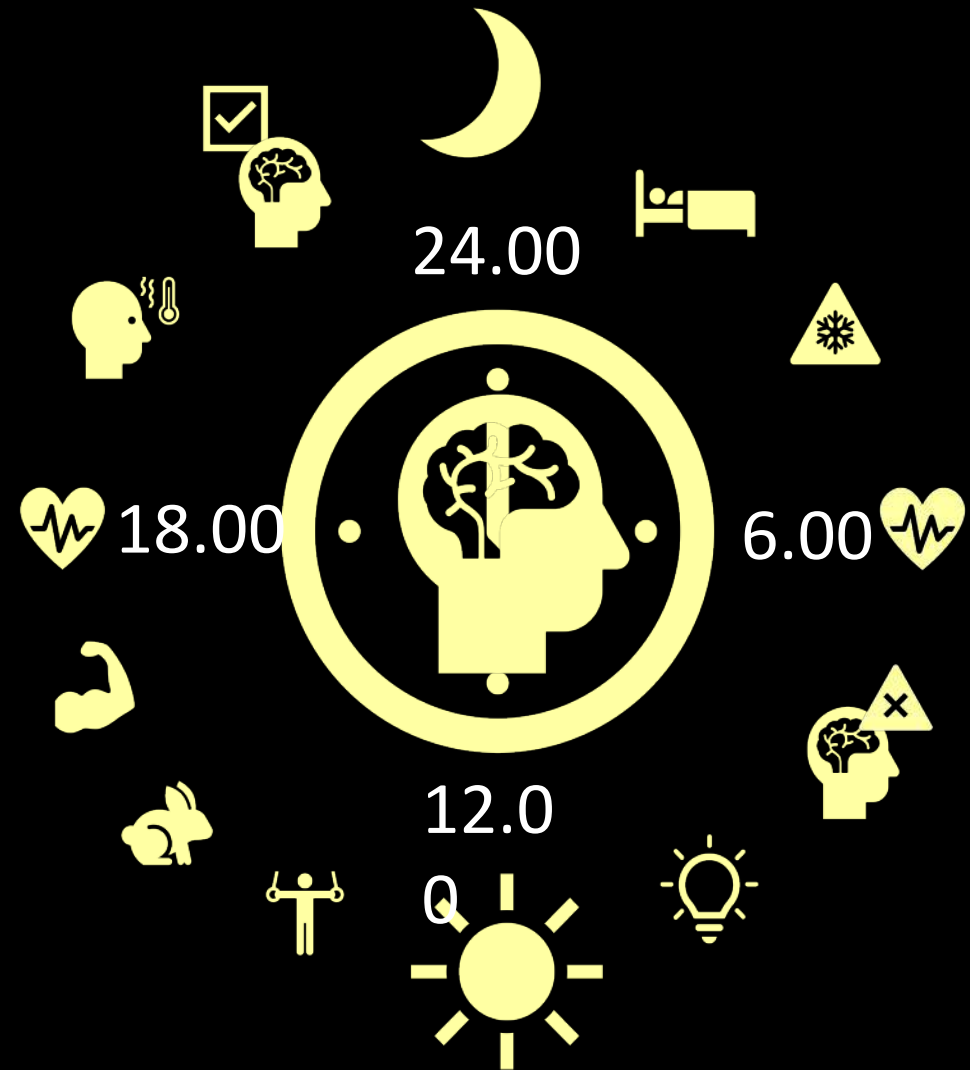


Lighting Strategies to Support a Healthy Circadian Rhythm

4. Duration (amount & time of day)

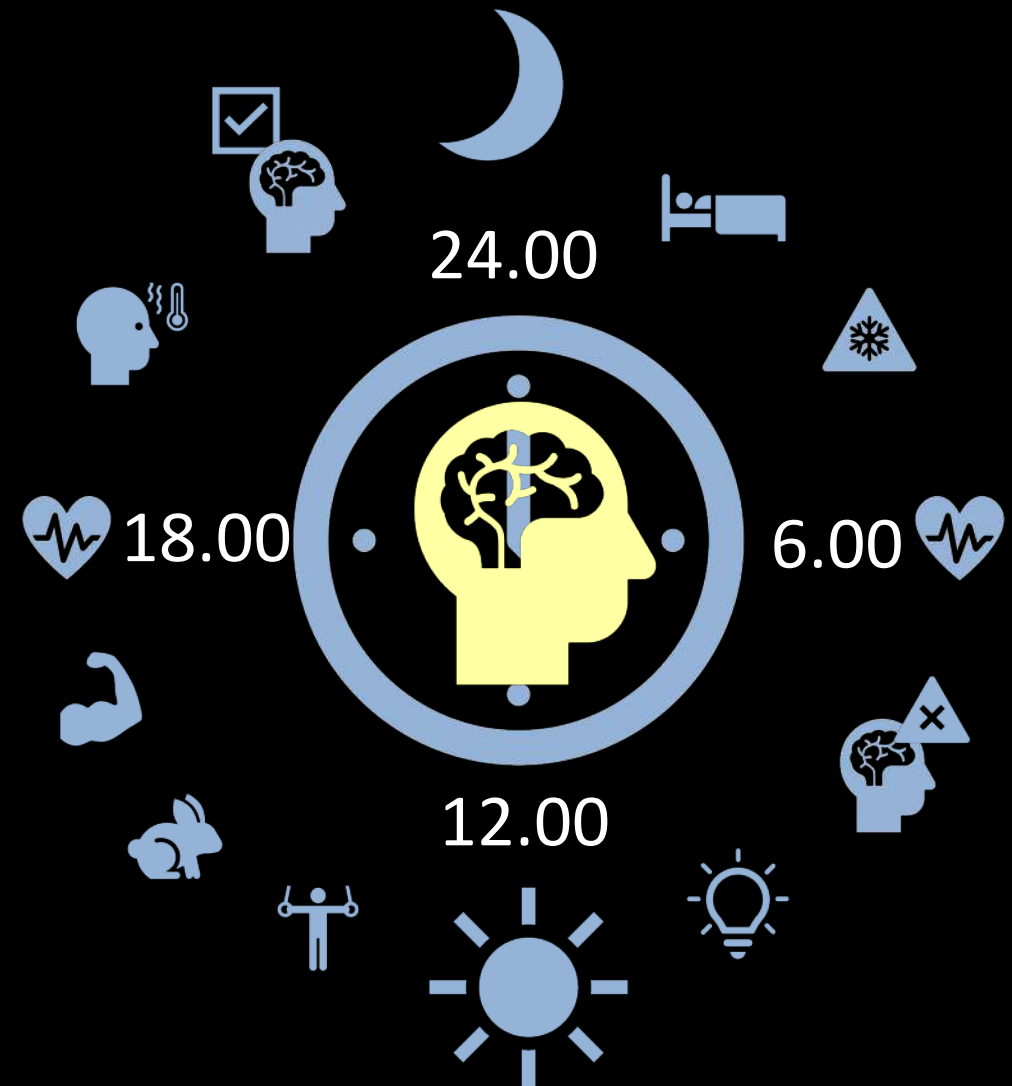
4. Duration & Timing

- Duration (amount & time of day)
- Most important light exposure is between 7am and 12pm
- Lux vs. EML
- More exposure is not always better – depending on timing



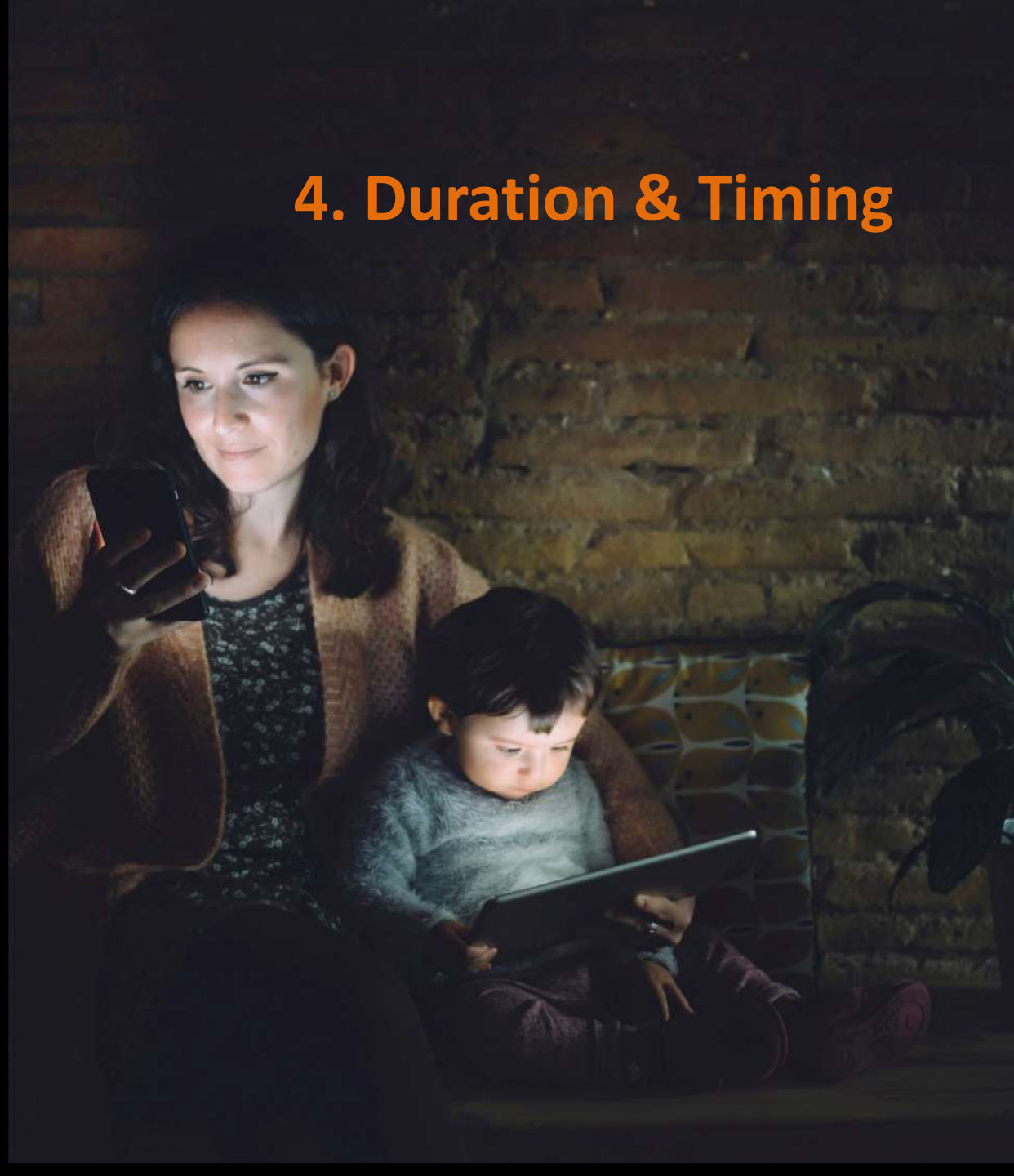
4. Timing

- Stimulate the body with bright, white light upon waking – at the eye level
- Exposure to warm, dim light in the morning should be avoided



- Reduce blue light (short wavelengths) and additional sources at night
- Laptop computers & phones can have 1.7 to 14.5 lux, but are often blue-light rich
- 50 lux at the eye at no more than 2700K in the evening
- Reduce lux for vision tasks only

4. Duration & Timing

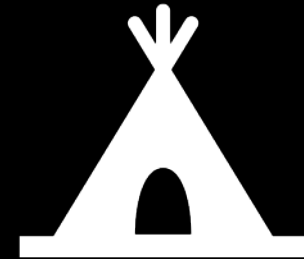
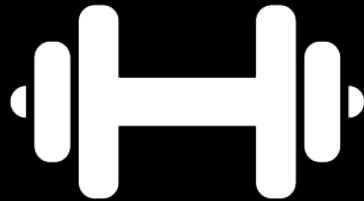


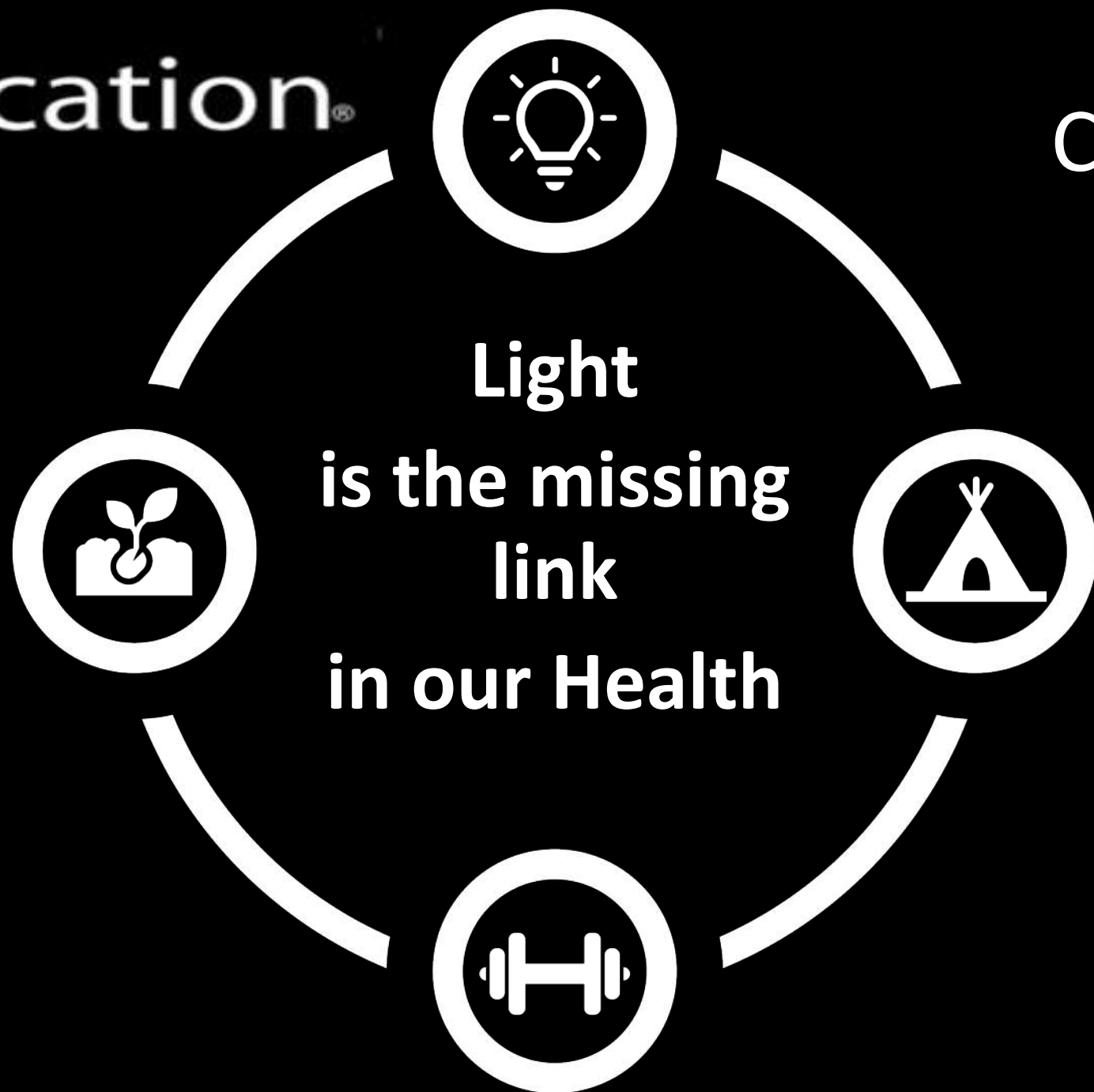
Conclusion

- Age, demographic, lifestyle & vision
- Design for individual's behaviour over a 24 hour period
- Educate the interdisciplinary team on the goal
- Educate and involve the user/occupant



- Consider light exposure as important and impactful as a healthy diet, exercise and connection with nature.







This concludes The American Institute of Architects Continuing
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