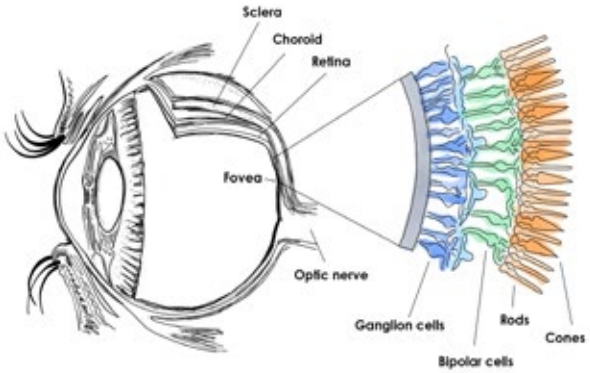
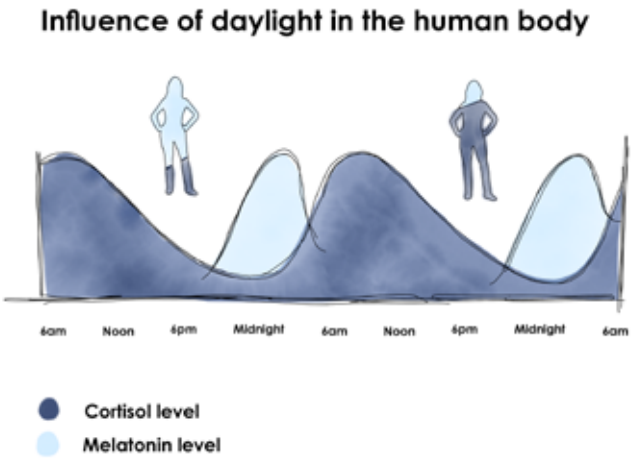
BRAINLIT

Why is Biocentric lighting important?

It all starts in the eye

Biocentric lighting is based on the understanding of how light affects our physiology. In the retina in the back of our eyes, we have rods and cones that help us interpret our surroundings: we call that the visual system. In addition to rods and cones, there is also a third type of photoreceptor, the retinal ganglion cells. Some ganglion cells contain melanopsin and are sensitive to light. Many ganglion cells are involved in the visual system. A small proportion of these cells send signals to our internal master clock[1], which in turn regulates the timing of a variety of processes such as our sleep / wake cycle, our metabolism[2], our immune system[3], etc. With the help of information in the influx of light via retinal ganglion cells, the production of melatonin is controlled, which in turn synchronizes the internal cyclic processes in the body.





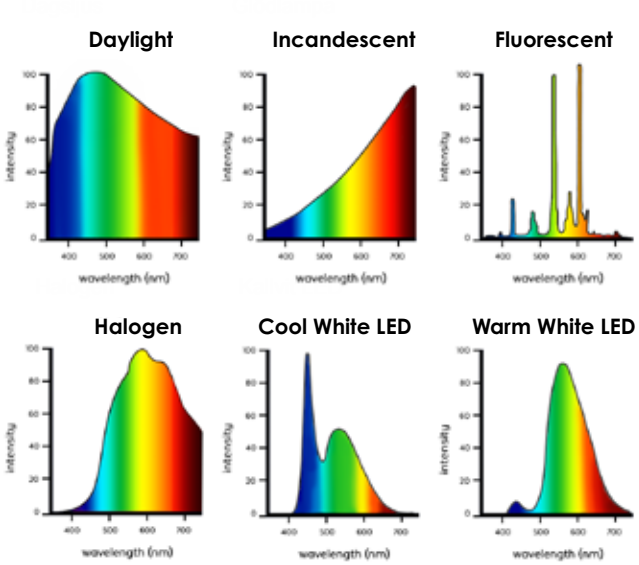
The circadian rhythm

The timing of our body's internal processes is collectively called our circadian rhythm. Light information from the retinal ganglion cells is used to synchronize the circadian rhythm with our surroundings to avoid circadian misalignment and sleep deprivation. The graphic describes the melatonin and cortisol levels based on a normal day with sunrise at 07.00 and sunset at 17.30.

The importance of daylight

Increasing amounts of evidence reiterate the importance of daylight for our health, wellbeing and sleep[4]. Scientists agree that almost 50% of our protein coding genes follow the circadian rhythm[5,6.]. Our modern society is often in conflict with our intrinsic biology. On average, we spend 21 of 24 hours a day indoors[7] in lighting which often does not have the necessary properties to entrain the circadian rhythm.

For example, a sunny day outside might give over 100,000 LUX[8], a cloudy day down to 10 000 lux[8], whereas indoor light might give 100-500 lux[8] with suboptimal color spectra. As seen in the graphics on the right, daylight is rich in delivering light with full color spectra, including blue wavelengths, which in spectra from fluorescent tubes, halogen lamps, or incandescent bulbs is scarce[9].



Benefits of Biocentric lighting

Biocentric lighting environments by BrainLit directly counter the effects of circadian misalignment caused by lack of proper light exposure. As an intelligent lighting solution that, like daylight, stimulates the circadian system appropriately, Biocentric lighting uses algorithm-based light recipes to both balance and sustain the circadian rhythm.

Biocentric lighting can have positive effects on cognition, alertness and sleep. A synchronized circadian rhythm, which Biocentric lighting supports, may include benefits such as:

- Better sleep[10]
- Improved alertness[11]
- Better cognitive function[12]

References

1. S. Wahl et al. The inner clock-Blue light sets the human rhythm. J Biophotonics. 12(12), (2019).
2. R. Méndez-Hernández et al. Suprachiasmatic Nucleus-Arcuate Nucleus Axis: Interaction Between Time and Metabolism Essential for Health. Obesity (Silver Spring). 28(1): 10-17 (2020)
3. R. Paganelli et al. Biological clocks: their relevance to immune-allergic diseases. Clin Mol Allergy 16(1), (2018).
4. A. Wirz-Justice et al. The relevance of daylight for humans. Biochemical Pharmacology 191, 114304 (2021)
5. R. Zhang et al. A circadian gene expression atlas in mammals: implications for biology and medicine. Proc Natl Acad Sci U S A 111, 16219-16224 (2014).
6. M. D. Ruben et al. A database of tissue-specific rhythmically expressed human genes has potential applications in circadian medicine. Sci Transl Med 10 (2018).
7. N.E. Klepeis et al. The national human activity pattern survey (NHAPS): a resource for assessing exposure to environmental pollutants. J Expo Anal Environ Epidemiol 11(3):231-52 (2001).
8. T.T. Norton and J.T. Jr. Siegwart. Light levels, refractive development, and myopia--a speculative review. Exp Eye Res. 114:48-57 (2013).
9. S. Kim, M. Jahandar, J. Jeong, D. C. Lim, Recent progress in solar cell technology for low-light indoor applications. Current Alternative Energy 3, 3-17 (2019)..
10. Figueiro MG, Steverson B, Heerwa- gen J, Kampschroer K, Hunter CM, Gonzales K, Plitnick B, Rea MS, The impact of daytime light exposures on sleep and mood in office workers, Sleep Health (2017) Jun;3(3):204-215.
11. Viola AU, James LM, Schlangen LJ, Dijk DJ, Blue-enriched white light in the workplace improves self-reported alertness, performance and sleep quality, Scand J Work Environ Health (2008) Aug;34(4):297-306.
12. Beaven CM, Ekström J, A comparison of blue light and caffeine effects on cognitive function and alertness in humans, PLoS One (2013) Oct 7; 8(10):e7607