

Human Centric Lighting and Its Effect on the Circadian Rhythm

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Over the last 200 years, humanity has undergone a radical change. One of the largest catalysts for this change was the introduction of electricity and, with it, electric lighting. Suddenly, humans were able to see in a dark closet, in the kitchen after dark, and even in the streets throughout the night. We weren't confined to the sun's movement, but instead got to pick our own schedule for work and sleep. While that made us more productive as a society, it also majorly affected our circadian rhythm and we are still dealing with those consequences.

The circadian rhythm is the body's natural internal clock, which regulates the production of hormones in the body throughout the day to keep us awake during the day and asleep at night. Most of the regulation of the circadian rhythm comes from the color temperature of the light we consume.

The correlated color temperature (CCT) of the light from the sun changes throughout the day along with the amount of light we experience. The Earth's natural cycle gives low light and low CCT in the morning, high light levels and CCTs at noon, low light levels and low CCTs in the evening, and extremely low light levels and a medium CCT under the moon.

While we were working in the sun every day two hundred years ago, our body was experiencing those natural light and CCT levels. However, with the introduction of electric light and the 9-5 workday, most of us spend 90% of our day inside, at a constant CCT. This directly impacts the amount of hormones that our bodies produce, among other things.

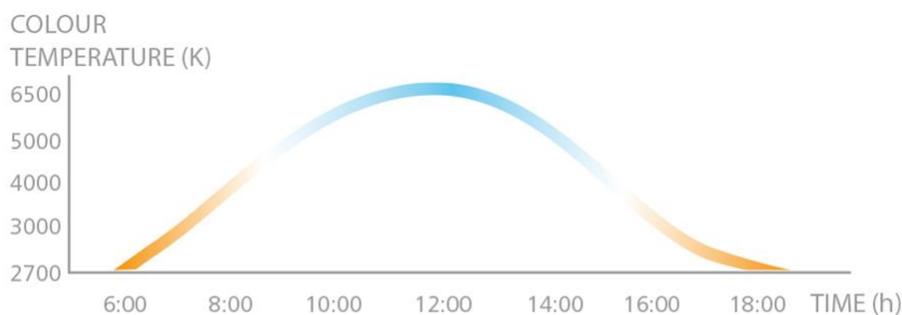
The body's circadian clock regulates sleeping and feeding patterns, mental alertness, hormone production, regulation of glucose and insulin levels, core body temperature, and many other biological processes. The most important hormone for sleep is melatonin. Without melatonin present in our bodies throughout the evening, we have a hard time falling and staying asleep.

Scientists have been able to find specific cells that set our circadian rhythm, called intrinsically photosensitive retinal ganglion cells (ipRGC). These cells are especially sensitive to blue light, like that can be found in the mid-day sky. This can be up to 10,000K. The blue content suppresses melatonin and encourages the production of cortisol, serotonin, and dopamine.

Recently, there has been a focus on creating lighting systems that can better duplicate the light intensity and CCT situations found in natural light throughout the day. In some patient care rooms in healthcare facilities, they were able to use these technologies to improve patient satisfaction and support patient recovery in those rooms.

Another area of focus for these systems are in classrooms. Setting lighting at 12,000K for the first 30 minutes of the day helps the students to wake up and finish shutting down their sleep cycle and melatonin production. For the normal studying periods, the CCTs are set between 5000K and 6500K and can be doubled for literature instruction and discussion. After recess and during rowdy classes, the CCT can be set to 2700K to calm down the class. So far, the results have shown increased academic performance over classrooms without the lighting systems.

LED lighting in particular is a great option for these systems because of how much control you have over the CCT and ability to increase or decrease lumens using dimming. They can also switch to giving red light at night instead of the normal blue light, which can help in the production of melatonin.



The visual impact of changing CCT throughout the day in an office setting

At the end of the day, for many businesses, there needs to be an impact on the bottom line for them to make a change. By improving productivity by just five minutes a day, the amount of time taken to get a second cup of coffee after lunch, businesses could save \$500 per person per year, assuming they are making an annual salary of \$50,000. In a 50 person office, savings could reach \$25,000 per person, just from being able to increase the CCT after lunch. This is on top of the overall decreased feelings of fatigue and better sleep that employees get.

The circadian rhythm is one of the most important functions of a human body. It keeps us on track throughout the day and lets us get the healthy restorative sleep we need. While we may not be able to spend the entire day outside under natural light, we can implement human centric lighting systems that can replicate these natural lighting cycles. We have a lot more to learn about the impacts this will have on the human body, but we have already seen improvements in offices, schools, and patient care facilities. The productivity increases alone show how valuable these impacts can be for a business's bottom line. The value for the human body will be priceless.