

WORKING BY DAYLIGHT

Prepared by:
Christine Culver, PE, LC, LEED GA, Lighting Designer
Jake Herman, EIT, Lighting Designer

HOW CIRCADIAN LIGHTING **INCREASES PRODUCTIVITY**

GLUMAC

THE LIGHT SIDE OF PRODUCTIVITY

BRINGING THE SUN TO PNCA

At Portland's Pacific Northwest College of Art, skylights interplay with warm lighting to maintain the sense of natural lighting throughout the facility.

By now, we all know that low access to daylight can be detrimental to our health. Eye strain, exhaustion, and weakening mental health are all issues that share a root cause in poor access to light.

But what if the implications of access to daylight went beyond wellness and energy savings, and we could prove it was inextricably linked to increases in productivity? If we were able to tell hour-by-hour (even minute-by-minute) how optimized a person's mind and body is under specific lighting conditions, we would be able to leverage that information toward creating a workplace that goes beyond simply housing business activity, and actually improves the quality of work being done.

In fact, we already can. It's called Circadian Lighting: a lighting system designed to tap into the proven cycles our bodies' follow each day, based on the position, duration, and color of natural sunlight at any given time. These cycles are known to lighting designers and medical researchers as "circadian rhythms," and a circadian lighting system is tailored specifically to maximize our functionality.

For example, in a traditional office space we tend to have electric lighting we can turn on or off. But, there is rarely a distinction in the color of that light, or its brightness (think: rows of fluorescents hung uniformly below a white dropped ceiling... your eyes may be hurting already). This works against occupants' naturally occurring circadian rhythms and can cause dramatic decreases in overall wellness and productivity. Circadian lighting systems mimic the behavior of the sun and incorporate it into the everyday environment, benefiting occupants by creating a comfortable space and actually increasing productivity. This can be achieved with a few methods that we'll explore in this article, including introducing natural light into areas through architectural elements and by mimicking the solar sequence through tunable LED lighting.

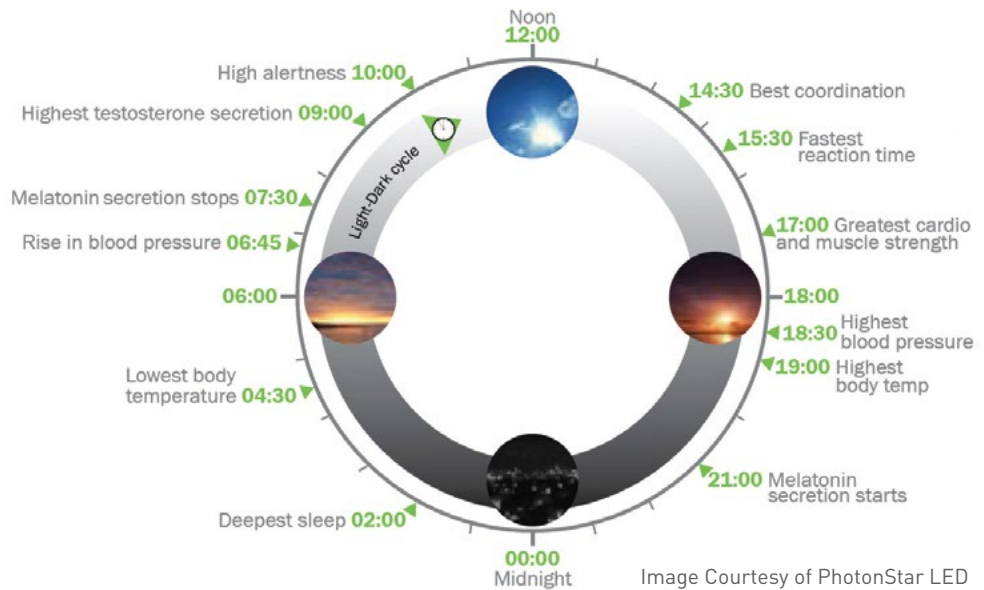
THE BIOLOGICAL ELEMENT

When we examine the pattern of the sun through its 24-hour cycle, we notice that the light it emits is more complex than simply light or dark. The color and intensity of sunlight changes throughout the day: Warm amber light at sunrise slowly changes into a cooler, brighter light during the afternoon, before warming back into an amber light at sunset. Human vision follows this cycle throughout the day. The eye consists of photoreceptors cells – rods, cones, and intrinsically photosensitive retinal ganglion (ipRGC) cells – which play a vital role. Cones sense changes in color and bright light, while rods sense changes in low light levels. The eye sends these signals to the brain to form images



HOW IT WORKS

A circadian lighting system harnesses the data we can capture from our natural biology and help optimize occupants for daylong focus, creativity, and productivity.



and trigger the release of serotonin (the body's natural antidepressant) during the day and melatonin (a hormone effecting sleep) at night. And perhaps most importantly, ipRGC cells – located at the lower back of the eye – send blue light information to our brains and act as an internal time keeper, using the different intensities to synchronize our bodies to the 24-hour light cycle. This is what creates our circadian rhythm and promotes our mental and physical health, our mood, and our energy.

THE BENEFITS

Lighting designers leverage data on how the human body reacts to light to create a system that understands the type of light an occupant needs to perform at optimum levels on an hour-to-hour (or even as we see in the image above, a minute-to-minute) basis. Just like with a healthy diet, if we feed the body what it needs, it will perform better.

The benefits of human-centric circadian lighting design include:

- Increased alertness in the morning
- Productivity and concentration improvements
- Improved mood
- Reduced hyperactivity
- Reduction in errors and accidents
- Faster cognitive processing
- Improved sleep

Recent studies show that office workers with the best possible view of natural light performed between 10% and 25% better on tests of mental function and memory recall. Those with poor views or no view at all (think high cubical partitions, heavy glare, basement offices etc.), reported increases in fatigue and decreases in overall speed of performance. These variables can be controlled with circadian lighting design. Incorporating daylighting in the architecture can boost not just the performance of a building, but of those who occupy it as well.

Circadian lighting has also shown to have useful applications in the healthcare industry, benefiting patients and institutions alike. A recent study published in Building



CIRCADIAN LIGHT DESIGN

As the day progresses, the natural light emitted by the sun changes in color, angle, and intensity. A circadian lighting system can be designed to mimic that progression.



THE RESULT

A circadian lighting system can lead to overall gains in morning alertness, cognitive processing, and concentration, and creates an environment primed for productivity.

and Environment reported findings that patients with direct access to morning light were seeing their stays shortened by anywhere from 16% to 41%.

HOW IT'S DONE

Existing technologies allow us to recreate the sun's daily routine to help manage occupants' circadian rhythms, particularly in spaces that have poor access to natural light. LED light fixtures can mimic the solar color shift with color changing technology and standard dimming to control intensity, creating health benefits similar to what we gain from natural daylight. For LED circadian lighting to work, a controls system is needed to handle the job. Presently, that is the biggest cost. Numerous manufacturers have already designed their own systems and it can be done using a variety of products. A full cycle of human-centric

lighting has already become a reality for workplaces and healthcare facilities across the U.S., and they are seeing the productivity benefits in real time.

That being said, natural light has the most direct effect on our circadian rhythms. And harnessing it for our interior spaces is the most effective way to optimize its effects. However, this means more than just allowing light into a space. Giant windows often overheat those nearby, do little to deflect glare, and leave much of the space unaffected. Proper daylighting involves controlling light and getting as much effective illuminance to target areas as possible, while minimizing heat gain and glare. Architectural design elements like light shelves and louvers can bring more light into the interior of a building. They can also direct light deeper into a space. Exterior overhangs and vertical fins on the glazing walls of a building can help mitigate glare and heat gain.

At GLUMAC, we believe **circadian lighting** is the future of lighting design. To learn more about our work, visit www.glumac.com, or email our Lighting Studio at contactus@glumac.com.