

WHITE PAPER

# OLED: TV Designed for Health

The Pioneering Low Blue Light Technology of Eyesafe® Certified OLED, Designed to Lower Impact on Circadian Rhythm and Promote Eye Comfort



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### INTRODUCTION

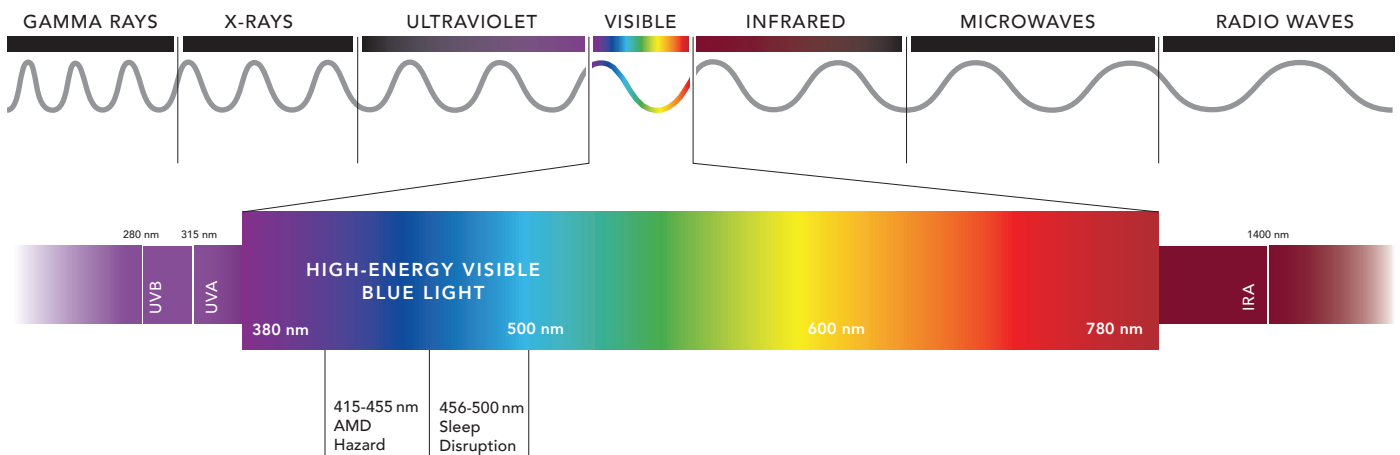
The last decade has seen a rapid expansion of digital devices in our daily life, far beyond instruments of work and entertainment. Digital devices are now used in every aspect of our lives, for gaming, sports, health, fitness, education and more. Our digital connectivity has escalated even further with the onset of COVID-19 in 2020, as the world moved to deliver programs and information through digital media to preserve the safety of the audience.

*A recent survey shows a considerable increase in screen time, with up to 13 hours a day in front of screens from different devices. Even more jarring, today U.S. households own an average of 11 connected devices, including seven smart screens to view content (e.g. smartphones or TVs), a 2019 study from Deloitte found.<sup>1</sup>*

These digital devices emit blue light. Blue light in nature is part of the solar spectrum, often called high-energy visible light (HEV) as it radiates within the high energy portion of the light spectrum, closer to the UVA. Blue light contributes to our alertness, memory, and cognitive functions, through its connection to our circadian clock. In the morning, there is more blue light to keep us awake compared to the rest of the day, in which the reds increase, triggering the secretion of melatonin so we can sleep at night.<sup>2-4</sup> There is evidence that a harmful portion of blue light may create irreversible damage to the retina from accumulated exposure over many years.<sup>5-7</sup> And while natural light has a changing spectrum during the day, digital devices emit constantly the same amount of blue light, at any time of the day, thus impacting our eyes, sleep and overall health.

This paper examines the major display technologies for television, including LCD and OLED, in respect to their potential influence on eye health and circadian rhythm.

Certain bands of blue light within the visible light spectrum have been linked to health concerns.



## LIGHT AND ITS IMPACT ON CIRCADIAN RHYTHM

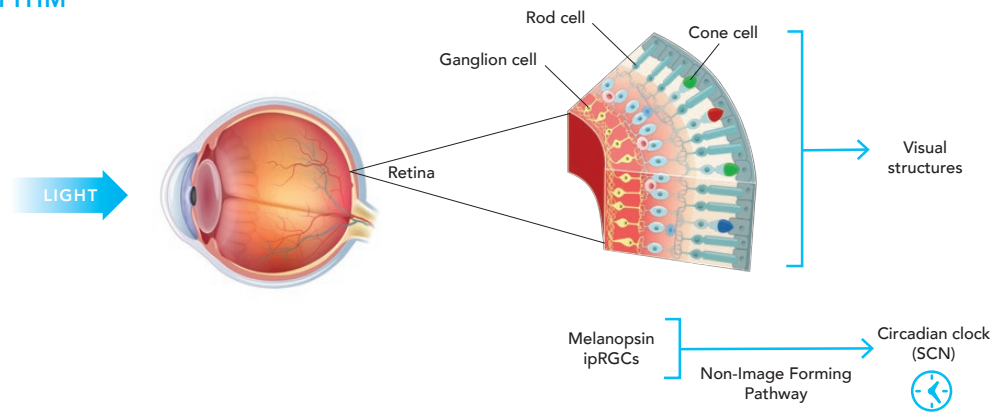
Light is essential for our daily functioning, our well-being, and our overall health. And it all happens through our eyes. At the back of the eyes lie the retina, and a portion of it, called the macula, is composed of rods and cones, the photoreceptors capable of differentiating contrast in lighting and colors. Another type of photoreceptor is present on the retina, called ipRGCs (intrinsically photosensitive retinal ganglion cells). These cells regulate pupil dilation and have a maximum sensitivity within the blue light range, transmitting a non-image forming signal to the brain, more precisely to the suprachiasmatic nucleus (SCN) (a small group of hypothalamic nerve cells), which is our central clock.<sup>5-7</sup> This clock synchronizes other clocks for the metabolism, including those of liver, heart, and kidney functions. It controls the circadian rhythm by influencing the secretion or suppression of melatonin, the sleep hormone responsible for controlling sleep and wake phases.

In a normal cycle, or circadian rhythm, the alternance of sleeping and waking phases is well synchronized over a period of about 24-hours. As natural daylight changes, less blue light stimulates the ipRGCs and the secretion of melatonin can start, followed by sleep. With the constant emission of blue light from digital screens, there is no change in the way the ipRGCs are stimulated and this can potentially lead to a disruption of the circadian rhythm.<sup>8,9</sup>

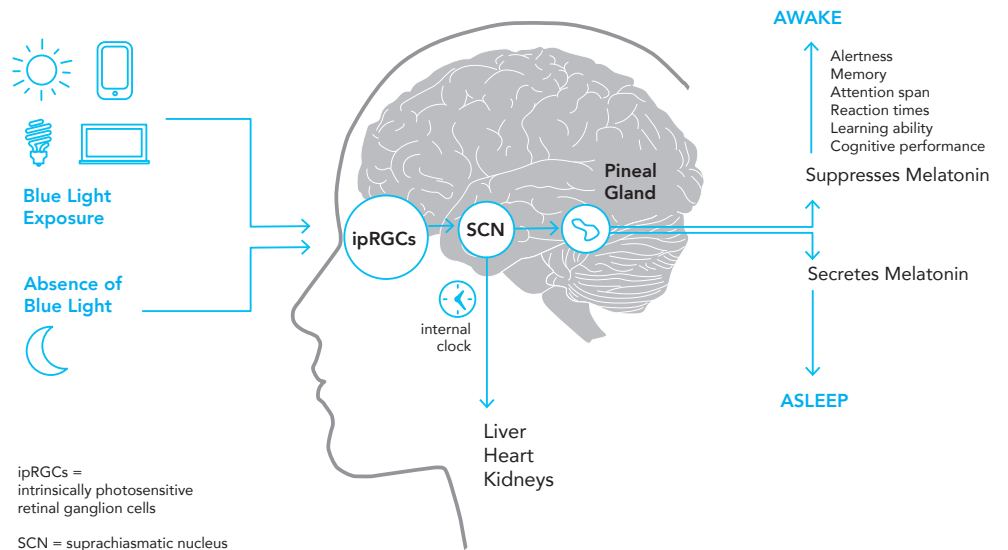
As the central clock influences the other clocks of our bodies, any disruption will have an impact on the other clocks. Thus, a desynchronization of the circadian rhythm can lead to other potential health issues, such as persistent fatigue, poor appetite, and sleep disorders, which in turn could lead to chronic insomnia, mood disorders and potential depression. Studies have shown that further disruption could be linked to chronic health problems.<sup>10-15</sup>

## BLUE LIGHT AND CIRCADIAN RHYTHM

Photoreceptors and the non-image forming pathway.



Blue light, through ipRGC pathways, affects sleep cycles by the secretion or suppression of melatonin.





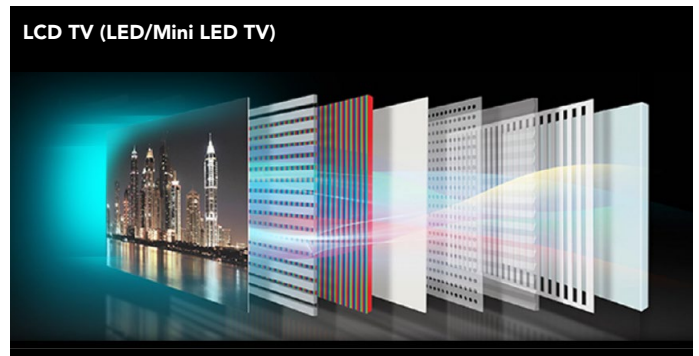
## OLED Technology: A Smarter Way to Manage Blue Light Exposure

Blue light emission can be managed with available technologies to limit potential impacts on our well-being. Presently, the major display technologies used are LCD (LED backlit) and OLED.

LCDs produce light through the LEDs within the backlight unit. As liquid crystals change shape, they are challenged to show very dark blacks, are generally brighter than OLED, and have less saturated colors.

OLEDs, or organic electroluminescent diodes, produce light directly from electrical current-activated organic compounds of which the emissive layer and conductive layers are made; the color of light will depend on the type of organic molecule or polymer used, and often several types of organic films can be placed in the same system. This approach leads to systems where the screen is lit from edge-to-edge, with rich contrast and outstanding color performance compared to traditional LCD screens. OLED panels have perfect blacks (no light emitted), brightness uniformity, and saturated colors relative to LCD TV display technology.

One of the benefits of OLED TV is its naturally low blue light emissions compared to traditional LCD TVs on the market. Even while maintaining perfect black and high contrast characteristics with excellent picture quality, it provides the user with better eye comfort and viewing experience.



Unlike traditional LCD TV, OLED pixels emit their own light, eliminating the need for a backlight which may distort colors, produce screen flicker, and light bleed.



## HEALTH PERSPECTIVE

Dr. Vance Thompson, an ophthalmologist surgeon and professor of ophthalmology at the University of South Dakota Sanford School of Medicine, confirms there may be health benefits to choosing an OLED TV. At a recent industry conference, he remarked “with TVs getting bigger and brighter, and people spending more time overall watching TV, our blue light exposure is rising quite fast. Many studies suggest blue light exposure in the evening contributes to sleep disturbance. There are many options for customers when purchasing a TV, but OLED is a great choice because it has lower blue light, which may help with sleep, especially if you’re one of the people that enjoys watching movies late at night. We have to be careful with blue light exposure, a little here and there adds up over a lifetime. Reducing daily exposure with OLED TV is a good choice because they emit less blue light overall than traditional LCD televisions.”

In support of these conclusions, the effect of display technology on the human body [melatonin] was recently studied at the Kookmin University of Seoul.<sup>16</sup> The research study evaluated the circadian illuminance, melatonin suppression and visual symptoms from two groups of volunteers, each exposed to two types of TVs. The study results revealed the display with lower brightness and higher contrast, such as OLED TV, could have a lower impact on visual fatigue, arousal, concentration, comfort, sleep disorder and circadian disruption than the other device.

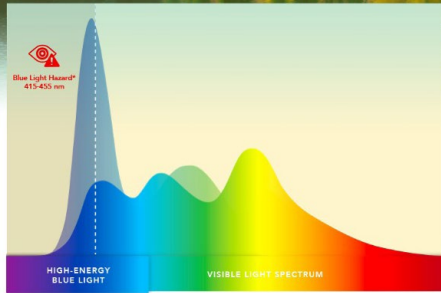
While more study is needed, early evidence points to the reduced health impacts of OLED technology. LG Display’s OLED TV is Eyesafe® Certified, which means it has attained industry standards for blue light emissions, toxicity, and color performance. The company will use its OLED TV display certification as a tool to communicate eye comfort and overall commitment to consumer well-being.

*“...our blue light exposure is rising quite fast. Many studies suggest excess screen time and blue light exposure contributes to sleep disturbance.”*

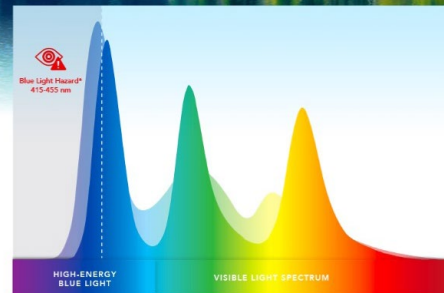


**Vance Thompson, MD**, is an internationally recognized specialist in Laser Vision Correction and Advanced Cataract Surgery. He is a member of the Eyesafe Vision Health Advisory Board and the Founder of Vance Thompson Vision Sioux Falls, SD. He is the Director of Refractive Surgery and also serves as a Professor of Ophthalmology at the Sanford USD School of Medicine.

## REDUCED HIGH-ENERGY BLUE LIGHT WITHOUT COLOR COMPROMISE



Other Solutions



Eyesafe® Certified OLED

Other filters and common software solutions adjust the blue light by shifting your screen to warmer hues. Eyesafe® Certified OLED reduces high-energy blue light, while maintaining color performance and luminance.

*OLED's blue light emission rates are 50% lower than the standard set by the International Electrotechnical Committee (IEC)*

### CONCLUSION

LG Display's OLED TV displays provide exceptional clarity, striking visuals and vivid color details. Blue light emission rates from OLED displays are 50% lower than the standard (100W/sr/m<sup>2</sup>) set by the International Electrotechnical Commission (IEC), which may help promote better sleep and eye comfort.

Customers can learn more about the collaboration between LG Display and Eyesafe:  
<https://eyesafe.com/oled>.



**Flicker-free &  
Low Blue Light Display (OLED)**  
50% Below Exempt Blue Light Risk Group Limit

OLED's blue light emission rates were measured 50% lower than the standard (100W/sr/m<sup>2</sup>) set by the International Electrotechnical Commission (IEC), which led to the leading global safety science company UL issuing a Verification Mark for "Low Blue Light Display (OLED)".

\*Rates are subject to change under different viewing environments.



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FOR MORE INFORMATION

**Eyesafe® Certified OLED TV displays emit lower amounts of blue light compared to traditional LCD TVs. While maintaining perfect black, high contrast characteristics and excellent picture quality, an OLED TV provides the user with better eye comfort and viewing experience.**

## About LG Display

LG Display Co., Ltd. [NYSE: LPL, KRX: 034220] is the world's leading innovator of display technologies, including thin-film transistor liquid crystal and OLED displays. The company manufactures display panels in a broad range of sizes and specifications primarily for use in TVs, notebook computers, desktop monitors, and various other applications, including tablets and mobile devices. LG Display currently operates manufacturing facilities in Korea and China, and back-end assembly facilities in Korea, China, and Vietnam. The company has approximately 60,000 employees operating worldwide. For more news and information about LG Display, please visit [www.lgdisplay.com](http://www.lgdisplay.com)

## Developed with Doctors

Developed with the Eyesafe® Vision Health Advisory Board, a group of leading optometrists and ophthalmologists from across the globe. These distinguished eye doctors consult with Eyesafe to provide valuable insights that help drive research regarding the effects of blue light on the eyes and brain. They also help guide the development of Eyesafe® technology and industry standards to limit harmful blue light emitted by the displays of electronic devices and other sources. Eyesafe industry-leading low blue light certification is based on comprehensive optical testing and research.



## About Eyesafe

Eyesafe Inc. is the worldwide supplier of advanced blue light mitigating technology, solutions, and standards. With pioneering products and services, in collaboration with healthcare, Eyesafe is shaping the future of consumer electronics designed for human health. Eyesafe® Standards, Eyesafe® Technology, and the associated intellectual property portfolio is developed by a world-class team of eye doctors, engineers, and scientists with decades of experience in electronics, display materials, light management, optometry and ophthalmology. The Eyesafe brand is trusted by consumers and integrated in millions of digital devices from LG Display, Dell, HP, Lenovo, ZAGG and others. Eyesafe was recently ranked #5 in category in the Inc. 5000 Fastest-Growing Private Companies in America. Learn more at [eyesafe.com](http://eyesafe.com)

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