PRO TO PRO
CONTINUING EDUCATION

PRODUCT SPOTLIGHT - KODAK TOTAL BLUE LENS

BLUE LIGHT LENSES: 5 REASONS FOR RISING DEMAND

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[1 CE CREDIT]

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LEARNING OBJECTIVES:

Upon completion, participants should be able to:

1. Understand the five reasons that consumers have increased demand for blue light attenuating lenses.
2. Differentiate the visual and non-visual effects of blue lights.
3. Describe the benefits of hybrid technologies such as Color Guard Lens Technology® used to produce KODAK Total Blue Lenses.

TO EARN CONTINUING EDUCATION CREDIT:

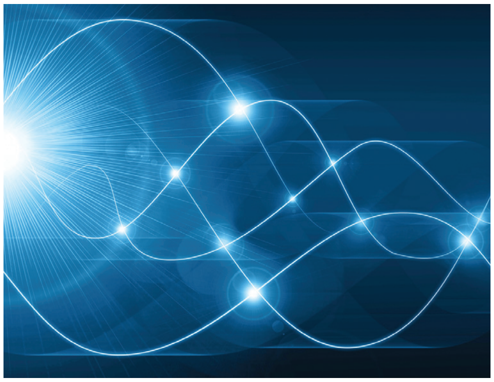
This course has been approved for one (1) hour of Ophthalmic Level II continuing education credit by the ABO. To earn ABO credit, please review the questions and take the test at 2020mag.com/ce. Note: As of January 2020, no tests will be graded manually. Please call (800) 825-4696 for more information.

INTRODUCTION

In this course, we will consider two things: the increase in screen time and the increase in outdoor activities. Why? Because both are on the rise, and both expose our eyes to increased levels of light radiation that can at least contribute to eye discomfort and at worst, result in cumulative and irreversible damage to our retina. With the escalation in remote, online learning, work, shopping, socializing and playtime, we are all experiencing the effects of excessive screen time, young and old. This upsurge concerns us for several reasons: increased exposure to blue light's potentially deleterious effects on our eyes, and the visual and physical discomfort experienced. Night driving and blue light will be discussed, as will the effect of blue light on color vision relative to traffic signal color recognition.

We've watched concerns rise over indoor screen exposure, but we must not overlook the apparent hazard posed by exposure to outdoor UVR and HEV blue light from sunlight. UVR can not only damage our skin but also harm our eyes. We will explore UV radiation's effect on the eye in tandem with HEV blue light.

Blue light affects us, albeit differently, indoors and outdoors. Actinic light (UVR and HEV) exposure rates reach high levels outside in the sun and potentially damage ocular structures from the cornea to the lens and even the retina. While outdoor light is linked to ocular photodamage, indoor exposure to digital devices can contribute to digital screen use-related eye



discomfort symptoms. The increase in blue light exposure from indoor LED-based lighting and LCD screens is being studied for potential long-term cumulative effects. To date, no study has shown a link between digital screen emissions and biological damage to ocular structures.

This course will explore the differences and review the newest blue filter lens technologies, including the KODAK Total Blue hybrid lens solution in clear and polarized that protects the eye from 100 percent UV while providing 80 percent or more reduction in HEV blue light.

5 REASONS FOR RISING DEMAND

1. **Screen time:** As we spend more and more of our day staring at screens, we are experiencing digital eye discomfort and musculoskeletal disorders at increasing levels. Craig T. Lee from StudyFinds assigns the label Screen Zombies in his article that shares results of a pre-coronavirus study

commissioned by Vision Direct, which surveyed 2,000 adults to find an average time Americans spend daily staring at screens. According to the results, we spend four hours and 30 minutes watching TV, four hours and 33 minutes looking at a smartphone, over three hours using a gaming device and nearly five hours on a laptop. Computer screens and digital device screens have high blue light emission rates, and blue light, by its nature, is unfocused visual "noise," reducing contrast and degrading visual quality.

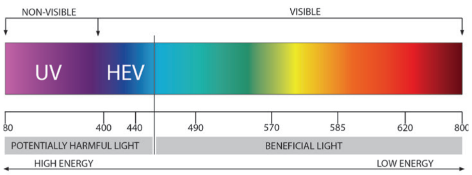
2. **Rising concern for their kids' eye health and comfort:** As kids spend their school day in front of screens, and during game time and social time, parents see the warning signs of digital device overexposure in their children, and this concerns them.
3. **Increased awareness of digital blue light emissions:** The word has spread. With information a click away, consumers do their homework and are well informed. The problem is the blue light information available online is contradictory and confusing. We turn to health information sites, seeking visual comfort and eye protection remedies for relief from digital eye discomfort symptoms. Ultimately, many of us turn to the ECP for guidance.
4. **Increased understanding that outdoor sunlight poses a risk both from blue light and even higher energy UVR:** Consumers/parents look for ways to improve eye comfort and protection outdoors. They have become aware that just as UVR poses a risk to our skin health, both UVR and HEV blue light can negatively impact our eye health, especially our children's vulnerable eyes. There is increasing awareness that the sun damage to the skin and eyes is cumulative. Parents are ever more aware that they must start protecting their child's eyes from an early age. A child's eyes are more susceptible to actinic light damage (UVR and HEV blue) because their young lenses transmit more to the retina. Of course, we need and want to spend time outdoors just as we want and need to spend time on digital devices. Time spent outdoors is invaluable, as Marc Berman discovered, the director of UChicago's Environmental Neuroscience Lab. Berman explored how interactions with nature can impact cognitive performance. Spending time in nature is linked to cognitive benefits and improvements in mood, mental health and emotional well-being. Being outdoors in nature is good for our mental and physical health, and has become our escape during the coronavirus pandemic, as evidenced by the fact that bike sales increased 67 percent in June of 2020. (Source: The NPD Group/U.S. Retail Tracking Service) As parents learn more about the outdoor benefits for their children, they also learn about the need to protect their eyes. Sunlight is a beautiful thing, and without it, life on this planet would perish. But for its benefits, we must respect its power and protect our skin and eyes to prevent damage. Protection needs to start young. A child's eyes are more vulnerable to photochemical injury from high-energy light, and their eyes absorb more of it than adult eyes.
5. **Consumers are seeking a trusted ECP to recommend a trusted brand solution:** Consumers are baffled by blue filter lens options and conflicting claims about blue light. We can explain the best products available to help, and when we offer a trusted brand like Kodak, the consumer is more confident in their purchasing decision.

SUMMARY

As ECPs, we can be part of the solution that provides relief from digital device overexposure and outdoor sun damage and solar glare when driving in the day or car headlight glare when driving at night. At the same time, discussing blue light opens the opportunity to speak to the patient about all the ways that they can increase comfort and protection from light, including outdoor and night driving.

HEV BLUE LIGHT AND UV RADIATION

What is actinic light? Actinic light comprises ultraviolet radiation (UVR) and High Energy Visible (HEV) blue light wavelengths. Actinic light is electromagnetic radiation that can cause an adverse photochemical reaction when absorbed by living tissue, meaning our skin and eyes. Photochemical damage is implicated in the process of retinal cell death caused by overexposure to HEV blue-violet light. How does photochemical damage harm the eye? The mechanism for photochemical damage is photo-oxidative stress that results in the production of free radicals that proliferate out of control, damaging molecules in our DNA and cells, causing cell dysfunction and ultimately cell death. We should also note that visual effects and risk arise from chronic cumulative exposure to actinic light over time and intense acute exposure.



Light is energy traveling as waves at the speed of light in a vacuum. A wavelength is measured in nanometers (one billionth of a meter) from crest to crest. Wavelength determines the frequency. The shorter the wavelength, the higher frequency. Frequency is determined by the number of wavelengths that pass a given point per second (units of cycles [waves] per second or hertz).

DELETERIOUS EFFECTS

Shorter wavelengths like HEV blue Light and UVR have higher frequencies. UVR and HEV blue light energy are sufficient to produce an adverse photochemical reaction if absorbed by living tissue such as skin and eyes. "In the UV and visible Light spectrum shown above, HEV blue Light wavelengths represent the violet and blue colors visible to the human eye in the 380 nm to 440 nm range. While ultraviolet (UV) light is invisible, its effects are well documented and known to the public relative to skin damage. Still, fewer are aware of the damaging effects to our eyes. Many industries, including the optical and health sectors, offer a wide range of products to protect vision, skin, cars, artwork in museums and even our homes from UV radiation. HEV blue light is emitted by natural sunlight, artificial energy-saving lighting, LED headlights, light bulbs, televisions, computer monitors and handheld devices. We are all exposed to some degree of HEV blue light from these varying sources. This exposure has increased with the proliferation of digital electronics and equipment with LED-backlit LCD screens in our

daily lives." (Source: kodaklens.us/about-lenses/blue-light-protection)

BIOLOGICAL/ENVIRONMENTAL

Our eyes are designed to process visible light and provide protection from radiation via natural defense mechanisms. Over time, with age or excess exposure to actinic light, we lose some of our natural defense, and damage accumulates, resulting in photosensitive by-products that lead to more damage. It's a vicious cycle. The cumulative damage can interfere with the normal metabolism when phototoxic waste products from the visual cycle accumulate between the retinal pigment epithelium (RPE) and the Bruch's membrane, disrupting the influx of nutrients and removal of waste products from the retinal pigment epithelial cells. Over the course of a lifetime, the buildup of toxic by-products accumulates and irreversibly damages the retina. Blue light covers a range of visible wavelengths, some of which are beneficial for full color photopic vision, melatonin suppression, body temperature, mood and more. Sunlight is composed of all the visible spectrum wavelengths, with approximately 25 percent to 30 percent in the visible blue spectrum. Before the digital age, our risk of blue light exposure was from the sun with incandescent light emitting a few blue wavelengths. However, LED lights have peak emission wavelengths in the blue spectrum. LCD screens are backlit with LED and emit blue wavelengths. Note: Photodamage is both wavelength and intensity dependent.

PROTECTION NEEDS TO START YOUNG

A concern for children is the cumulative effect of photochemical damage. Damage starts young. A child's retinae can absorb up to 70 percent more UVR than an adult eye. UVR is even more damaging to the retina than HEV blue light. And more HEV blue light reaches their retina because their crystalline lenses haven't yet become pigmented yellow to absorb some of the blue light.

OUR LONG-TERM VISION AND BLUE LIGHT

Several aspects of HEV blue light screen emissions can impact our long-term vision, from intraocular straylight to scatter and defocus. Blue light has

been shown to cause substantial over accommodation in students. (Source: Seeing Blue: The Impact of Excessive Blue Light Exposure) Researchers found that when exposed to wavelengths below 430 nm, rather than having the typical 0.3D lag of accommodation when focusing on a near target, students experience 1.0D of over accommodation on average, or 1.3D sum total accommodative change from the normal posture for focusing at near. Additionally, this over accommodation can cause distance blur as well. These accommodative changes are constant even in decreased luminance.

Over accommodation, mediated by the parafovea, appears to be caused by the absence of short-wavelength sensitive cones in the central fovea. This mechanism is also thought to trigger night myopia and is a potential driver of the myopic shift seen in our population in recent years. ("Seeing Blue: The Impact of Excessive Blue Light Exposure," reviewofoptometry.com)

Blue light screen emissions raise multiple concerns:

1. The proximity of screens, especially smartphones, is closer to our eyes, and proximity increases intensity. Because radiation intensity is inversely proportional to distance squared, closer equals higher intensity, equating to more eye discomfort.
2. Daily average time spent staring at screens increases daily exposure to blue light.
3. Blue light scatter decreases contrast, reducing acuity.
4. Blue light by its nature does not focus on the retina and reportedly causes up to -1.00 of defocus, making the eye muscles overwork as we spend hours reading screens. This is believed to contribute to accommodative stress and eye discomfort.

BLUE LIGHT DEFOCUS AND SCATTER EFFECTS

Blue scatter: Short-wavelength blue light molecules are attracted to the small molecules of hydrogen and oxygen present in our environment, causing blue light to scatter in the air. The shorter the wavelength, the greater it scatters, causing what's known as veil illuminance or blue haze. In our industry, we call it blue blur. The result of this scatter and blur is a loss of contrast sensitivity where it becomes difficult for our eyes to see objects against their background as detail and edges become ill-defined. Think of looking through a veil of haze.

Straylight: Blue light scatters intraocularly, leading to straylight-induced loss of acuity and contrast. "Ocular straylight is a phenomenon where parts of the eye scatter light, creating glare. It is analogous to stray light in other optical systems; scattered light reaches the retina but does not contribute to forming a correct image. The effect of straylight can be observed by looking at a distant bright light source against a dark background. If the source is small, it would look like a small bright spot if the eye imaged it perfectly. Scattering in the eye makes the source appear to spread out, surrounded by glare." (Source: Wikipedia)

Blue defocus: Blue light comprises shorter wavelengths with a higher index of refraction, resulting in a shorter focal length inside the eye. The result is that blue light focuses before reaching the retina. This means that blue light is out of focus; in fact, it can produce a full -1.00D of defocus.

REDUCING OUTDOOR UVR AND HIGH ENERGY VISIBLE BLUE LIGHT EXPOSURE

Outdoor protection from HEV blue light helps safeguard the retina from photochemical damage. And the outdoor attenuation of HEV blue light has the same benefits as indoors; enhanced color and contrast due to reduced HEV blue light scatter. Outdoors, HEV blue light scatters in the environment and induces veil luminance, obscuring vision and reducing contrast sensitivity and detail discrimination. "Light in the 350 - 430 nm range has also been shown to cause the eye's lens to fluoresce, resulting in intraocular veiling luminance." (Zuclich et al., 2005) "Although increased scatter may not lead to a reduction in the amount of retinal illumination, it does cause image degradation due to loss of image contrast via the introduction of veiling luminance." (Physiology of Aging3 – SlideShare; slideshare.net)

Important note: Outdoors, lenses need to block 100 percent UV, which is higher energy than HEV Blue Light. By age 60, no UVR reaches the retina, but in children, "The young lens transmits 300 - 340 in UV range max 8 percent 320 nm." ("Age-Related Changes in the Absorption Characteristics of the Primate Lens," Elizabeth R. Gaillard et al.)

BLUE LIGHT AND COLOR DISCRIMINATION

While HEV blue light degrades vision, beneficial blue light contributes to our tristimulus response from our retinal photoreceptors. Our three types of photoreceptors work together to produce color sensation based on the combined response of short (blue), medium (green) and long (red) wavelength photoreceptors received by the brain.

BLUE LIGHT AND NIGHT DRIVING

We use our rod photoreceptors in dark conditions. The peak sensitivity wavelengths of light for our rod photoreceptors lie in the blue wavelengths, making blue brighter to our eyes at night and low light conditions such as night driving. Blue light seems more glaring at night, especially the new bright blue-emitting LED headlights and streetlights.

NON-VISUAL EFFECTS OF BENEFICIAL BLUE LIGHT

Non-image-forming (NIF) or non-visual (NV) responses to light: Our circadian rhythm is entrained to beneficial blue light. Entrainment is the synchronization or alignment of the internal biological clock rhythm, including its phase and period, to external time cues, such as the natural dark-light cycle.

BENEFICIAL BLUE IS BAD FOR SLEEP

Light (photons) are electromagnetic radiation. The visible light spectrum is a narrow range of wavelengths on the electromagnetic spectrum. Visible light waves absorbed by the outer segments of retinal photoreceptor cells initiate the visual cascade producing electrochemical signals for the brain. The brain organizes and interprets these retinal signals as visual perception. In addition to enabling vision, we have specialized photoreceptor cells that drive biological effects. Beneficial blue light synchronizes our biological clock. It is visible blue wavelengths from 465 to 480 nm that set our circadian rhythm to control sleep timing and quality. These long wavelengths of visible blue light are important during the day as they increase heart rate, improve alertness, affect mood, influence body temperature and brain activity. Exposure to these wavelengths stimulates fast responses in pupillary reflex or brain activity. An important distinction is that exposure to these wavelengths within one to three hours of bedtime can be disruptive to our normal sleep cycle by suppressing the release of our sleep hormone melatonin. We are exposed to these wavelengths when we stare at digital device screens.

Beneficial blue light sets the 24-hour biological clock (sleep/wake, etc.). Long wavelength blue light in the range of roughly 465 to 480 nm sets our internal clock in the morning. We have non-seeing photosensitive retinal cells that have melanopsin pigment with peak sensitivity around 479 nm. The human circadian rhythm is facilitated by non-visual photoreceptors in the retina, with a response function peaking near 479 nm in the long-wavelength blue portion of the visible spectrum. Exposure in the morning wakes us and keeps us alert, controls our body temperature and is essential for photopic hi-resolution color vision. Exposure to light at night, particularly blue-rich light, suppresses the production of melatonin, our sleep hormone. According to Bailes, H.J., and Lucas, R.J. (2013), human melanopsin forms a pigment maximally sensitive to blue light (lmax 479 nm), supporting activation of Gq/11 and Gi/o signaling cascades. (Proc. Biol. Sci. 280, 20122987)

SLEEP DEPRIVATION FROM NOCTURNAL EXPOSURE TO BLUE LIGHT

Low energy blue light is essential for full-color perception and helps regulate the sleep cycle. This beneficial blue light promotes alertness during the day but disrupts the nighttime sleep cycle. Repeated sleep disruption, some studies report, reportedly increases the risk of Type 2 diabetes, lowers the immune system, increases the risk of heart disease and cancer. Artificial digital blue light exposure too close to bedtime activates the melanopsin in intrinsically photosensitive Retinal Ganglion Cells (ipRGCs), tricking them into thinking it's daytime.

HIGH FREQUENCY LIGHT

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ACTINIC LIGHT

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KODAK TOTAL BLUE LENSES

Hybrid lens technology in KODAK Total Blue Lenses (clear and polarized options): You have heard of hybrid cars, hybrid flowers, hybrid racehorses and now you will learn of a hybrid lens that addresses building consumer concerns about blue light and UVR.

Signet Armorlite developed Color Guard Lens Technology in response to the increasing exposure to HEV blue light and its potentially harmful effects on our vision and well-being. Color Guard Lens Technology combines a specially formulated lens material that absorbs UV with a protective lens coating that filters and deflects harmful blue light. This unique hybrid solution, branded KODAK Total Blue Lens, is an excellent option for healthy vision.

KODAK Total Blue Lens provides a hybrid solution that effectively protects against harmful UV and HEV blue light, with minimal residual color while transmitting long-wavelength beneficial essential blue light to the eye. While the clear KODAK Total Blue Lens reduces glare outdoors, the polarized option blocks the blinding glare from reflections in our environment for more visual comfort to enjoy outdoor activities and safer more comfortable driving.

KODAK Total Blue Lenses feature Color Guard Lens Technology, which combines a specific lens material and the specially formulated Total Blue AR coating. It is a registered trademark. In this unique process, a combination of lens material in 1.56, 1.67, 1.74, or polycarbonate and a specially formulated anti-reflective coating collectively filter and reflect up to 80 percent of High Energy Visible (HEV) blue light, as well as blocking 100 percent of UV light. KODAK Total Blue Lenses are clear, with no residual tint while providing up to 80 percent reduction in short-wavelength HEV blue light. Cosmetics matter to consumers, and many blue filter lenses in the market have an undesirable yellow hue. KODAK Total Blue lenses check all the boxes for the consumer, providing visual clarity without color distortion and the highest UV/Blue Light/HEV protection. They work particularly well at reducing glare from fluorescent lighting, bright sunlight, water reflections and urban surroundings. In production, Quality Control tests and measures KODAK Total Blue Lens performance continuously through a universal spectrophotometer. Batch samples are processed through the SA Demonstration Unit to ensure the optimum level of HEV blue light transmission across all materials and prescription ranges is filtered.

Features include:

1. Blue light filtering: filters up to 80 percent of High Energy Visible (HEV) blue light.
2. UV protection: 100 percent protection from direct UV rays.
3. Object recognition: The AR coating helps with object recognition in low-light and night-driving conditions.
4. Glare reduction: protects from glare and reflections caused by digital devices (televisions, computer monitors, handheld devices), LED lighting and energy-efficient compact fluorescent lights (CFLs).
5. Versatile options: Clear and polarized materials in progressive, single vision and computer lens designs.
6. Brand strength: Kodak is one of the most trusted and recognized consumer brand names.

Patient benefits:

1. Significantly reduces harmful blue light indoors and outdoors.
2. 100 percent direct UV protection.
3. Reduces eye discomfort caused by prolonged exposure to harmful blue light (indoors and outdoors).

Practice benefits:

1. Filters up to 80 percent of HEV blue light.
2. Options for both indoor and outdoor activities.
3. Progressive, single vision (available in stock lenses), and computer lens designs to accommodate a majority of patients.
4. Trusted Kodak brand: known for reliability and consumer loyalty.

SUMMARY

Children use handheld devices at an earlier age, while the general population views some form of device screen for increasingly longer periods every day, sometimes well into the night. The increase of HEV blue light exposure could lead to unhealthy repercussions ranging from headaches, blurred vision and insomnia to adverse moods and unrest. Optical and electronic companies have created lenses, coatings, screen covers and software that reduce blue light emissions to alleviate these repercussions. It is recommended that whenever possible, the exposure to HEV blue light-emitting devices be reduced or eliminated, especially before bedtime.

Not all blue light is harmful. Only the HEV Blue Light wavelengths on the high-frequency end of the spectrum have been noted to have potentially damaging effects. Low energy blue light is essential for full-color perception and helps regulate the sleep cycle. Blue light, in general, promotes alertness which is beneficial during the day but disrupts our sleep at night by suppressing melatonin, the hormone that promotes sleepiness at night. (Source: Blue Light Protection Lenses - High Energy Visible, kodaklens.us/about-lenses/blue-light-protection)

CONCLUSION

The consumer turns to you, their trusted ECP, to advise them and guide them through the confusing messages around blue light lenses. You are presented with an opportunity to add to their understanding of blue light, including the need to protect their eyes and the eyes of their child from the damaging UV and HEV blue light present in sunlight.

Consumers inquiring about blue light products present us with the opportunity to make them aware of all potentially harmful light and light that contributes to glare or discomfort. We have much to share with our patients to help them understand the effects of exposing the eyes to UVR and HEV blue light radiation. And we can present them with product options to increase their comfort while lowering their risk of deleterious effects of exposure to actinic light (UVR and HEV blue light).

KODAK is an iconic, trusted brand that will boost consumer confidence. Leverage this when you recommend the highest level of light protection from blue light and UV in a lens. And you have the bonus of offering it in clear and polarized to meet their indoor and outdoor needs.

To earn ABO credit, please review the questions and take the test at 2020mag.com/ce.