

**VISION EXPO**

# Blue Light



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## The SUN is the source of HBL

► It's a simple matter of mathematics...



**A smart phone emits  
0.0013 watt/m<sup>2</sup> at 435nm**



**The sun emits  
0.175 watt/m<sup>2</sup> at 435nm**  
(facing away from the sun  
on a normal day)

The woman in the top image would need to view her smartphone for **over 2 hours** to receive the same HBL exposure the woman in the bottom image receives in **ONE MINUTE**.

Exposure to the sun is a proven risk factor for AMD (Beaver Dam Study). It is unknown whether exposure to LED and CFL lighting is sufficient to be a risk factor.

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## The SUN is the source of HBL

► Dark lenses are necessary to provide outside protection against HBL.

- ✓ sunglasses & photochromic lenses filter 85-97% of HBL




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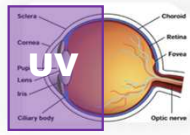
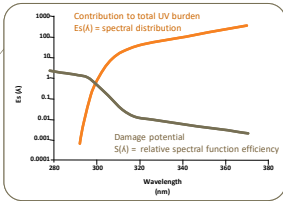
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### Light and the Human Eye – UV

**UVC** is absorbed by the atmosphere  
**UVB** is absorbed by the cornea  
**UVA** is absorbed by the crystalline lens




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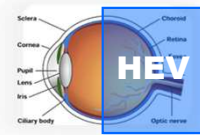
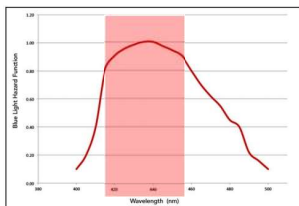
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### Light and the Human Eye – HEV

**"Near UV Visible"** is largely absorbed by the anterior eye  
**"Harmful Blue"** reaches the retina (decreasing with age)  
**"Beneficial Blue"** reaches the retina (decreasing with age)




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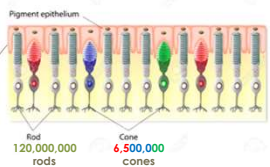
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### The Retinal Environment

The outer portion of the rods and cones do replenish- in the form of "discs."

#### STRUCTURE OF THE RETINA



Every day, a number of discs slough off into the RPE- where they are digested (completely replaced every 10 days).

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### The Retinal Environment

Retinal cells are part of the brain (develop from neural tube) and do NOT regenerate.



However, they are exposed to radiation in an oxygen-rich environment (this is a potentially bad combination).

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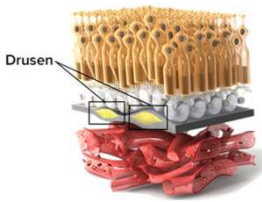
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### The Retinal Environment

As we age, the process for digesting those discs breaks down resulting in an accumulation of debris...



Drusen

...this debris can eventually be detected in the form of lipofuscin and then drusen (a component of which is A2E).

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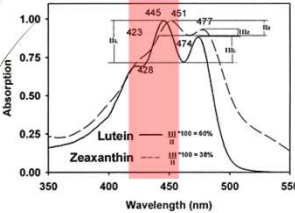
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### Light and the Human Eye – HEV

The eye has two forms of "natural" protection against blue light:

- crystalline lens yellows with age
- macula lutea has yellow pigmentation (Xanthophyll)



Xanthophyll in Muller cells absorbs damaging short-wavelength light (400-500 nm).

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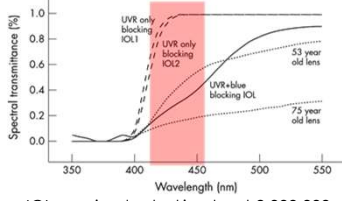
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### Light and the Human Eye – HEV

Approximately 3,600,000 cataract surgeries are performed each year in the US...



...clear IOLs are implanted in about **2,000,000** eyes per year.

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### AMD Statistics

- 69% of people diagnosed are already late-stage\*
- 40% of people are 20/20 at initial diagnosis\*\*
- 25% missed cases of AMD in one study\*\*\*



Source:  
\*Anand E, Bhanu C, Nirmala C, Chandrasekhar V, Bhanu K, et al. "Phototoxic Action Spectrum on a Retinal Pigment Epithelium Model of Age-Related Macular Degeneration Exposed to Single Incoherent Coherent Light." *Optik* 191:106453 (2019).  
\*\*National Institute of Health. "National Eye Institute. Facts about Age-Related Macular Degeneration." <https://nei.nih.gov/health/maculadegener/ama2010>.  
\*\*\*Nguyen Q, Bhanu K, et al. "Performance of an Automated Age-Related Macular Degeneration Screening System." *JAMA Ophthalmol* 2017;135(6):443-450. 444 patients were diagnosed to have late-stage macular degeneration according to the record of that institution at baseline in combination with a primary ophthalmologist or optometrist who was evaluated by multiple graders. The system used to have AMD as detected by the prototype Age-Brain-to-Maculopathy Imaging System.

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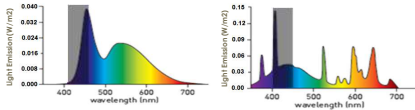
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### Artificial Lighting

Today, we use electrons or gas to create light!



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| <p><b>Cool White LED's</b></p> <ul style="list-style-type: none"> <li>• Smartphones</li> <li>• Tablets</li> <li>• Computers</li> <li>• TVs</li> <li>• Gaming devices</li> </ul> | <p><b>Fluorescent Light Bulbs:</b></p> <ul style="list-style-type: none"> <li>• Compact Fluorescent Lights</li> <li>• Office Lighting</li> <li>• Government regulations to phase out incandescent lighting</li> </ul> |
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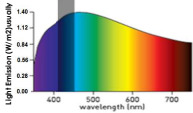
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### Natural Lighting



**The Sun is over 100 times more intense than electronic devices and screens**



**Daylight:**

- All weather conditions
- Sunlight entering through windows

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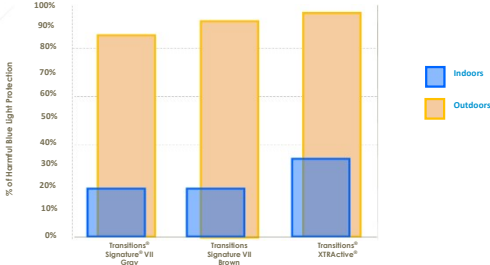
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### Essilor Solutions for Outside



Lens Type	Indoors (%)	Outdoors (%)
Transitions Signature VII Gray	~20%	~85%
Transitions Signature VII Brown	~20%	~95%
Transitions XTRActive	~35%	~98%

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### Thank You... Questions???

Recommended Reading:  
**Hiroyuki Nagai, MD, et al., Prevention of increased abnormal fundus auto-fluorescence with blue light-filtering intraocular lenses, J Cataract Refract Surg 2015; 41:1855-59**

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 Vice President Professional Services  
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