BLUE LIGHT

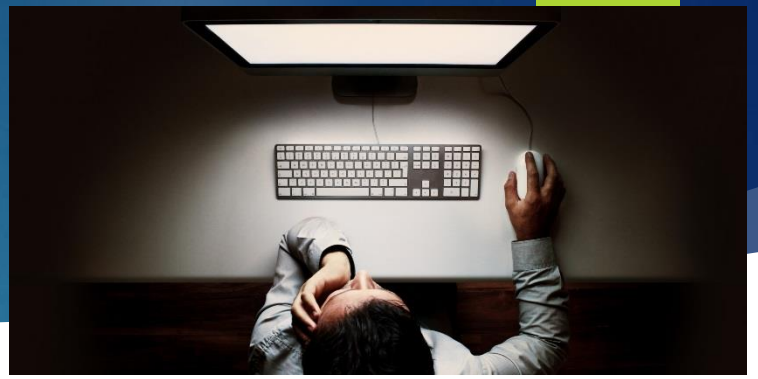
and its influence on our eye and body

TEREZA HÖFEROVÁ

FACULTY OF BIOMEDICAL ENGINEERING, CZECH TECHNICAL UNIVERSITY IN PRAGUE

Overview

- What is blue light
- Light absorption in the eye
- Natural vs. artifical blue light
- Beneficial and harmful effects
- Changes within the circadian rhythm
- Negative effects causing retinal damage
- Protection against the blue light



What is blue light?

- Electromagnetic spectrum covers a continuum of electromagnetic waves from radio waves (1 km) through to the gamma rays (0,1 nm)
- **VISIBLE SPECTRUM 380-780 nm**[1]

  ↓ wavelenght ↔ ↑ photon energy

- **HEV (high energy visible light) 380-500nm = BLUE LIGHT**
  - **435 nm +/- 20 nm** – harmful blue-violet radiations[2]

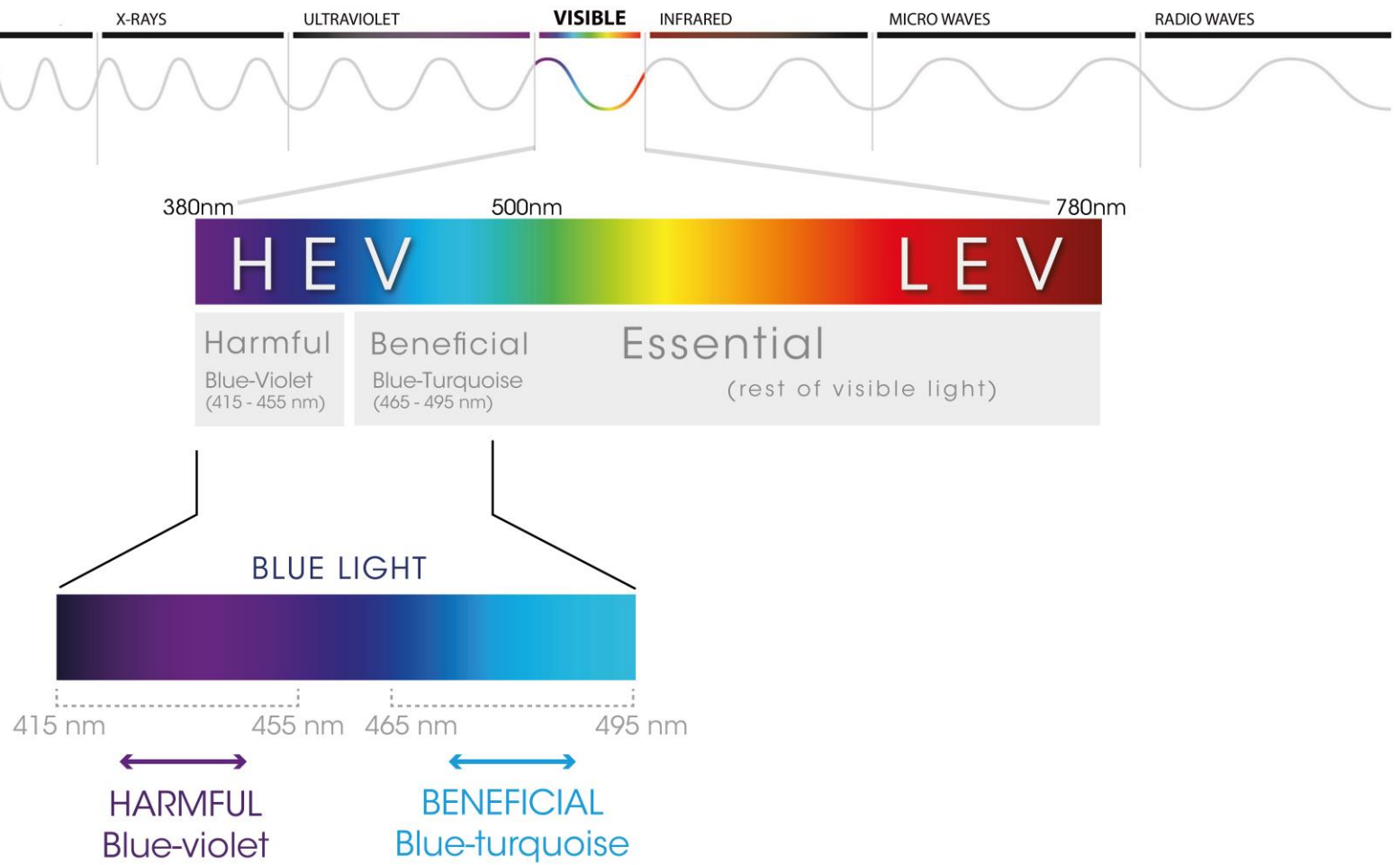


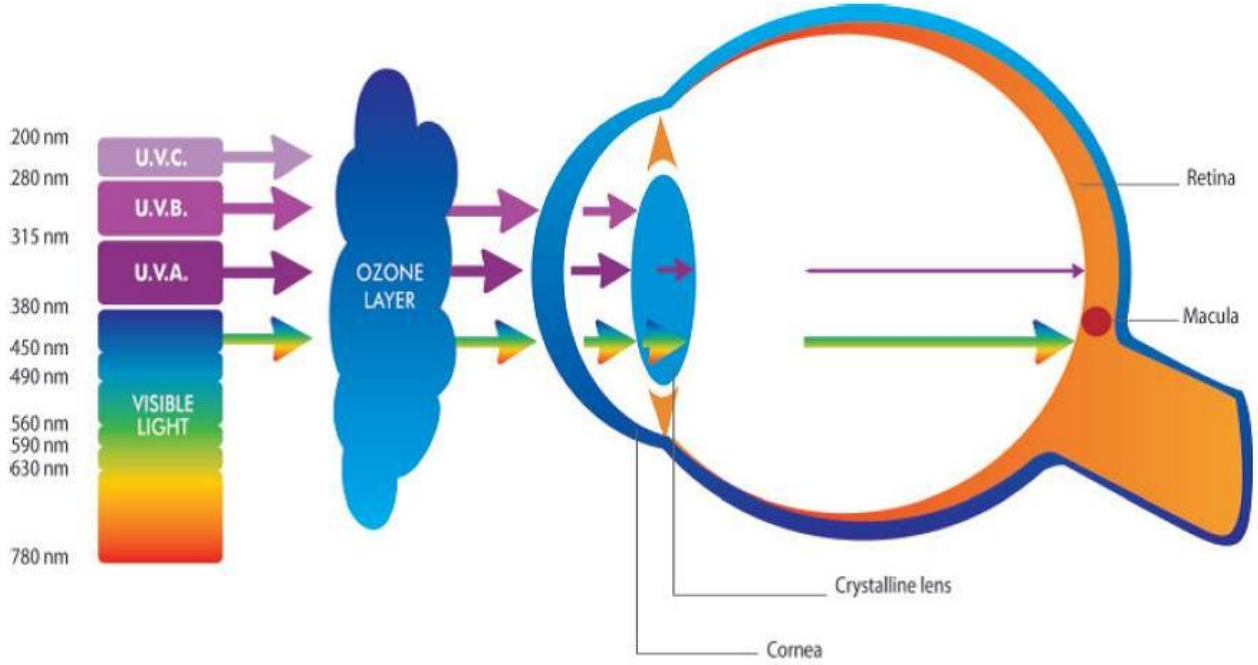
Figure 1: Visible light (380-780 nm) in the electromagnetic spectrum. HEV, high energy visible; LEV, low energy visible.

DOT, Corinne, Leonardo DR. COLOMBO a Alain DR. LAMOUREUX. *Ocular light toxicity and the requirement for protection* [online]. 2017. Accesible at: Points de Vue, International Review of Ophthalmic Optics, online publication, http://www.pointsdevue.com/

Light absorption in the eye

- The cornea and crystalline lens filter out:
  - UVB
  - most of the UVA

→ most energetic light reaching retina is **short wavelength blue-violet light** (435nm) [3]



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Natural vs. artifical blue light

- **BLUE LIGHT IS EVERYWHERE**

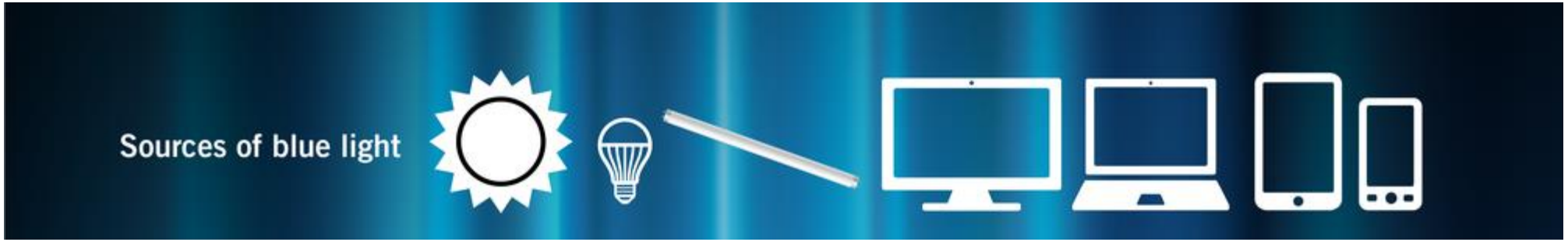
Natural source: SUN

Artifical sources: digital screens (computers, laptops, smart phones and tablets)

LED lightning

electronic devices

fluorescent lightning

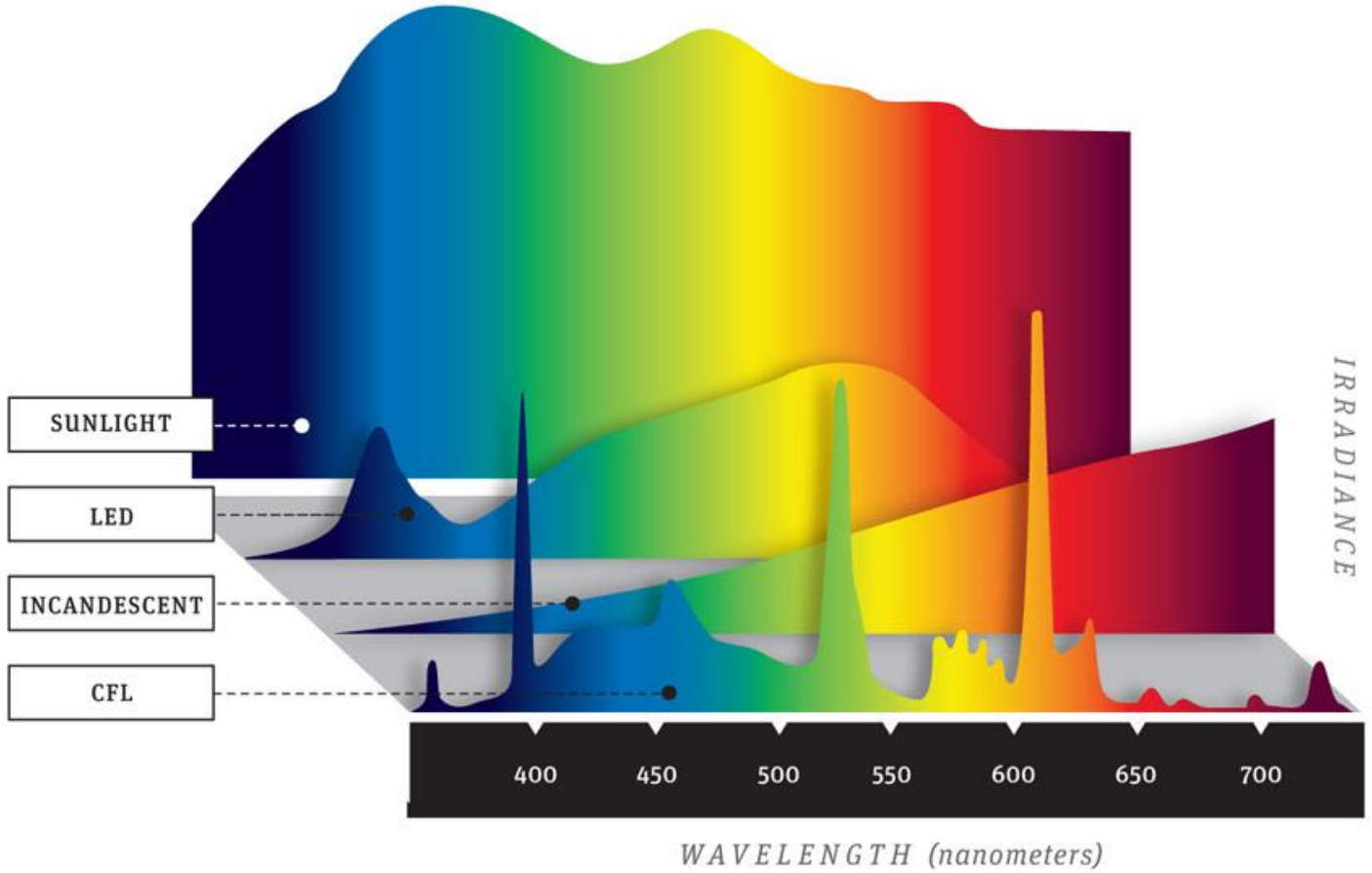


Natural vs. artifical blue light

- Why to be aware of the blue light?

Our exposure to the blue light is high and biggest in the human history. [4]

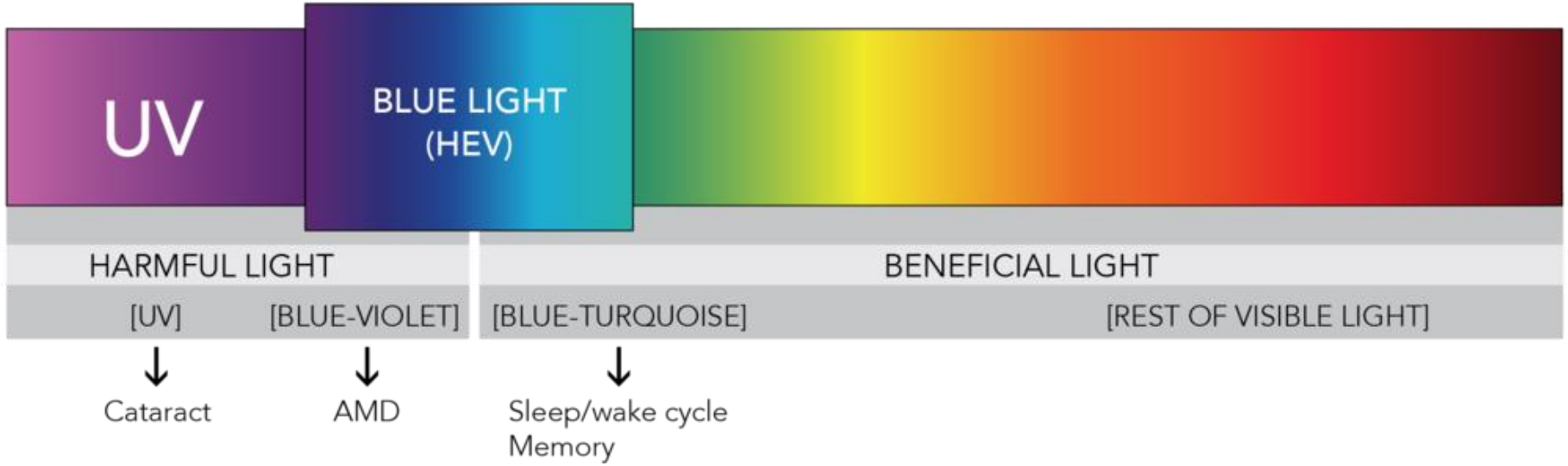
→ **PROLONGED EXPOSURE TO BLUE LIGHT**



HERRMAN, John. *Ultimate Light Bulb Test: Incandescent vs. Compact Fluorescent vs. LED*[online]. In: . 2011. Accesible at: http://www.popularmechanics.com/technology/gadgets/reviews/g164/incandescent-vs-compact-fluorescent-vs-led-ultimate-light-bulb-test/?slide=1

Beneficial and harmful effects x exposure

BENEFICAL EFFECTS	HARMFUL EFFECTS
regulates circadian rhytm	**disruptions to the circadian rhytm**
boost alertness	**may cause permanent eye damage - ARMD**
elevates mood, hormonal balance	**digital eyestrain syndrome – blurry vision, difficult focusing, …**
helps memory and cognitive function	increased risk of depression



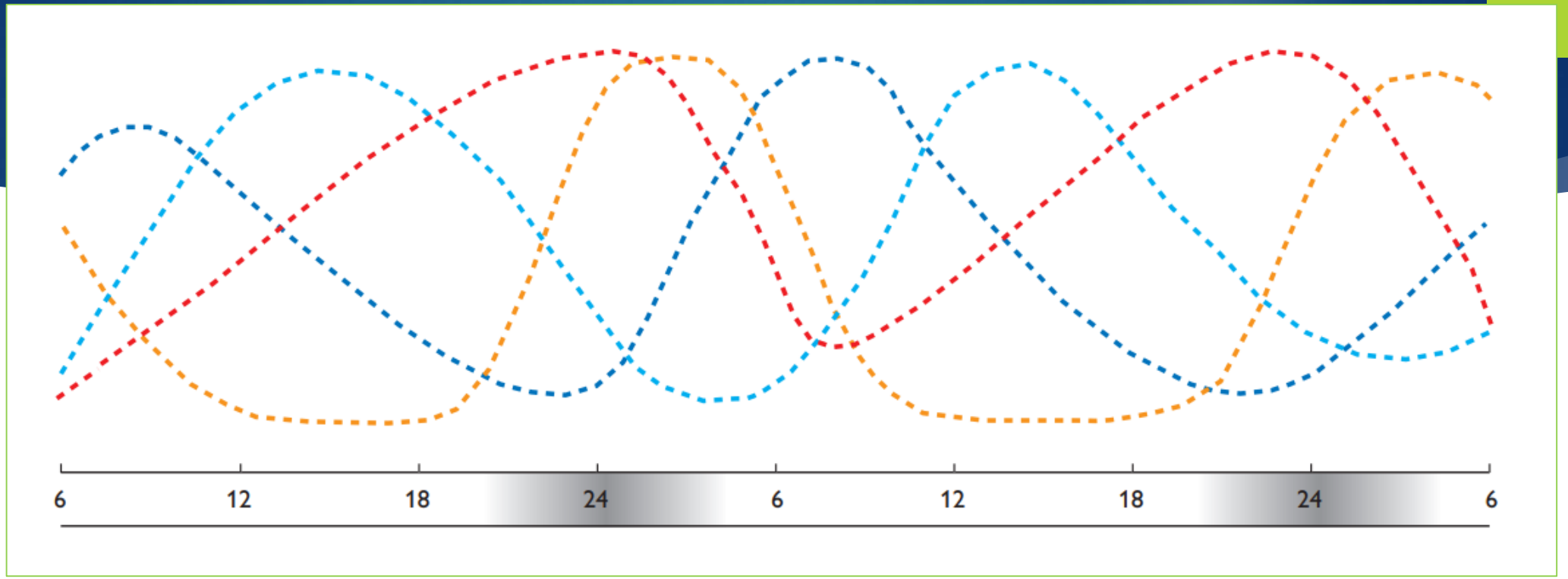
Changes within the circadian rhythm

- Circadian rhythm = **biological period of 24 hours** determines period of ***ALERTNESS / SLEEP***
  - CR controled by centres in brain near optic nerve (and chiasma)
  - circadian clocks influcenced by the time of ***LIGHT / DARKNESS***

- **HORMONES:**
  - ***MELATONIN*** – sleep hormon, producted with the darkness → light supresses melatonin
  - **cortizol** – stress and activity hormon

- melatonin production is different with the various wavelengths – peak of sensitivity is in the blue wavelenght

  → **blue light** → **melatonin supression** → **shifting circadian clock**[6]



- cortisol
- melatonin
- alertness
- body temp.

BOMMEL, W.J.M. van, G.J. van den BELD a M.H.F. van OOYEN. *Industrial lighting and productivity* [online]. In: . The Netherlands: Philips Lighting, 2002. Dostupné z: http://www.iar.unicamp.br/lab/luz/ld/Arquitetural/interiores/ilumina%E7%E3o%20industrial/industrial_lighting_and_productivity%5B1%5D.pdf

Changes within the circadian rhythm

Reading light-emmiting device x printed book before sleep:

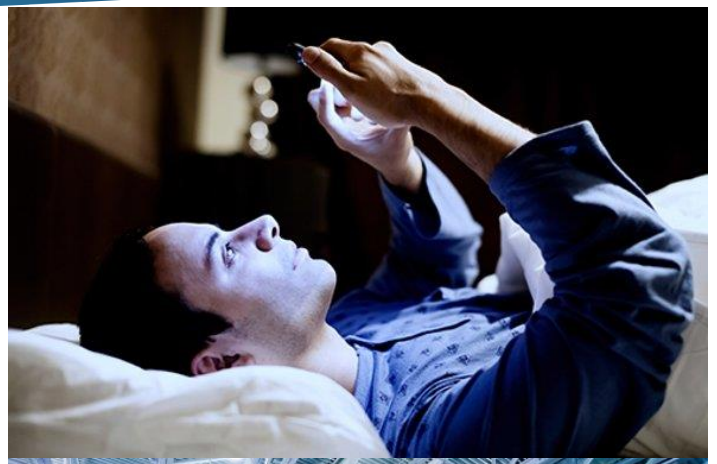
- possible negatives of blue light at night:

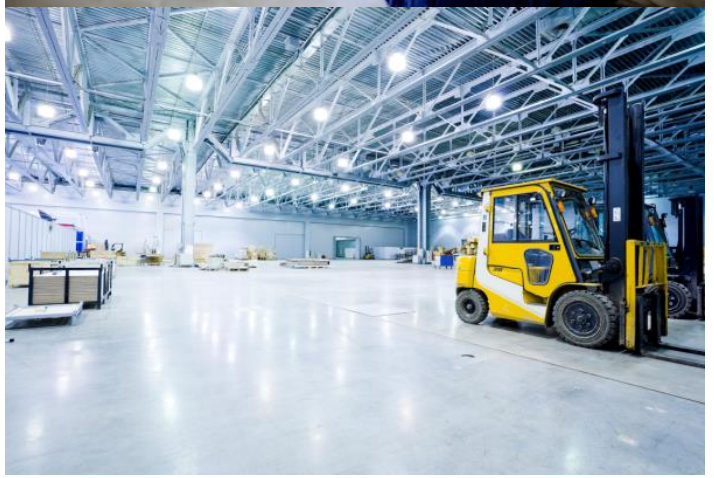
  longer time to fall asleep

  less REM sleep (the period we dream)

  longer to wake up / higher sleepiness in the morning

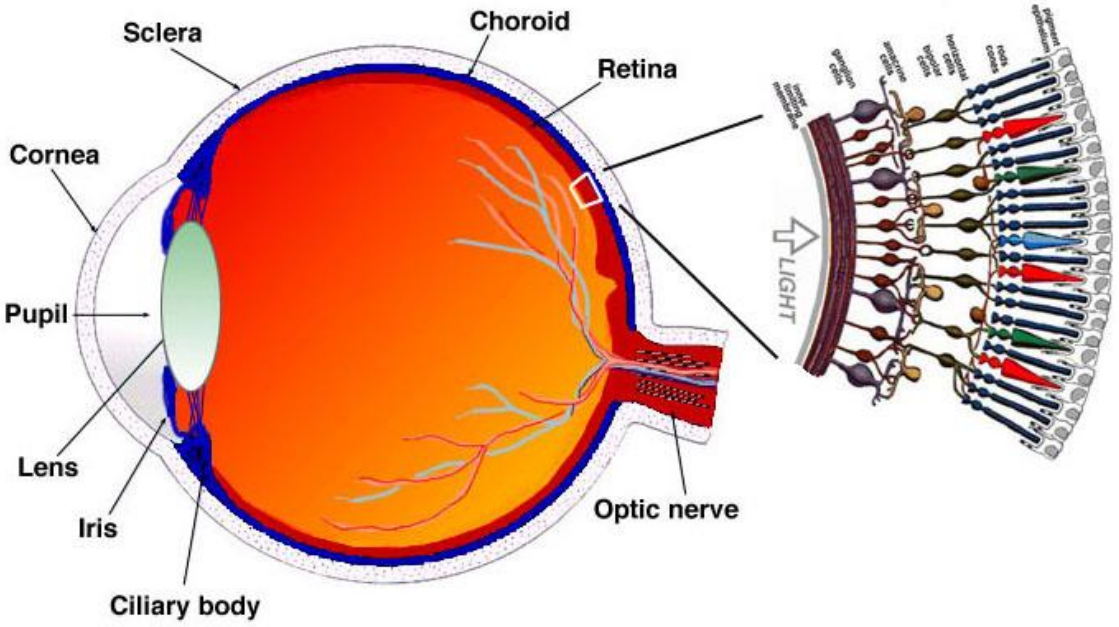
- other possible negatives: function of the body organs (different biorhythm)
- possible positives: in need of shifting the clock: **shift workers** (different sleep patterns)/jet lag [6]





Negative effect causing retinal damage

- ***HEV*** and ***chronic sunlight*** belong among risk factors of ARMD - **age-related macular degeneration** (other factors: age, tobacco, genetic factors, lifestyle)
- ***ARMD*** – condition of retina which leads to **progressive blindness** – no vision in the center of the visual field
- no cure – just prevention[7]

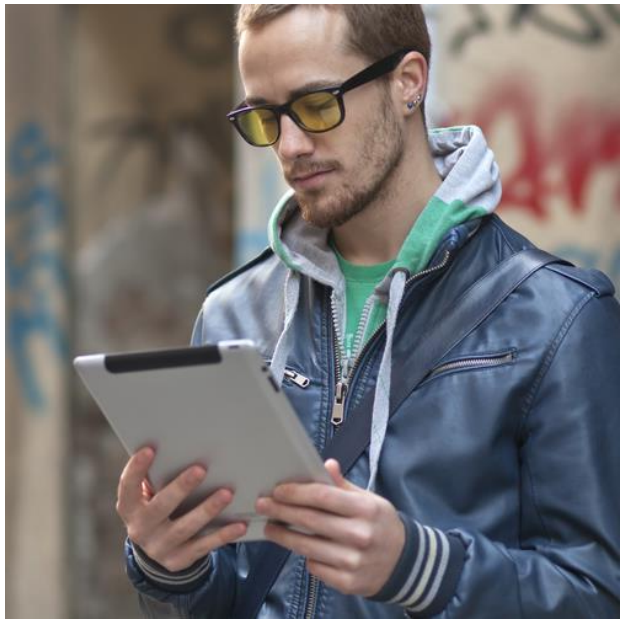


Negative effect causing retinal damage

- exposure to blue light is recognized as a potential risk factor for AMD because of its impact on **lipofuscin** accumulation and **A2E**-mediated phototoxic effects
  - ***degeneration of RPE*** (retinal pigment epithelium)- last retina layer
  - ***retina cell death*** – photoreceptors → loss of the vision in a center of the visual field

Protection against blue light

- Limit the amount of the screen time – mainly before bed time
- Dim the brightness of the screen/***antiblue light mode***
- Special ***antireflex*** cutting a part of the blue light – based on ***reflectivity*** – antireflex should be cutting around 20% of the blue light
- Amber = ***yellow tinted glasses*** – based on ***absorbation***
- 20-20-20 Rule – every 20 minutes stare at something at least 20 feet away far at least 20 seconds



Blue light

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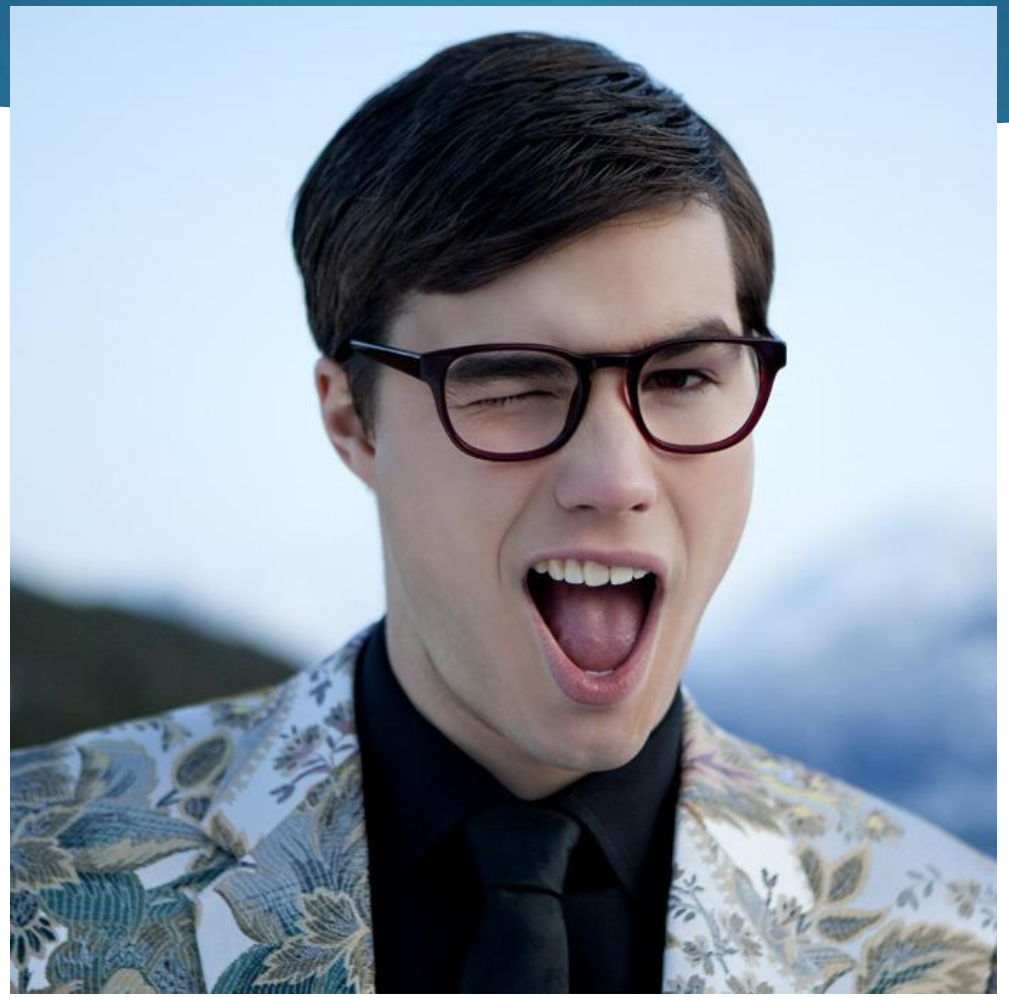

Tereza Höferová
Faculty of Biomedical Engineering, Czech Technical University in Prague
2017