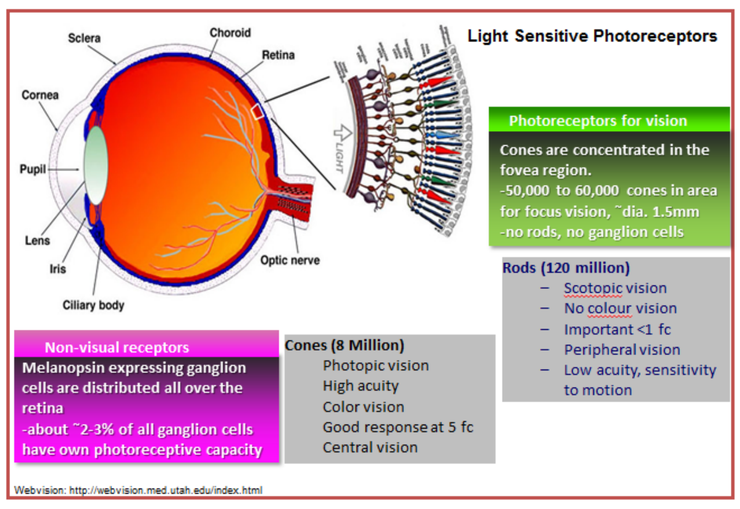
Architectural Lighting Design and Health:

A Human-Centered Approach to Indoor and Outdoor Lighting Design to Synchronize with Our Circadian Rhythms Using LED Technology



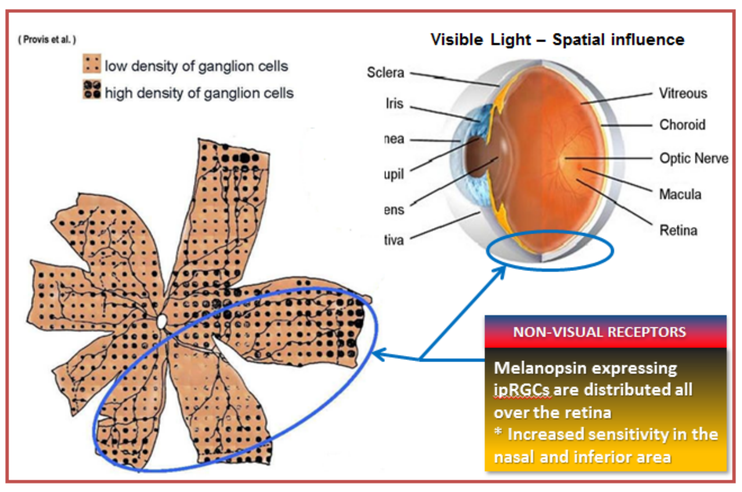
Background: The human eye sensitivity to light varies based on age, alertness, physical and mental conditions of a person. The light intensity, quantity, distribution, direction, color, time, duration, history, etc. play a significant role in the visual, circadian, neuroendocrine and neurobehavioral responses. The various scholars and scientist completed the experiments throughout the world did not produce any single objective result to mitigate this disorder. In this juncture, the proposed new methods to light indoor and outdoor built environment, as well as new approaches for the future lighting design, will accommodate the human health and well-being.

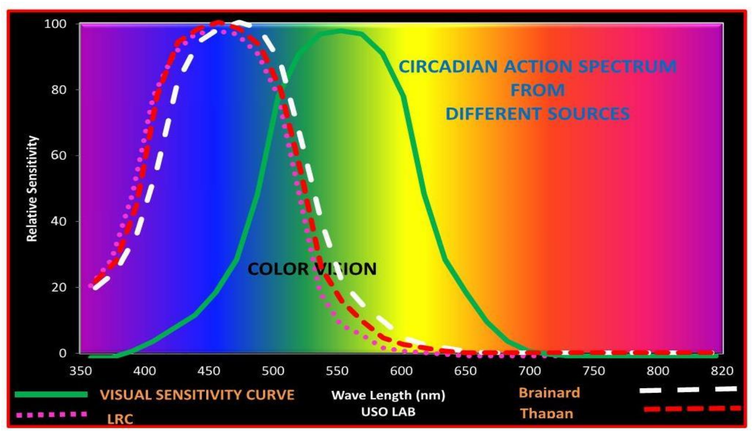
Colors are a physiological & psychological response to the wavelengths of light entering our eyes.

Objective: The objective of this poster is to select the accurate lighting sources, control system & mounting arrangements, pick the modifier, and protect the users or any combination of these. These solutions are based on the application to promote human health and well-being as well as the quality of life for built environment.

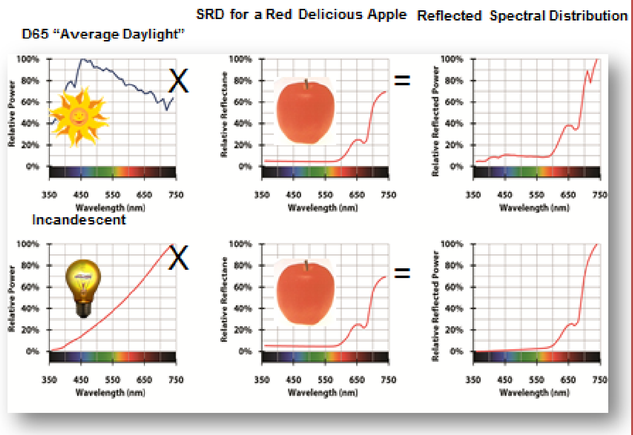
Remarks: Our physiological and psychological response to the physics of light waves that is incident on the retina based on the sensitivity of cones. The physiological photochemical reactions occur within the cones to produce electrical impulses that are sent along nerves to the brain. The psychological occurs when the brain detects the electrical messages being sent by the cones and interprets the meaning of the messages. The most of the researches completed using naked monochromatic color light for the experiment. This does not match the real world application.-

Methods Used: The optical radiation affects the human health and the quality of life. This complicated issue will be solved by new methods using source, modifier and receiver level approaches or any combination of these for any indoor and outdoor application.





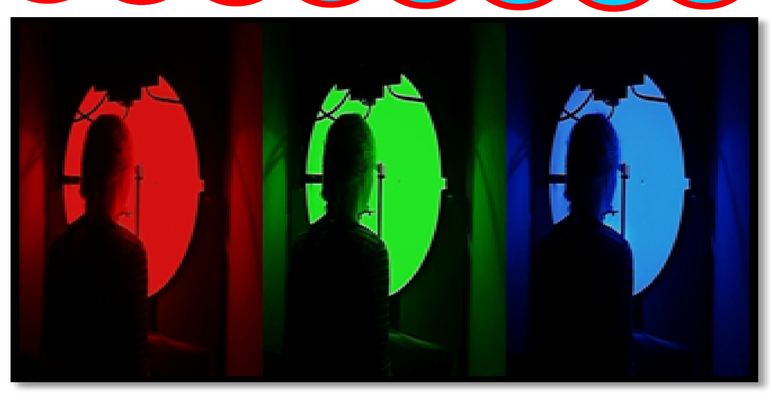
- The Spectral Power Distribution of the light source affects the resultant appearance of an object.
- Daylight is fairly equal across the visible spectrum, while incandescent is strong in the red and weak in the blue which will change the appearance of the apple.

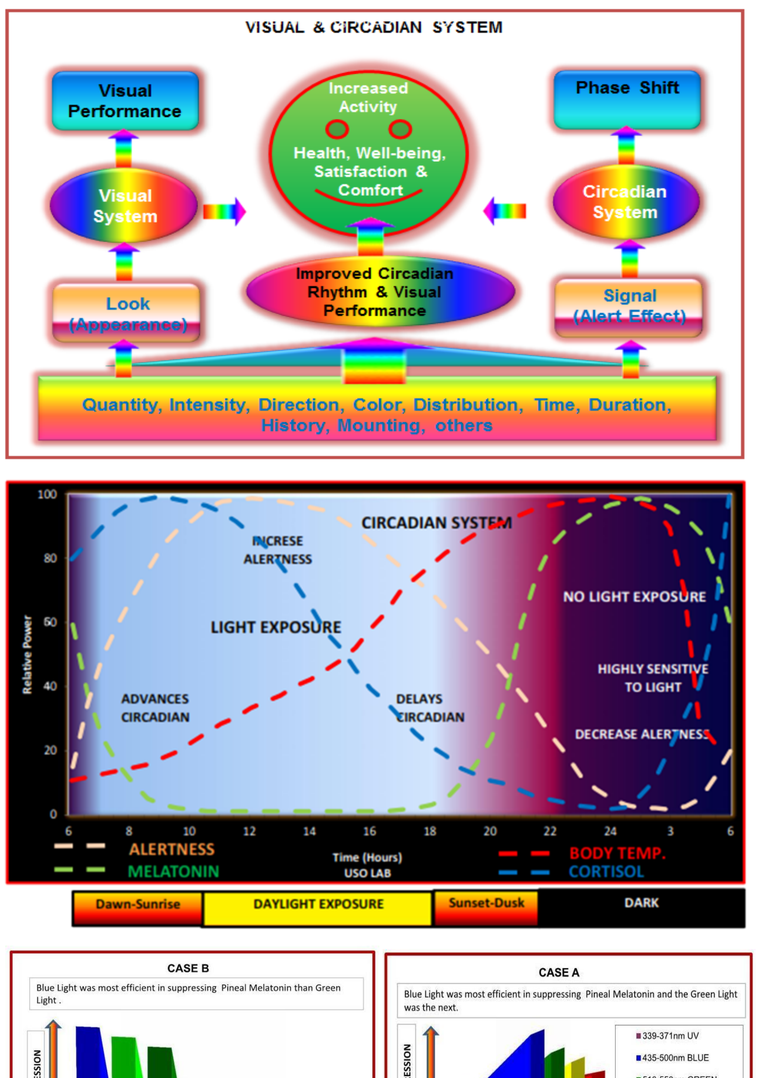


IESNA, The Lighting Handbook 10th Edition, 2011.

Source – SPD's determine object color

Modifier: Selection and Application of Modifier





Method 1: The following source level four step method will be used to integrate the non-visual optical radiation into the lighting design.

a. A new method will be presented to calculate the Retinal Illuminance by optical radiation.
b. The required threshold values will be established based on human biological experiments.
c. Create a method for classifying luminaires based on the non-image forming optical radiation.
d. Integrate non-image forming optical radiation into all the lighting design.

Method 2: The following modifier level method will be used to integrate the non-visual optical radiation into the lighting design.

a. Identify the places where human inhabit during the hours of darkness
b. Choose the modifiers that block the non-image forming signal at night.
c. Install the luminaire such a way to receive indirect light exposure

Method 3: The following user level method will be used to integrate the non-visual optical radiation into the lighting design if any of the above is not used.

a. Identify the places where human inhabit during the hours of darkness
b. Choose the filter/blocker/shield which blocks the non-image forming signal at night.

Conclusion: The non-visual optical radiation affects human physiology and behavior both directly and indirectly. The direct acute affects include melatonin suppression, elevated cortisol production, increased core body temperature, etc. The indirect affects mainly resetting the internal circadian clock. The Optical radiation impacts the visual, circadian, neuroendocrine and neurobehavioral responses. The various researches indicate that light at night may produce melatonin suppression, cancer, insomnia, depression, lower productivity, body temperature regulation, weak immune system, cardiovascular disease, obesity, pollution, trespass lighting, accident, etc. The existing physical measurement based on the photopic luminous efficiency function method which is not adequate to characterize non-visual optical radiation. We know that there is no simple direct relation between vision and optical radiation. This non-image forming photoreceptor melanopsin will play a major role in future lighting design. Most of the researches for the non-image forming optical radiation have been completed in laboratory environment. There is insufficient documentation about the typical exposures to nocturnal optical radiation in field applications. Therefore, the proposed new method to calculate the non-visual optical radiation and new approaches for the future lighting design are important.