

April 8, 2022

The Soft Lights Foundation is a non-profit corporation registered in Oregon. We advocate for protection of people and the ecosystem from the harms of light pollution, especially LED light. Since 2017, we have accumulated extensive knowledge about the toxicity of artificial light at night, especially non-uniform surface source light such as LEDs.

LED lights are a type of light called a surface source light. Light from an LED chip creates a narrowly directed beam of non-uniform energy, unlike anything ever seen in nature previously. LEDs emit non-uniform energy light that interferes with the human nervous system. Many LEDs emit exceedingly high levels of high-energy blue wavelength light that is toxic for human eyes and circadian rhythms.

Numerous research studies have shown that Artificial Light at Night (ALAN) is a toxin that is harmful to human health. Below is a categorized list of several of these studies.

## INTERRUPTION OF SLEEP

**March, 2021** - Do No Harm: The Beginning of the Age of Healthy Hospital Lighting<sup>1</sup> - Under blue wavelength light, melatonin is suppressed, circadian timing is disrupted, and total sleep time is decreased.

**January, 2021** - Moonstruck Sleep: Synchronization of Human Sleep with the Moon Cycle Under Field Conditions<sup>2</sup> - Artificially lit environments, which can acutely inhibit sleep, also entrain the central body clock in the brain that controls the timing of sleep leading to a delayed onset of sleep and a shorter nocturnal sleep bout.

**January, 2016** - Effects of Blue Light on the Circadian System and Eye Physiology<sup>3</sup> - Light has a cumulative effect and many different characteristics; for example: wavelength, intensity, duration of the exposure, time of day. Blue light exposure poses a danger to circadian rhythms.

**August, 2014** - The Effects of Light at Night on Circadian Clocks and Metabolism<sup>4</sup> - Disruptions in circadian clock mechanisms are associated with weight gain.

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<sup>1</sup> <https://academic.oup.com/sleep/article/44/3/zsab016/6158960>

<sup>2</sup> <https://www.science.org/doi/10.1126/sciadv.abe0465>

<sup>3</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4734149/>

<sup>4</sup> <https://academic.oup.com/edrv/article/35/4/648/2354673>

## EYE INJURY

**July, 2020** - Comparison of Ophthalmic Toxicity of Light-Emitting Diode and Organic Light-Emitting Diode Light Sources<sup>5</sup> - LED light induces oxidative stress and stress-response pathways, which result in retinal cell death.

**February, 2017** - Light-emitting-diode induced retinal damage and its wavelength dependency *in vivo*<sup>6</sup>- LED blue-light exposure poses a great risk of retinal injury.

**October, 2016** - Blue Light: What are the Risks to Our Eyes?<sup>7</sup> – Exposure to blue light risks ocular injury and the effects of blue light exposure are cumulative.

## GANGLION CELL INJURY

**February, 2020** - Light-Induced Retinal Ganglion Cell Damage and the Relevant Mechanisms<sup>8</sup> Retinal ganglion cells (RGCs) are the bridging neurons that connect the retinal input to the visual processing centers within the central nervous system. Excessive light damages these RGCs.

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<sup>5</sup> <https://www.nature.com/articles/s41598-020-68565-3>

<sup>6</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5313540/>

<sup>7</sup> <https://www.pointsdevue.com/article/blue-light-what-are-risks-our-eyes>

<sup>8</sup> <https://link.springer.com/article/10.1007/s10571-020-00819-0>

## HEART DISEASE

**March, 2022** - Light Exposure During Sleep Impairs Cardiometabolic

Function<sup>9</sup> - Ambient nighttime light exposure is implicated as a risk factor for cardiometabolic disease.

## INCREASED INSULIN RESISTANCE

**March, 2022** – Light Exposure During Sleep Impairs Cardiometabolic

Function<sup>10</sup> - Exposure to artificial light at night increases insulin resistance.

## MOOD DISORDERS

**January, 2017** – Timing of Light Exposure Affects Mood and Brain Circuits<sup>11</sup> -

Artificial light at night is associated with mood disorders.

## CANCER RISK

**February, 2021** - Associations Between Artificial Light at Night and Risk for

Thyroid Cancer: A Large US Cohort Study<sup>12</sup> - There is a 55% increase of risk of thyroid cancer due to exposure to artificial light at night.

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<sup>9</sup> <https://www.pnas.org/doi/10.1073/pnas.2113290119>

<sup>10</sup> <https://www.pnas.org/doi/10.1073/pnas.2113290119>

<sup>11</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5299389/>

<sup>12</sup> <https://acsjournals.onlinelibrary.wiley.com/doi/abs/10.1002/cncr.33392>

**October, 2018** - Melatonin: An Anti-Tumor Agent in Hormone-Dependent Cancers<sup>13</sup> - Exposure to light-at-night, which abolishes the nocturnal peak of melatonin, is associated with an increase in the risk of breast and prostate cancer.

#### AUTISM SPECTRUM DISORDER

**March, 2022** - Outdoor Light at Night and Autism Spectrum Disorder in Shanghai, China: A Matched Case-control Study<sup>14</sup> - Exposure to bright light at night is significantly associated with risk of developing Autism Spectrum Disorder.

#### PREMATURE BIRTH

**December, 2020** – Light pollution, sleep deprivation, and infant health at birth<sup>15</sup> - Exposure to artificial light at night increases the risk of premature birth by 13%.

In summary, the research studies show that artificial light at night greatly increases risk of mood disorders, cardiometabolic disorders, weight gain, loss of sleep, breast cancer, prostate cancer, and thyroid cancer, Autism Spectrum

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<sup>13</sup> <https://www.hindawi.com/journals/ije/2018/3271948/>

<sup>14</sup> <https://pubmed.ncbi.nlm.nih.gov/34914994/>

<sup>15</sup> <https://onlinelibrary.wiley.com/doi/abs/10.1002/soej.12477>

Disorder, and premature birth. Blue wavelength light at night is especially harmful since blue wavelength light suppresses melatonin and causes cumulative eye damage.

## ECOLOGICAL IMPACTS

Numerous studies have shown that the natural night resource is fundamental to the proper functioning of cellular organisms. Below is a list of a few of these studies.

**August, 2021** - Street Lighting Has Detrimental Impacts on Local Insect Populations<sup>16</sup> – Artificial light at night greatly reduces insect abundance and blue/white LED light has an even greater negative impact on insect populations.

**March, 2021** - Mechanisms and Mitigation: Effects of Light Pollution on West Nile Virus Dynamics<sup>17</sup> - Light pollution is driving infectious disease patterns in nature and increasing the risk of West Nile virus transmission.

**August, 2019** - Anthropogenic Light Disrupts Natural Light Cycles in Critical Conservation Areas<sup>18</sup> - Anthropogenic lighting drastically alters nocturnal environments, threatening a wide range of species by disrupting light regimes

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<sup>16</sup> <https://www.science.org/doi/10.1126/sciadv.abi8322>

<sup>17</sup> <https://digitalcommons.usf.edu/etd/8806/>

<sup>18</sup> [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3439670](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3439670)

that regulate fundamental biological processes such as reproduction, foraging, and predator defense.

## CRIME AND SAFETY

Safety and security are often used to justify the use of artificial light at night outdoors. However, the research studies repeatedly show that the idea that artificial light at night increases safety or reduces crime is a myth. Below is a list of several of these studies.

**March, 2022** - Street lighting may help rather than hinder vehicle crime<sup>19</sup> -

The use of streetlights **increases** vehicle property crimes.

**November, 2017** – Part Night Light Report, 2017<sup>20</sup> - There is no evidence that artificial light at night reduces levels of crime, anti-social behavior or the risk of being killed or seriously injured.

**September, 2015** - The Effect of Reduced Street Lighting on Crime and Road Traffic Injuries at Night in England and Wales: A Controlled Interrupted Time Series Analysis<sup>21</sup> - There was no evidence from the study showing that turning off

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<sup>19</sup> <https://www.lshtm.ac.uk/newsevents/news/2022/street-lighting-may-help-rather-hinder-vehicle-crime>

<sup>20</sup> <http://www.softlights.org/wp-content/uploads/2022/03/Essex-Police-Crime-and-Lights-Study.pdf>

<sup>21</sup> <https://www.ncbi.nlm.nih.gov/books/NBK316511/>

the streetlights increased crime, nor did turning off the streetlights increase traffic accidents.

**December, 1997** - Dark Campus Programs Reduce Vandalism and Save Money<sup>22</sup> - Turning off the lights reduces crime on school campuses.

The results of the studies are consistent: The use of artificial light at night does not increase public safety, does not reduce traffic accidents, and increases property crimes. Thus, the use of artificial light as a method to protect property or increase security is ineffective, instead wasting energy, polluting the natural night resource, and harming public and ecosystem health.

## LIGHT TRESPASS NUISANCE

While light trespass is not yet commonly explicitly listed as a nuisance, numerous local Codes have listed light as a nuisance. Because LED light is so much more intense and powerful than previous technologies, and often with far more energetic blue wavelength light, light trespass has become a major new nuisance. Below are some examples showing that light trespass is a nuisance.

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<sup>22</sup> [https://popcenter.asu.edu/sites/default/files/problems/vandalism/PDFs/DarkSky\\_1997.pdf](https://popcenter.asu.edu/sites/default/files/problems/vandalism/PDFs/DarkSky_1997.pdf)



**Law Insider**<sup>23</sup> - Light trespass means light emitted by a luminaire that shines beyond the boundaries of the property on which the luminaire is located.

**Gilgal Pointe Restrictions, Michigan**<sup>24</sup> – “No outdoor lighting nuisance shall be permitted.”

**Camden, South Carolina**<sup>25</sup> - “Any artificial light source which creates glare observable within the normal range of vision, under normal weather conditions, from any property other than the property where the light source is located is considered a nuisance and is prohibited.”

**Rancho Cordova, California**<sup>26</sup> - “Nuisance Prevention. All outdoor lighting shall be designed, located, installed, directed downward or toward structures, shielded, and maintained in order to prevent glare, light trespass, and light pollution.”

## SUMMARY

Artificial Light at Night is a toxin that causes significant negative health impacts. Outdoor artificial light does not improve safety, does not reduce traffic

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<sup>23</sup> <https://www.lawinsider.com/dictionary/light-trespass>

<sup>24</sup> [https://estatedocbox.com/Buying\\_and\\_Selling\\_Homes/66760271-Gilgal-pointe-restrictions.html](https://estatedocbox.com/Buying_and_Selling_Homes/66760271-Gilgal-pointe-restrictions.html)

<sup>25</sup> [https://codelibrary.amlegal.com/codes/camden/latest/camden\\_sc/0-0-0-18085](https://codelibrary.amlegal.com/codes/camden/latest/camden_sc/0-0-0-18085)

<sup>26</sup> <https://www.codepublishing.com/CA/RanchoCordova/html/RanchoCordova23/RanchoCordova23725.html>

accidents, and does not reduce property crimes. Artificial light that trespasses beyond property lines is a nuisance, interfering with the right of health, safety, and quiet enjoyment of the property owner where the light trespasses.

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