LIGHT AND HEALTH

Inspired by commentary from Karolina M. Zielinska-Dabkowska

1. THE CIRCADIAN RHYTHM & LIGHT

THE CIRCADIAN RHYTHM
The circadian rhythm is a 24-hour internal clock that governs the timing of biological processes. It's not just about when to get sleepy and when to wake up. Disruption of natural rhythms is responsible for a host of health problems and chronic diseases.

PLANTS, ANIMALS, AND THE BIOLOGICAL CLOCK
Plants and animals share the rhythm of light and dark. Life evolved under stable patterns of light and dark. Even insects such as the fruit fly, have biological clocks that are controlled by light patterns.

ARTIFICIAL LIGHT & THE DISRUPTION OF THE RHYTHM
The circadian rhythm is calibrated by ambient lighting conditions. Light (especially blue light), tells the body that is daytime. Light exposure after dark sends conflicting signals and prevents the smooth transition into nighttime physiology.

2. LIGHT AFFECTS HEALTH

NOT ENOUGH LIGHT IN THE DAY

SEASONAL AFFECTIVE DISORDER
Seasonal affective disorder is on the rise. Depression in the Winter. Such disturbances can have wide effects: on sleep and waking cycles, eating patterns, metabolism, reproduction, mental alertness, blood pressure and heart rate, hormone production, temperature, mood patterns and the immune system.

LACK OF VITAMIN D
People lack vitamin D. The best way to get vitamin D is through exposure to natural sunlight.

INCREASED RISK OF MYOPIA
Children who don't get enough sunlight are at increased risk of becoming near-sighted.

LIGHT EXPOSURE AT NIGHT

HUMANS NEED DARKNESS
Numerous studies have demonstrated that light at night disrupts the circadian rhythm and can be disastrous for health. Circadian disruption has been linked to increased risk of cancer, obesity, and sleep problems. Light at night, from screens, electronic devices, and artificial illumination trigger the photosensitive cells in the eye which signals the brain to stop producing melatonin. Melatonin is a key hormone for nighttime rejuvenation and cellular repair.

CANCER RISK
Circadian disruption has been shown to increase the risks of breast and prostate cancers. In fact, shift work is a known carcinogen.

OBESITY
Circadian disruption is linked to metabolic disorders and may be a major contributer to the obesity epidemic.

SLEEP PROBLEMS
In humans, melatonin signals the body to initiate sleep. When melatonin levels are suppressed the body does not transition into nighttime physiology. This often leads to problems falling asleep.

EFFECT ON OTHER SPECIES
Artificial light at night impacts other species, too. Pollinators such as moths, flies and beetles are attracted to lights instead of focusing on feeding, mating or breeding. Bats alter their feeding behavior; birds, fish and turtles change their migratory routes; and the growth of trees and plants are affected.

3. LIGHTING OLD AND NEW

THE ENERGY EFFICIENCY PROBLEM
Lighting uses a lot of energy. About 15% of residential power consumption is from lighting. To combat this problem, the European Commission began to withdraw incandescent lamps. Other countries followed, from Switzerland and Australia to Russia, the United States and China. Low-energy lamps — at first mainly compact fluorescent lamps (CFLs) and later light-emitting diodes.

Incandescent Lamps

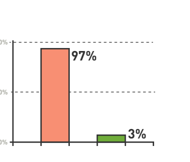
Incandescent lamps were the dominant light source for over a hundred years. They use a wire filament heated to such a high temperature that it glows with visible light. Much of the energy released is not visible infrared heat.

POSITIVES

NO DANGEROUS METALS
Incandescents use a tungsten filament. They can be safely disposed of in landfills.

NATURAL SPECTRUM
Because their light is produced by high temperatures, they have a similar spectral output as a fire. They are excellent for color rendering.

NEGATIVES



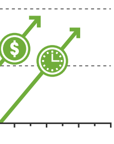
INEFFICIENT
Much of the energy is released is not visible infrared heat. They are very inefficient. Less than 3% of the energy consumed is emitted as visible light.

SHORT LIFE
Compared to CFLs and LEDs, incandescents don't last very long. They are typically rated at 1000 hours.

CFL - Compact Fluorescent Lamps

The compact fluorescent lamp was the first generation of energy efficient lamps. They use a fluorescent tube which is curved or folded to fit into the space of an incandescent bulb. Compared to incandescents of the same lumen output, they use up to one-fifth the electric power and last eight to fifteen times longer.

POSITIVES



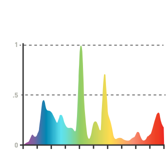
EFFICIENCY
CFL's last longer and are more efficient than incandescents.

NEGATIVES

TOXICITY
Compact fluorescent lamps are the most hazardous. They contain mercury, a neurotoxin. Even worse, they are easily and often broken.

RECYCLING
There are no protocols for recycling or disposing of them — at least 80% are thrown into landfill.

ULTRAVIOLET LIGHT
Ultraviolet light can escape from defective tube coatings to burn skin or damage the retina at close range.



SPIKY SPECTRA
CFLs have 'spiky' rather than smooth spectra: they emit only certain blue, green and orange-red frequencies. This is a very unnatural spectra and makes for poor color rendering. They are also higher in blue light than incandescents.

ENERGY SAVINGS OVERESTIMATED
CFLs take time to warm up, so are likely to be left on for longer. When switched on and off often, they fail more quickly.

LED - Light Emitting Diodes

A LED lamp produces light using light-emitting diodes . LED lamps have a lifespan and electrical efficiency which are several times greater than incandescent lamps, and are significantly more efficient than most fluorescent lamps.

POSITIVES

ENERGY EFFICIENT
They are more energy efficient, brighter, and last longer than CFLs and incandescents.

NO MERCURY
LED Lamps do not contain mercury.

LOW UV EMISSIONS
Produce only a small amount of UV compared to CFL or incandescent lamps.

OTHER BENEFITS
Unlike CFLs, they can be dimmed or tuned and render colors well.

NEGATIVES

HIGH BLUE OUTPUT
Standard LED lamps use a blue LED with a phosphorus coating that glows white. This causes a higher blue output than other types of lighting.

HEAVY METALS STILL AN ISSUE
Some contain heavy metals such as nickel, lead and copper, and poisons such as arsenic.

NO CLEAR RECYCLING OPTIONS
There are no special programs for recycling or disposing of them.

INCONSISTENT QUALITY
The coating on low quality LEDs can deteriorate which unleashes a lot more blue light. Poorly manufactured LEDs can have a much shorter life span that advertised.

FLICKER
Poor-quality LEDs can also flicker, especially when dimmed. This produces stroboscopic effects, such as trails of lights that can confuse pedestrians, cyclists, or car drivers. It can also cause headaches, eye strain and even trigger seizures in epileptics.

WHAT CAN WE DO?

"Biologically benign forms of energy efficient lighting are needed. I call on physicists, engineers, medical experts, biologists and designers to develop them. Policymakers, planners and regulators should rethink standards, encourage the use of natural light and minimize the negative impacts of artificial lighting at night, indoors and out." - Karolina M. Zielinska-Dabkowska

4. AWARENESS, GOOD LIGHTING DESIGN, AND TIGHTER STANDARDS

PUBLIC AWARENESS
The public's awareness of lighting issues must be raised. Researchers and lighting practitioners need to communicate the dangers and challenges. Healthy lighting design is becoming an important ethical issue that cannot be ignored.

EXPOSURE LIMITATION
Ideally, there should be no exposure to light at night with a spectrum under 600 nm (amber or red color). Lighting should be indirect, flicker-free and dimmable. Children are particularly susceptible to light at night. Parents should be advised to use only red nightlights.

ELIMINATE CFLs
CFLs are outdated and dangerous. They should be withdrawn from sale due to the lack of recycling protocols and mercury toxicity.

EMISSIONS OUTSIDE THE VISIBLE RANGE
Emissions outside the visible range must be considered, such as near-infrared radiation (750–950 nm) that is present in daylight and incandescent lamps but not LEDs. More research is need on the health effects of removing infrared light from our lamps.

HEAVY METAL REDUCTION
Reduce heavy metals in LEDs.

USING NATURAL LIGHT EFFECTIVELY
Better use of natural light in the day with full spectrum artificial light only used when needed.

LIGHT POLLUTION
Outdoor lighting must be designed and implemented in a way that minimizes light pollution. Fixtures should be shielded and only illuminate downward. LED streetlights have been a disaster so far. Blue-white light scatters causing glare and illuminating far most than they should. Using amber colored LEDs would make a huge difference in mitigating light pollution.

INTELLIGENT CONTROL SYSTEMS
Outdoor lighting systems should be turned off when not needed. The use of timers, motion sensors, and control systems Lighting should be indirect, flicker-free and dimmable with intelligent control systems.

BUILDING REGULATIONS & URBAN LIGHT MASTER PLANS
Building regulation should reward good lighting design and use of natural light where possible. Municipalities should incorporate sustainable night-time illumination policies and guidelines into their urban lighting master plans. Street and security lighting should be designed to minimize light pollution.

ACCURATE SPECTRAL PROPERTIES
Most people choose a lamp by its correlated color temperature (CCR) in Kelvin. This is very limited. We need to judge a light source by its full spectral wavelength output as measured in nanometers.

www.BlueLightAtNight.com

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