Energy focus™

ENLIGHTEN AND INSPIRE

LED Lighting Sets the New Standard in Schools

Improving Health, Safety and Performance in Classrooms with a Simple Switch

The Current State of Classroom Lighting

For over a century, fluorescent bulbs have been the groundbreaking technology in lighting. Since the 1940s, we have been educated under fluorescent lights in schools, worked under them in offices, exercised under them in gymnasiums, and treated under them in hospitals. With the advent of the compact fluorescent bulb, we even brought them into our homes.[1]

Fluorescent lights are gas-filled tubes with a phosphorescent coating on the inner surface. Electrical current is passed through a voltage-regulating ballast to a tungsten-coiled electrode. When the lights are turned on, a voltage “kick” from the ballast instantly (or, in older technologies, more gradually) vaporizes small amounts of mercury within the tube, causing them to emit ultraviolet (UV) light. The inner surface coating absorbs the UV light and converts it to visible light, producing a ‘white-ish’ glow.[1]

With lighting a necessity in our lives, unfortunately fluorescent lights have become essential due to the lack of competitively priced technology with comparable light output and efficiency.

Current Impact of Fluorescent Lighting on Students

Mercury is a hazardous material. Fluorescent tubes contain a mixture of mercury and inert gases when current is running through them, and a broken fluorescent tube carries the risk of mercury entering the body through the lungs (via breathing in the gas) or the skin (from coming in contact with mercury residue on the inner glass surface).[2] In the unforeseen event that a fluorescent light bulb shatters, anyone in the vicinity will be exposed to the dangers of mercury, making it a safety hazard in schools.

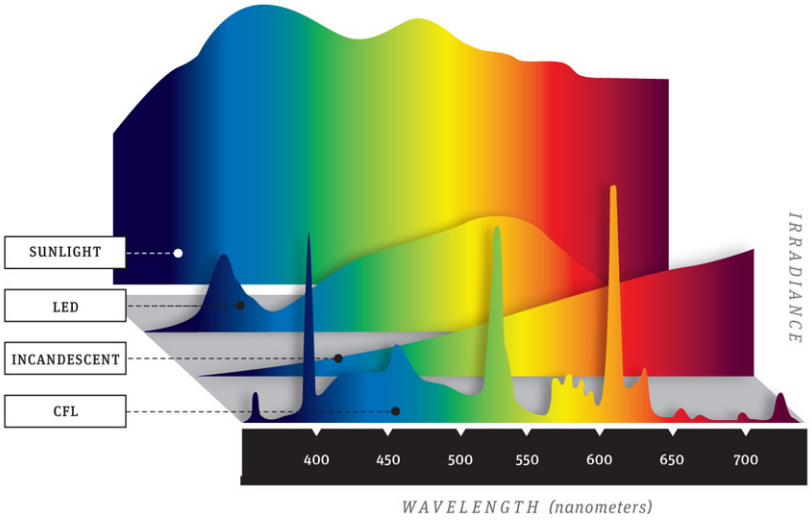
The mercury gas in fluorescent bulbs produces UV light, which is partially, but not completely, converted to light in the visible spectrum. Ultraviolet radiation operates at a higher frequency than visible light and is able to break bonds in many polymers, causing damage to materials such as plastics, as well as the tissues in our eyes and skin. Prolonged exposure can result in a clouding of the lens, commonly known as cataract formation, and is a contributing factor to age-related macular degeneration - the leading cause of blindness.[3] Young people are especially at risk to the hazards of UV light, as a protective deposition of yellow pigments in the eyes occurs with age, attenuating the amount of radiation reaching the retina in older adults.[4]

In addition to UV light, the visible radiation emitted by fluorescent light sources consists of three spikes (magenta, yellow-green, and orange), with minimal if any other wavelengths contributing to the output.[5] The human visual system transmits those light signals to the brain, which must 'fill in the gaps' to process the picture. Students learning in poor-spectrum lighting environments often have a difficult time concentrating. Some people have extremely sensitive vision, particularly in the scotopic (low-lit) range, and low-spectrum lighting can trigger the same visual response. These individuals with scotopic sensitivity syndrome are commonly misdiagnosed with dyslexia or other learning disabilities, as well as being subjected to dizziness, headaches and nausea caused by the spikes and gaps in fluorescent light output.[6]

The LED Lighting Technology Alternative

Light Emitting Diodes (LED) are a cutting-edge solid-state technology that are predicted by the US Department of Energy to replace almost all artificial lighting in the United States by 2030. While the basic technology has been available for years, recent developments have driven down cost and made LEDs more widely-available to the general public. Available as alternatives to everything from industrial and landscaping feature lighting, to residential settings, to the ubiquitous fluorescent tubes in schools and offices, LEDs provide a number of benefits over their predecessors.

Full-Spectrum Light Array- Graph 1 [7]



Known primarily for their energy efficiency, LED bulbs produce more lumens per watt, resulting in higher efficacy as less power is needed to produce the same or more light output. LEDs are also superior when it comes to quality of light output, as white tubular LED lamps provide the closest spectral match to sunlight (Graph 1)[7], with no spikes or gaps in color output. And unlike their fluorescent counterparts, LEDs are visually efficient; that is, they only produce radiation in the visible range, with virtually no harmful UV or wasted infrared.

The Benefits of LEDs for Students

Good lighting aids cognition in many ways. This is especially important in the case of children and young adults.

Geneva High School replaced their outdated fluorescents with Energy Focus Flicker-Free LEDs in their special needs classroom as part of our Change a Light, Change a Life program. Flicker-Free LEDs can drastically impact the learning environments for students with special needs by eliminating flicker and the hum associated with the high levels of flicker in fluorescent lighting.

Physical Utility

The smooth curve and constant irradiance across the full spectrum of visible wavelengths results in more saturated, vivid, discriminable color rendering and effortless visual acuity. Fully directional down-lighting also provides more illumination on working surfaces, rather than the diffuse glow produced by the gas-filled fluorescent tubes.

The correlated color temperature, color rendering, and luminous efficacy of LED lights combine to improve visibility to create a better learning environment. Vision is a contributing factor to an individual's ability to attend and respond to classroom instruction.

Cognitive Utility

Most parents encourage their children to get a good night's sleep on a school night. A healthy sleep/wake cycle (or Circadian Rhythm) is crucial to mental cognition. Our bodies' roughly 24-hour cycle is governed by hormonal responses that are triggered by full-spectrum light – light provided by sunlight and LED, but not fluorescent.[9]

When the light needed to trigger circadian responses is provided, alertness, attention and participation increase among students, as shown by a Case Western Reserve University study.[10] Similarly, the US Army conducted a study with Tufts University showing that LED lighting resulted in increased productivity over fluorescent lighting.[11]

Flicker in Lighting

Frequencies of light above the visible threshold have been demonstrated to cause headache and eyestrain. The sensitivity to flicker in this range and above is a spectrum, and the effects on the population are not quantified. However, studies have shown that performance on tasks decreases with long exposure to frequencies in this range.[6] Persons on the autism spectrum are typically hypersensitive to visual stimuli, and are especially susceptible to encountering issues with flicker in lighting.[5]

Conclusion

LED lighting is the best choice for schools that want to foster a safe, healthy, comfortable, and "green" environment for their students and teachers. The benefits range from monetary savings – from electricity costs and less frequent bulb replacements – to increased teacher productivity, student participation and learning, and ocular safety. These lights best eliminate the lighting-related competing element in schools that physically directly affects the students' vision and physiologically affects their ability to and capacity to learn. Just like the societal revolution, LEDs are no longer the future of the lighting industry. They are the present, and should be the source illuminating future generations.

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Energy Focus, Inc.
32000 Aurora Road
Solon, OH 44139

800.327.7877 • **www.energyfocus.com**

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