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Research Areas: human factors research includes cognition, dementia, visual perception, photobiology and chronobiology; energy systems research includes passive environmental systems such as efficient building envelope design, natural ventilation and daylighting techniques, and active systems like daylight-mimicking LED lighting, low-energy luminous surfaces and dynamic building envelope design

### **dLUX explores light in the built environment**

dLUX brings together students, faculty, and partners from a variety of disciplines to investigate light in the built environment and its effect on life and energy use. In today's rapidly-changing, inter-connected world, the need is increasing for building technologies that are not only environmentally friendly, but also in tune with human factors. With experts from the design and engineering disciplines and the health professions, the dLUX team seeks to better understand the links between the inherent characteristics of natural and electric light sources and their effects on biological rhythms and health outcomes.

### **Energy-effective design**

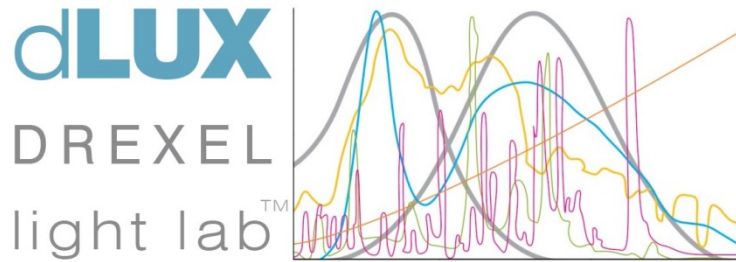
Solar orientation, natural ventilation, and low-energy systems can all play a major role in reducing the environmental footprint of a building. Combined with adaptive natural and artificial lighting, as well as shading and building envelope technologies, dLUX's research addresses the impact of these strategies on resource consumption and occupant comfort.

### **Impact on health outcomes**

Characteristics of the built environment contribute significantly to human physiological factors. The dLUX team investigates the effects of existing and next-generation building systems on human health with a focus on circadian rhythmicity, visual perception and acuity, and cognitive function. dLUX works with human services organizations to create indoor environments for special needs populations such as children with autism spectrum disorder, older adults with dementia, and others with intellectual or behavioral disabilities.

### **Representative Projects**

St Columba for Project H.O.M.E. – solar day matching light to improve sleep and behavior  
AJ Drexel Autism Institute – effects of fluorescent light versus LED light on children with ASD  
St Francis Country House for the Archdiocese of Philadelphia – ameliorate symptoms of dementia  
San Diego Zoo – circadian lighting for “Africa Rocks” lemur exhibit and living environment  
Philadelphia Zoo – use of light to deter birds from flying into glass windows  
Synesthetic Lighting – use of light, color and sound to improve adolescent behavior



## RESEARCH PROJECTS

### St Columba for Project H.O.M.E.

evidence-based design research on the effects of solar-day mimicking LED light to improve sleep and reduce violent behavior for 25 resident homeless men

### AJ Drexel Autism Institute

evidence-based design research comparing the effects of fluorescent light versus LED light on children with autism spectrum disorder

### Carillon House – Senior Living Community – Lubbock, Texas

evidence-based design research on the effects of solar-day mimicking LED light to reduce symptoms of dementia and improve health outcomes for older adult residents

### San Diego Zoo

development of a diurnal daylight-mimicking LED light to recreate lemur biomes in a subterranean zoo environment

### Philadelphia Zoo

development of an LED light or laser light system to deter birds from flying into glass windows

### Synesthetic Lighting

match-tuning LED light color wavelengths with sound frequencies to achieve an emotional effect and improve mood and cognitive functioning—developing an interactive system for the Please Touch Museum in Philadelphia that will teach children cause and effect relationships between music and light

### Plants and Light for Improved Indoor Air Quality

plant, LED light and ventilation ecosystem that optimizes plant oxygen production—red light at night stimulates increased oxygen production by plants and stimulates melatonin production in humans for improved sleep patterns

### Characterizing Sensors

environmental sensors for the home that will adjust lighting, humidity and temperature based on user preferences and optimal circadian human performance potential

### Diurnal Daylight-Mimicking Controls System

controls system for LED light that matches color temperature and light intensity of the solar day

### Light Wavelength and Melatonin Production

comparing melatonin production in various lighting conditions, especially the use of red light

### Flicker, Wavelength and Eye Fatigue: Fluorescent versus LED Lighting

measuring how flicker and light wavelength affect eye fatigue / comparing fluorescent and LED light sources