

# Quantifying Impact of Lighting on K-12 Students' Performance and Well-being

**H**uman circadian rhythms, such as sleep/wake behavior, are synchronized, or entrained, to the solar day by morning light. Lack of synchrony in adolescents has been linked to an inability to fall asleep at appropriate evening hours and get up early for school the following morning.

The LRC received a grant from the U.S. Green Building Council to quantify the amount of daylight and electric light students are being exposed to, and whether circadian light exposure promotes entrainment and improves performance in school.



## Experiment details

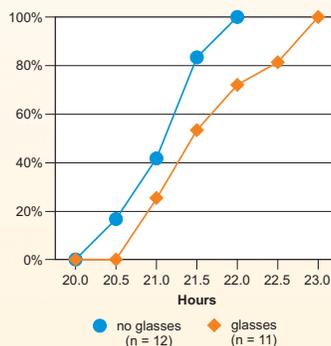
Daily light exposure for 22 students was measured using a personal circadian light meter, called the Daysimeter. The study was conducted at Smith Middle School in Chapel Hill, NC, where students have access to daylighting during the entire day. Half of the subjects also wore orange tinted glasses during school hours as a means to prevent short wavelength light exposure, eliminating morning "circadian" light.

The researchers then collected saliva samples from the students to determine their dim light melatonin onset (DLMO), a well-known circadian marker, to relate the light exposures to the timing of their circadian system. The students were asked to complete standardized performance tests on a PDA twice daily while school was in session and to complete self-reports of sleepiness.

Phasor analysis, a technique based on signal processing, was used to draw correlations between the periodic changes in light and in activity. The greater the phasor magnitude, the greater the level of behavioral circadian entrainment.

## Results summary

- Removing circadian light in the morning delayed the DLMO by 30 minutes compared to those who did receive circadian morning light.
- Those wearing orange glasses experienced shorter phasor magnitudes and increased sleep latency, demonstrating that daylight during the morning does advance the clock, allowing students to fall asleep earlier.
- Standardized test results indicate that those wearing the orange glasses had lower performance levels.



Cumulative frequencies of DLMO for both groups (with and without glasses). The Y-axis shows the percentage of students who reached DLMO for the hours of 20:00 to 23:00. Those not wearing the orange glasses reached DLMO earlier than those wearing the glasses.

## Sponsors

U.S. Green Building Council

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