



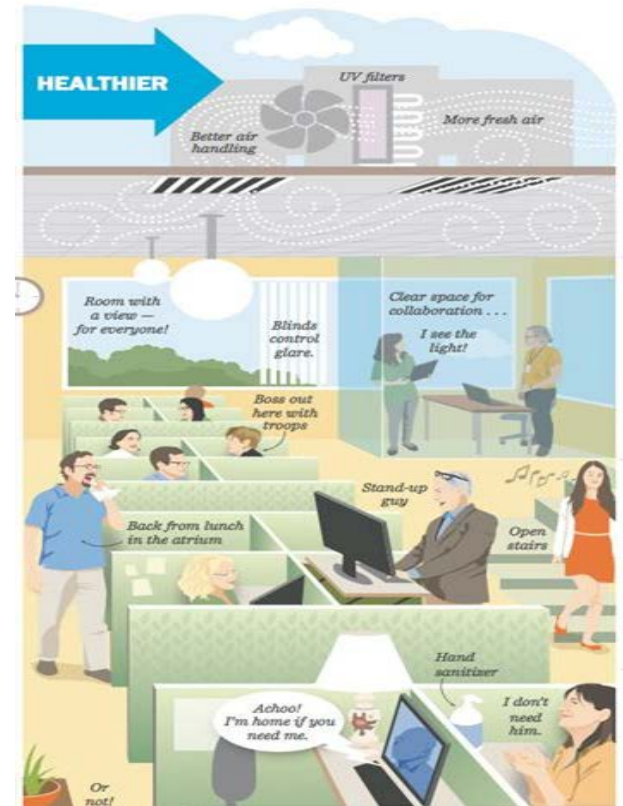
Circadian Light For Your Health



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U.S. General Services Administration

Health in Buildings


How do we Shift our Focus from Risk Avoidance to Health Promotion?



"Are You in an Unhealthy Office Relationship?"
Washington Post, June 2014

Risk Avoidance

Health Promotion

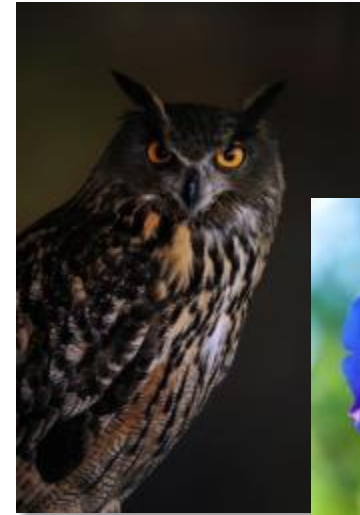


**We know that
daylight can help
light our buildings
and reduce energy.**

**Can it also provide
circadian health
benefits, improving
sleep and daytime
alertness?**

Circadian System

- Plants and animals exhibit patterns of behavioral and physiological changes over an approximately 24-hour cycle that repeat over successive days—these are circadian rhythms
- *circa* = about; *dies* = day



Why is Light So important?

Light reaching the retina has several impacts



Q: Why are we concerned with circadian light?

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A: There is a disconnect between our biology and our modern lifestyle.

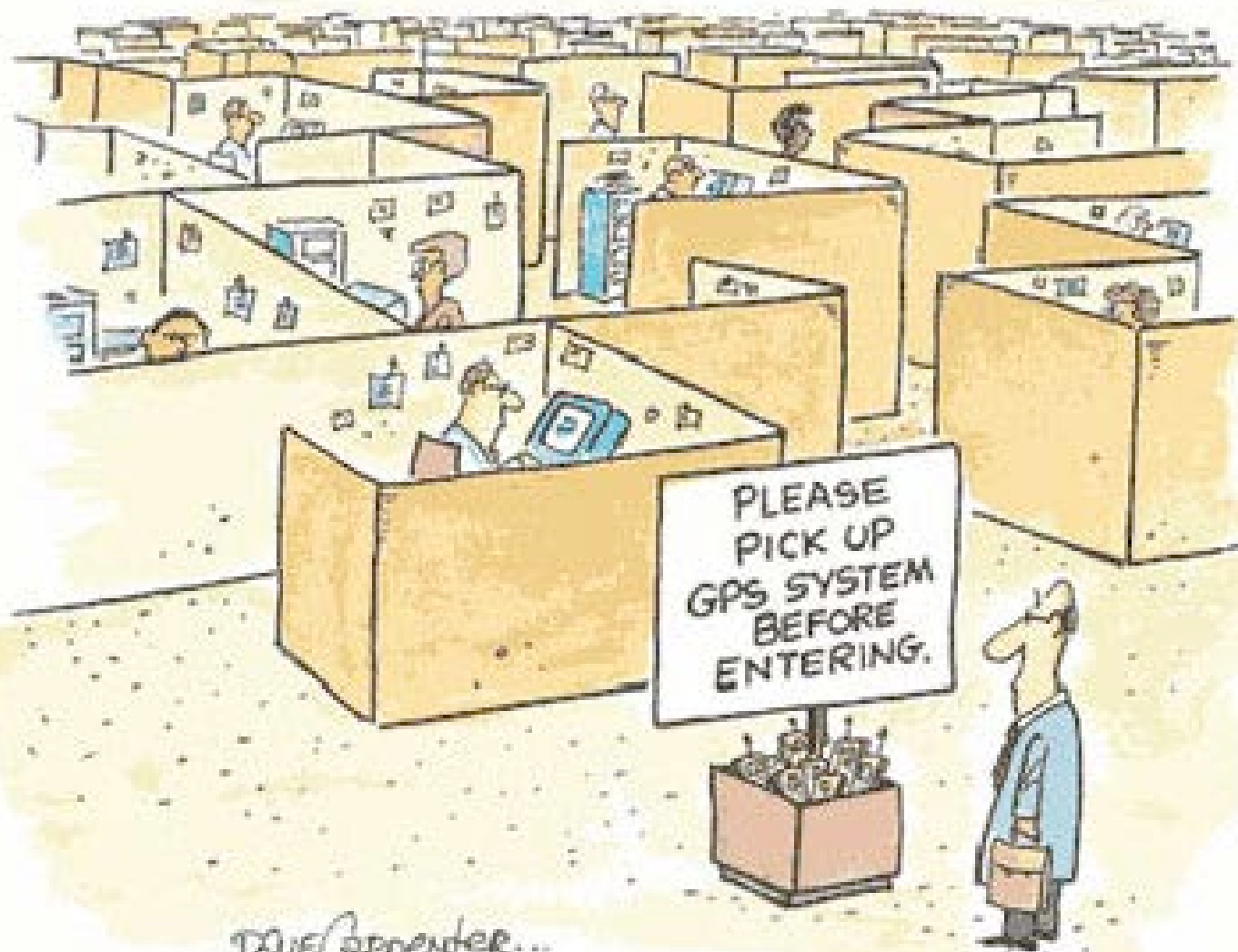
For most of human history, we lived outdoors in a daylight rich world as hunter-gatherers...

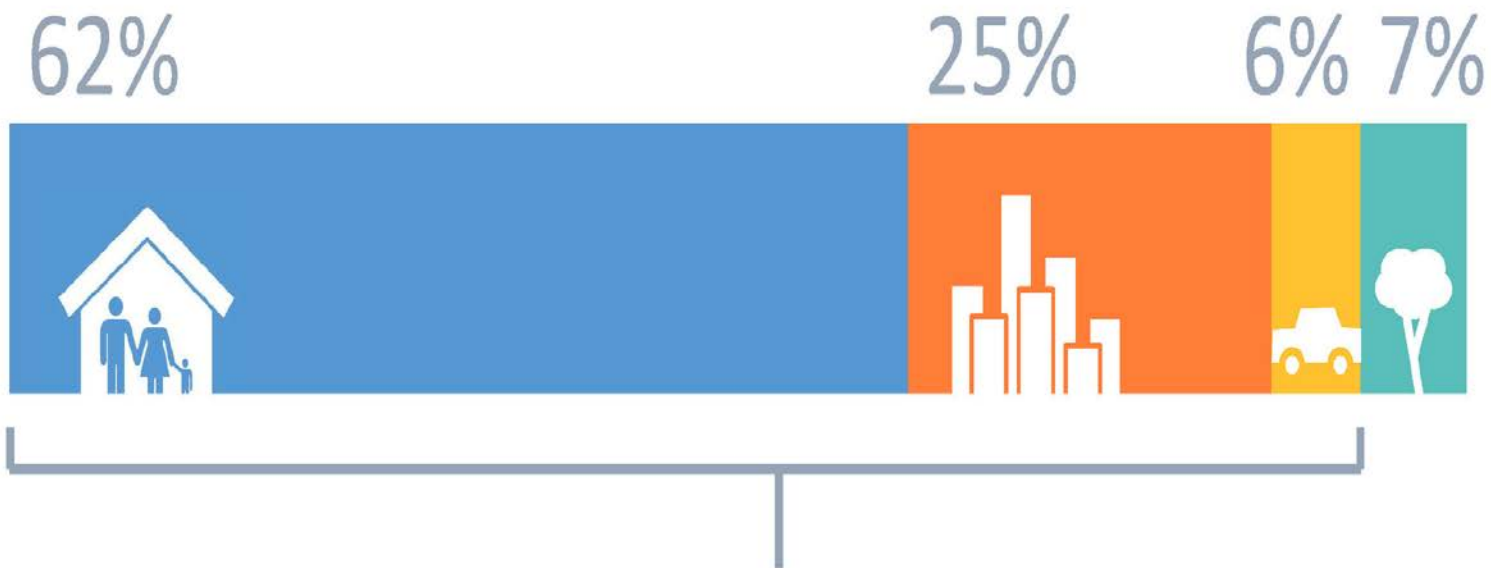


“Someday this will all be done by consultants.”

Tim Birkan

We now live and work indoors most of the day under evolutionarily novel light conditions.





We spend about **93%** of our time indoors

J. Spengler, Harvard School of Public Health, 1983



River Road
Lynchburg
Sta. George/2000 Rg. 2

George Washington
Memorial Parkway
Washington

Exit 43

11550

11550

KBS

43200









What are the
consequences
of this dramatic lifestyle
change?

Later that morning....



Circadian disruption has been associated with:

- Poor sleep
- Higher stress, anxiety and depression
- Increased smoking
- Cardiovascular disease
- Type 2 diabetes

Can we improve
employee health through improved
indoor daylight ?

Study Sites

Phase 1

Buildings designed for max daylight penetration



Typical Federal Buildings



Measurement of light stimulus

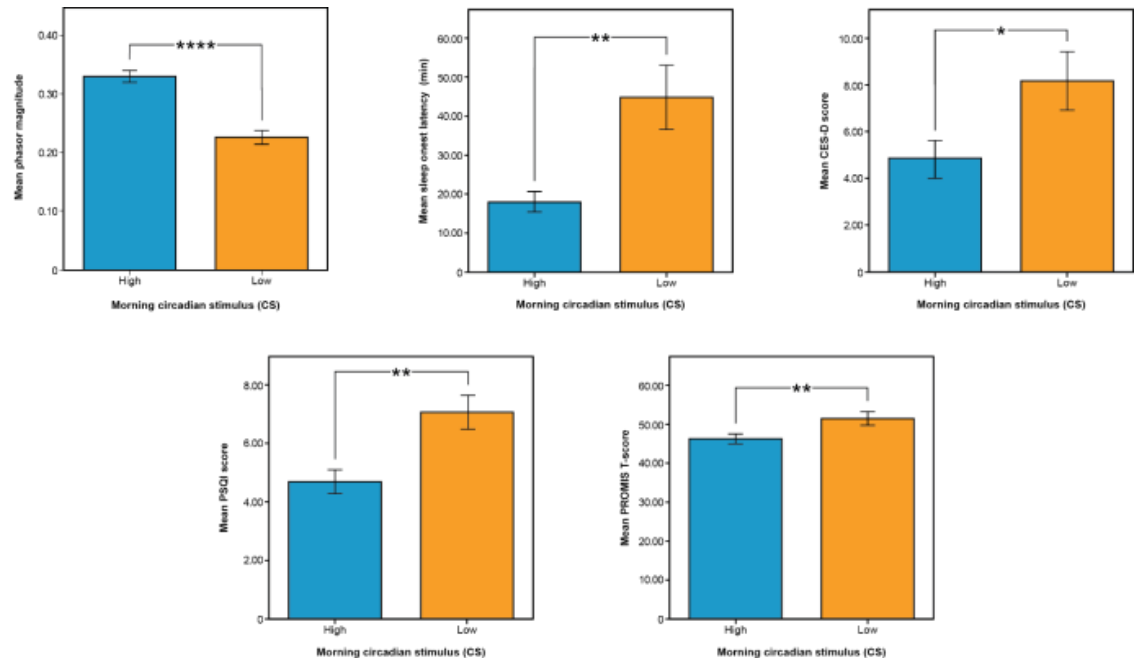
- Developed by Lighting Research Center, Rensselaer Polytechnic Institute
- Calibrated meter that measures circadian light (Daysimeter)
 - From that we can calculate circadian stimulus over the waking period



Phase 1 Findings

Greater circadian stimulus exposures in the morning:

- Participants fell asleep faster at night (by almost 30 min)
- Reported decreased depression
- Reported improved sleep quality

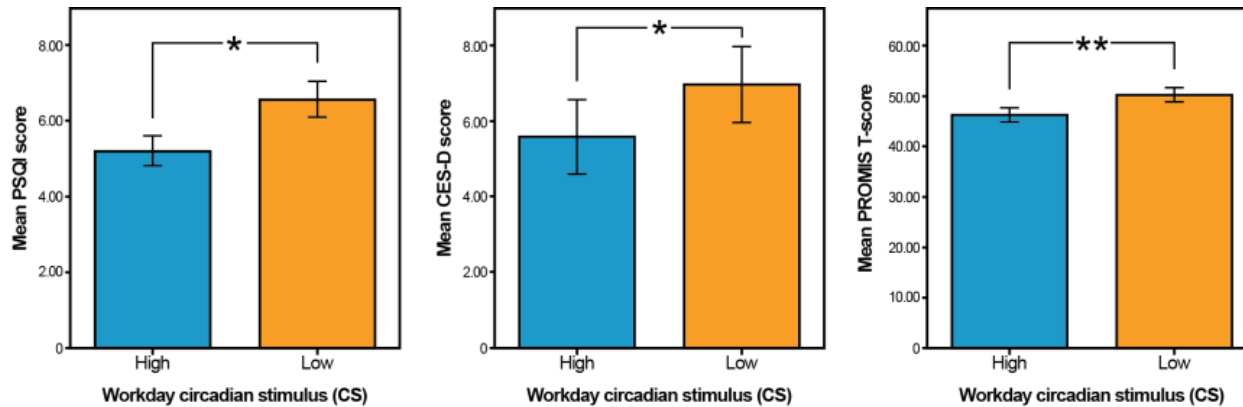


Figureiro M.G., Steverson B., Heerwagen J., Kampschroer K., Hunter C.M., Gonzales K., ... Rea, M.S. (2016). The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health*; In review.

Phase 1 Findings

Those exposed to higher daytime circadian stimulus reported:

- Sleeping better
- Feeling less depressed



Figueiro M.G., Stevenson B., Heerwagen J., Kampschroer K., Hunter C.M., Gonzales K., ... Rea, M.S. (2016). The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health*; In review.

Some Other Observations

1. The benefits of circadian light were slightly better in winter than in summer.
2. Behavior matters - People close shades when it is too bright and leave them closed, reducing indoor daylight
3. Computers are a key driver of shade use and other daylight reducing behaviors
4. Federal employees do not sleep a lot.....
AT ALL
5. **Daylighting alone is insufficient for circadian stimulus in most spaces due to interior design choices and the difficulty in achieving daylight penetration**

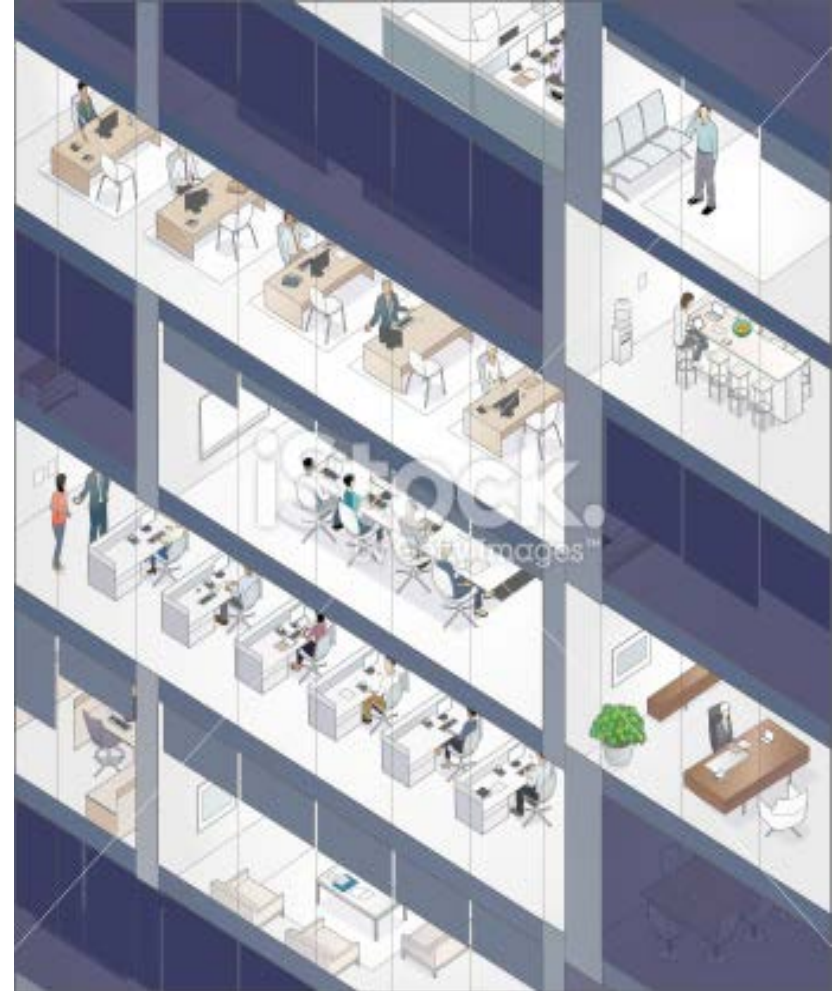


The Daylight Ecosystem

Daylight Design – Windows, Controls, Integration with Electric Light

Interior Design – Furniture, Layout, Colors, Finishes, Computer Ergonomics

Organizational System – Culture, Occupant Behavior, Nature of Work, Reward Structure, Work Technologies



How do we compensate for low daylight?

How do we bring daylight deeper?

Could this be a Lumen Shower space?

Who operates shades?

Where do we put break areas?

How mobile are people?

Should we use daylight maps for layouts?

Who gets the window?



Will adding desktop LEDs yield similar results in workspaces with limited access to daylight?

Creating desktop lighting solutions



Why the desktop?

1. People spend the most time at their desks.
2. When at the desk, they are largely working on their computers – forward vision.
3. Light at the desktop can be designed to have maximum effect – it is more likely to enter the retina and it can be better controlled.

Study Sites

Phase 2



**FHWA - Turner Fairbank
Highway Research Center,
McLean VA**



**White River Junction VA Medical
Center,
White River Junction VT**



**Federal Highway
Administration**



And...

Preliminary results are positive, but analysis still being finalized



Collaboration with U.S. Department of State

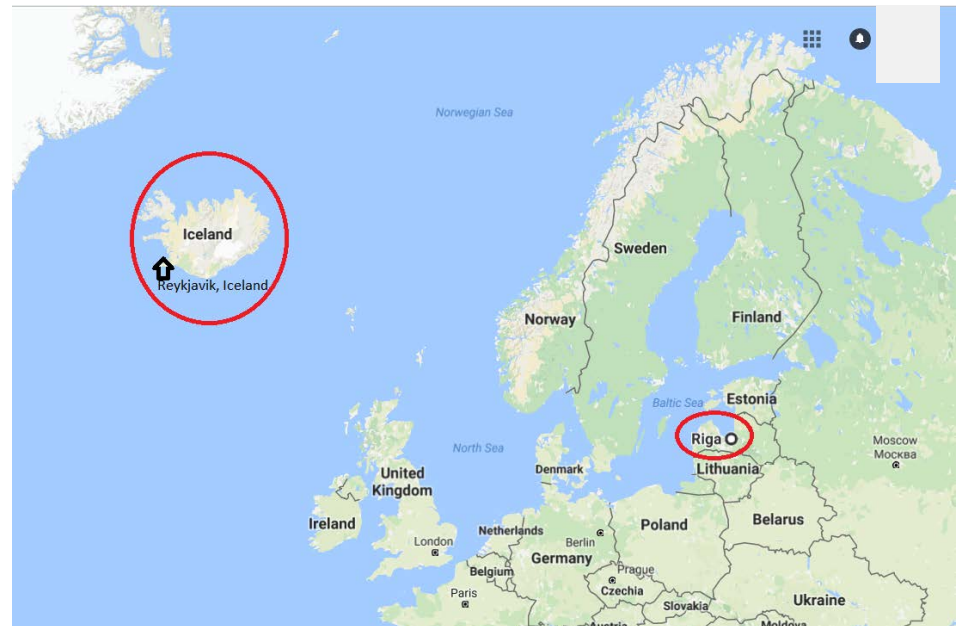
- All secure facilities have fully enclosed artificially lit office spaces
 - Varying amounts of solar access based on worldwide locations and geography
- U.S. Embassy in Riga, Latvia and Reykjavik, Iceland



U.S. Embassy, Riga Latvia



U.S. Embassy, Reykjavik Iceland



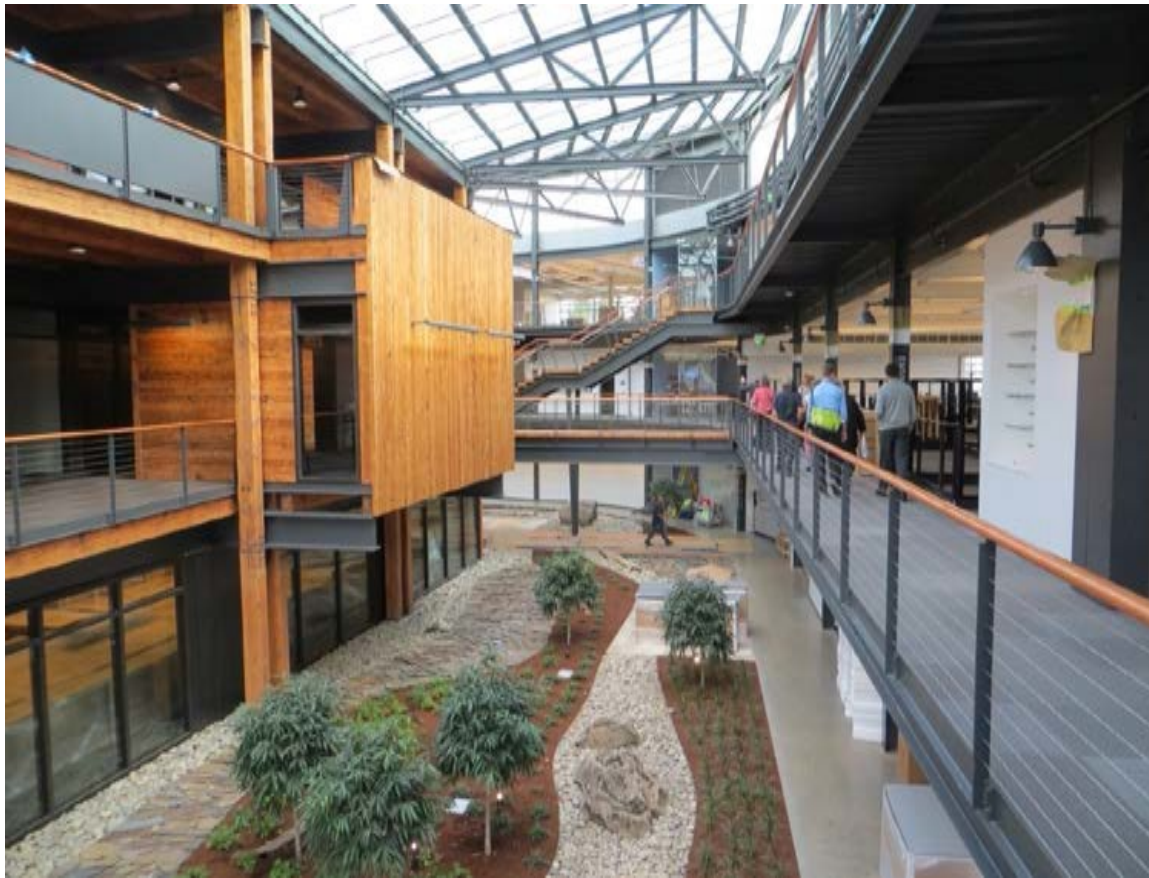
In Summary

- Data shows health benefits associated with increased circadian stimulus during day, especially in the morning
 - Falling asleep faster at night
 - Better sleep quality
 - Better moods
- Daylight penetration not always possible; may need to supplement with additional light sources
 - Must consider the daylight ecosystem

What's Next?

- Publish Results
 - *MG Figueiro and MS Rea. "Office Lighting and Personal Light Exposures in Two Seasons: Impact on Sleep and Mood." Lighting Research and Technology. Vol 48, Issue 3. 2016*
 - Figueiro M.G., Steverson B., Heerwagen J., Kampschroer K., Hunter C.M., Gonzales K., ... Rea, M.S. (2016). "The impact of daytime light exposures on sleep and mood in office workers." *Sleep Health*; In review.
- Leverage other research and create expert consensus around the best evidence for links between buildings and health outcomes
- Translate evidence into building design and operational practices
- Work with standards organizations to integrate health promoting practices into existing building standards.





<http://www.gsa.gov/circadianlight>

Get Light, Mostly Daylight, Morning Best!

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