

# Health and Wellness In The Built Environment – An Introduction

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Charleston, SC



# EDUCATION PARTNER

## Health and Wellness In The Built Environment – An Introduction

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- ❖ Chapter Membership Promotion
- ❖ Chapter Research Promotion
- ❖ Chapter Student Activities
- ❖ Chapter Technology Transfer

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## **Health and Wellness In The Built Environment – An Introduction**

This session introduces emerging, consumer driven trends in the areas of health, wellness and well being in the built environment. The session discusses new research focused on Indoor Environmental Quality and it's potential affects on human occupants. In addition, the session covers how health and wellness requirements are being integrated into new and existing building rating systems and standards. Finally the session concludes with a conversation regarding what ASHRAE's role has been in the past, and what leadership roles we should be taking now and in the future with respect to maintaining and improving thermal comfort, humidity control, indoor air quality, acoustic and lighting comfort within buildings.

# **Learning Objectives**

- 1. Describe a framework for beginning to understanding building health.**
- 2. Apply the framework to current design, construction and operation processes.**
- 3. Recognize issues and challenges unique to addressing health and wellness in buildings.**
- 4. Identify common design and operational pitfalls.**
- 5. Recognize new and existing Building Rating Systems that are based on or have integrated requirements for health and wellness.**

# AGENDA

A Framework for Building Health

Research and Impact

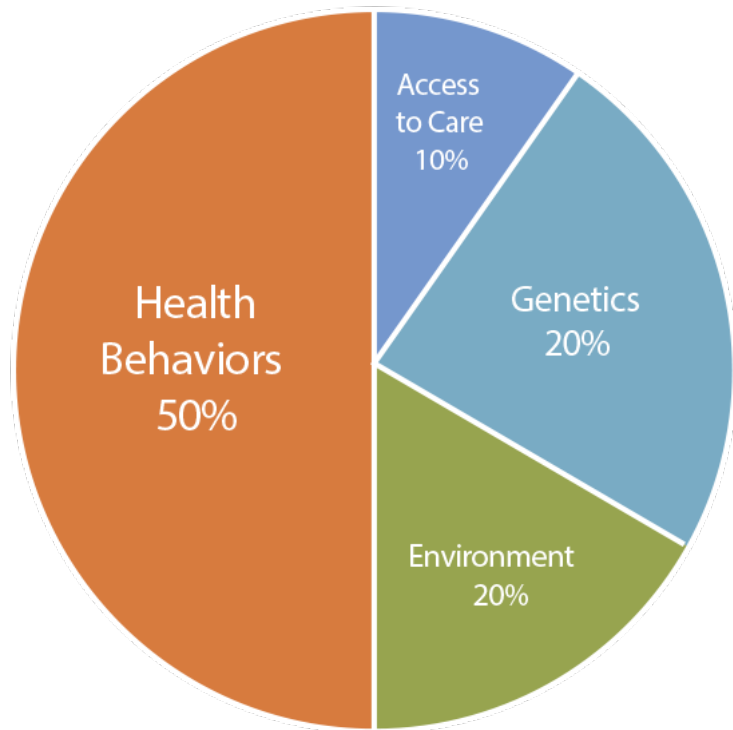
Toxins in Buildings

Ventilation and Air Quality

Lighting and Daylight

Comfort and Productivity

Looking Forward



"The people who are responsible for the design, operation and maintenance of your building may be as important to your overall health as your primary care physician."

Harvard T.H. Chan School of Public Health, 2018  
Center for Health and The Global Environment



 **90%**  
**SALARIES  
& BENEFITS**

**90%** of the costs associated with a building come from the people inside the building – **SALARIES AND BENEFITS.**<sup>2</sup>

 **10%**  
**OPERATING COSTS**

Just **10%** of a building's operating costs are attributed to **ENERGY, MAINTENANCE, MORTGAGE/RENT,** among others.<sup>3</sup>

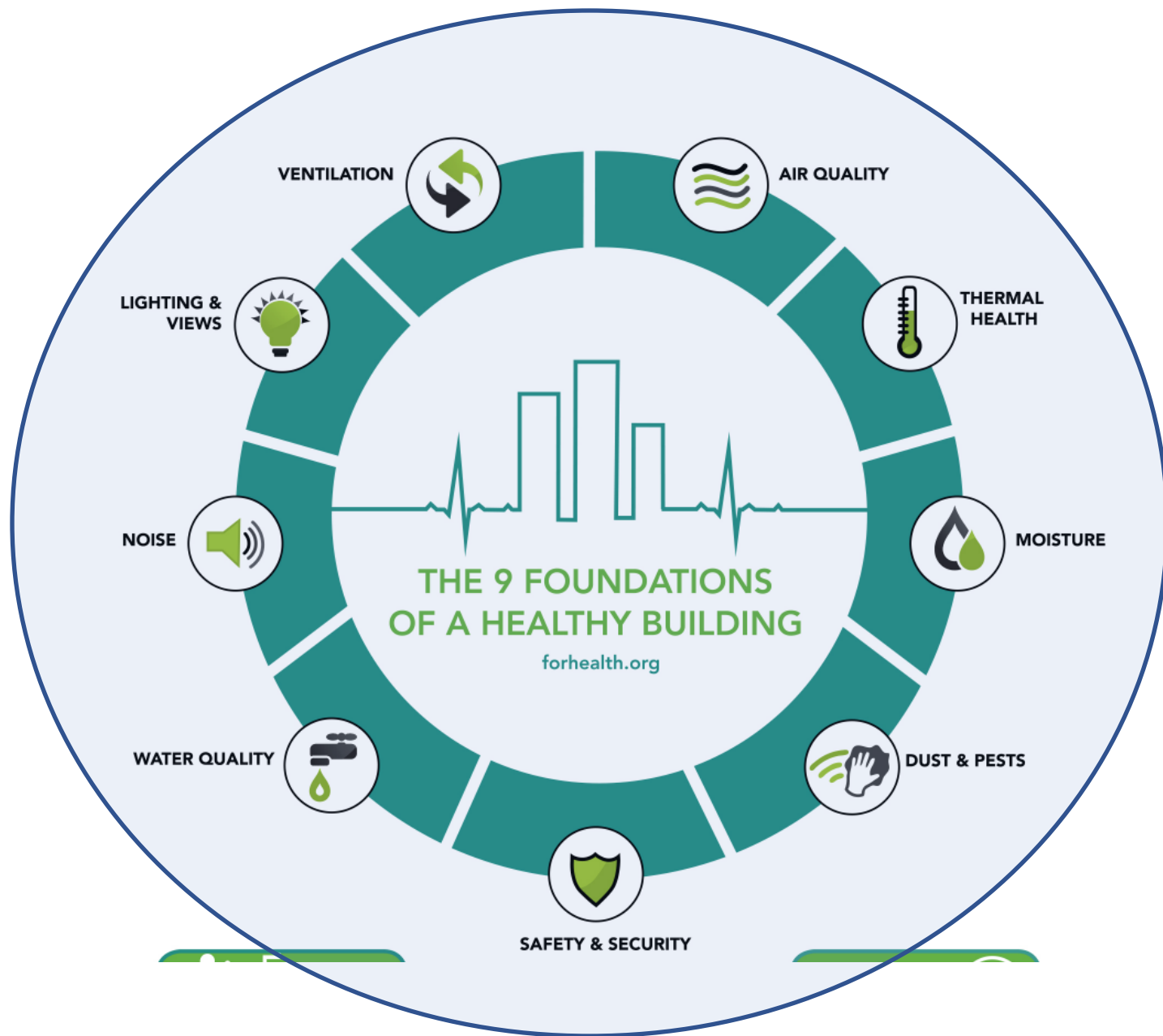
Allen JG, MacNaughton P, Satish U, Santanam S, Vallarino J, Spengler JD. 2015. Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments. Environ Health Perspect DOI: 10.1289/ehp.1510037

Source 2: Center for the Built Environment, University of California, Berkeley (2007). The Impact of Ventilation on Productivity. Retrieved from

<http://www.cbe.Berkeley.edu/research/briefs-ventilation.htm>

Source 3: Terrapin Bright Green, LLC (2012). The Economics of Biophilia. Retrieved from [http://interfacereconnect.com/wp-content/uploads/2012/11/The-Economics-of-Biophilia\\_Terrapin-Bright-Green-2012e\\_1.pdf](http://interfacereconnect.com/wp-content/uploads/2012/11/The-Economics-of-Biophilia_Terrapin-Bright-Green-2012e_1.pdf)

Graphics: <http://naturalleader.com/thecogfxstudy>



# A FRAMEWORK FOR BUILDING HEALTH

## Research and Impact

Toxins in Buildings

Ventilation and Air Quality

Lighting and Daylight

Comfort and Productivity

Looking Forward

# WHY MATERIALS MATTER

“Most people assume that the chemicals we use in our building products have been tested and approved as safe for human health by the US Government.

That is not true.”

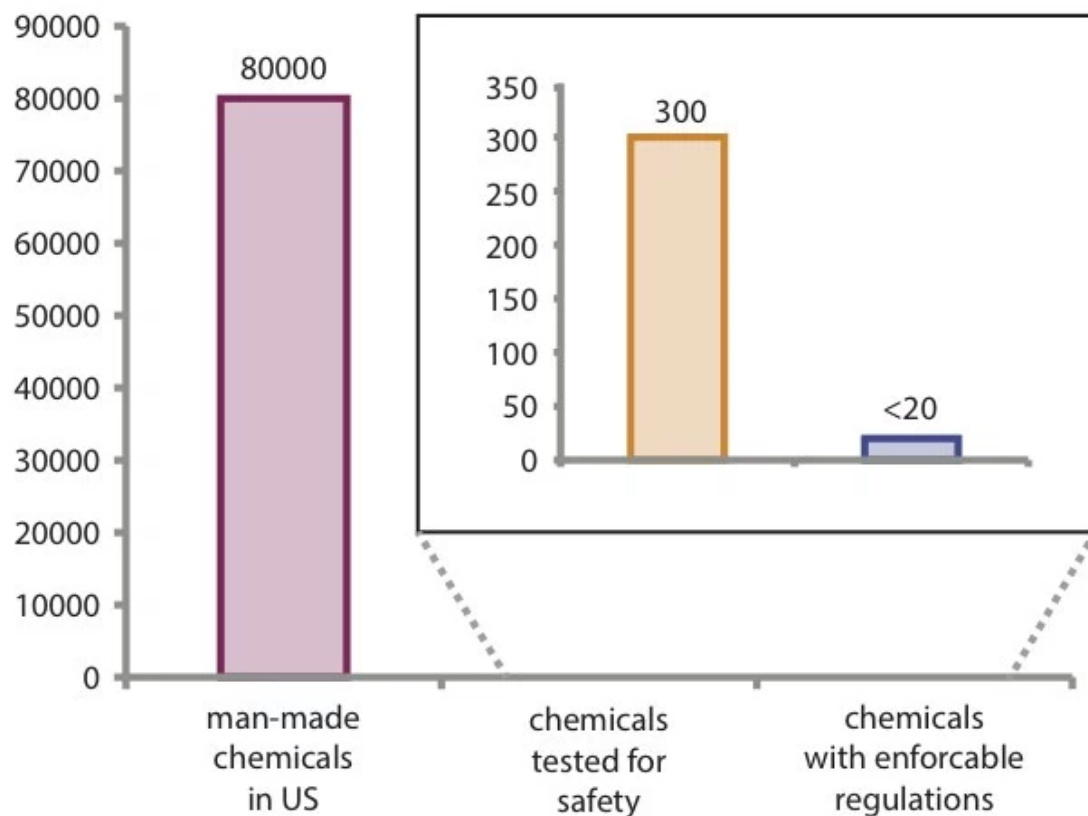


# WHY MATERIALS MATTER

80,000 chemicals used in manufacturing with minimal regulation and oversight.

85% of chemicals in use today have no health data...

67% have no data at all!



# SIX CLASSES OF CHEMICALS TO AVOID

1

Highly  
Fluorinated



2

Antimicrobials



3

Flame  
Retardants



4

Bisphenols  
+ Phthalates



5

Some  
Solvents



6

Certain Metals

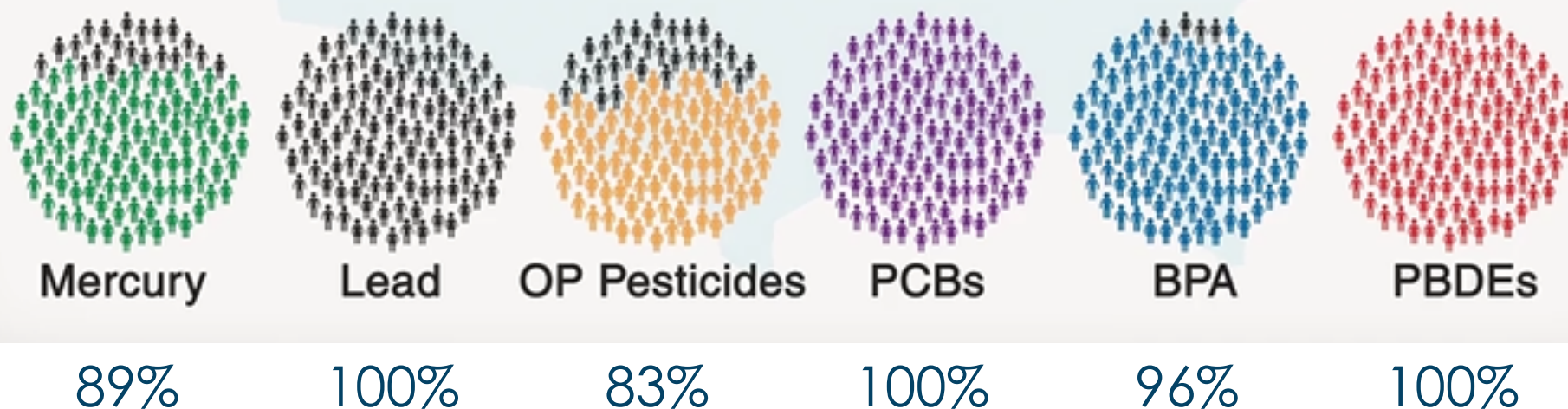


# MANY COMMON BUILDING PRODUCTS CONTAIN TOXINS

An assessment of 102 commonly used building products found 86% contain chemicals that are toxic to mammals.

# TOXINS ARE GETTING INTO OUR BODIES

Percentage of US Children with Detectable Toxin Levels



# EVIDENCE OF LINK BETWEEN TOXINS AND NEGATIVE HEALTH OUTCOMES IS BUILDING RAPIDLY

Exposure to common flame retardant chemicals may increase thyroid problems in women

immediate release: Monday, May 23,



*Proc Natl Acad Sci U S A*. 2010 Nov 23;107(47):20405-10. doi: 10.1073/pnas.1010386107. Epub 2010 Nov 8.

**Bisphenol A impairs the double-strand break repair machinery in the germline and causes chromosome abnormalities.**

Allard P<sup>1</sup>, Colaiácovo MP.

⊕ Author information

## Abstract

Bisphenol A (BPA) is a highly prevalent constituent of many consumer products. It is a known risk of miscarriages in humans. In mice, BPA causes chromosomal lagging and has been partially responsible for the increased risk of miscarriages.

*Environ Health Perspect*; DOI:10.1289/ehp.1510037

**Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments**

Joseph J. Spengler<sup>1</sup>, Joseph J. MacNaughton,<sup>1</sup> Usha Satish,<sup>2</sup> Suresh Santanam,<sup>3</sup> Jose Vallarino,<sup>1</sup> and John D. Spengler<sup>1</sup>

*Environ Health Perspect*. 2005 Apr;113(4):425-30.

**Evidence of interaction between polychlorinated biphenyls and phthalates in relation to human sperm motility.**

Hauser R<sup>1</sup>, Williams P, Altshul L, Calafat AM.

⊕ Author information

## Abstract

Previously, we reported evidence of inverse associations between exposure to some polychlorinated biphenyls (PCBs) and some phthalate monoesters in relation to semen parameters, specifically sperm motility. Because humans are exposed to both phthalates and PCBs and because

ase, and an increased molecular pathways is at internal

# IN SOME INSTANCES THE TOXINS DO NOT EVEN WORK!

“No evidence that flame retardants in home furniture, baby products, and some other consumer products improve fire safety.”

- Chicago Tribune

**Chicago Tribune**  
QUESTIONS? CALL 1-800-TRIBUNE      SUNDAY, MAY 6, 2012      BREAKING NEWS AT CHICAGOTRIBUNE.COM

**TRIBUNE WATCHDOG**

## Playing with fire

A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.

BY PATRICIA CALLAHAN AND SAM ROSE  
Tribune reporters

**D**r. David Heinrich knows how to tell a story. Before California lawmakers last year, the noted burn surgeon drew gasps from the crowd as he described a 7-week-old baby girl who was burned in a fire started by a candle while she lay on a pillow that lacked flame retardant chemicals.

"Now this is a tiny little person, no bigger than my Italian greyhound at home," said Heinrich, gesturing to approximate the baby's size. "Half of her body was severely burned. She ultimately died after about three weeks of pain and misery in the hospital."

Heinrich's passionate testimony about the baby's death made the long-term health concerns about flame retardants voiced by doctors, environmentalists and even firefighters sound abstract and petty.

But there was a problem with his testimony: It wasn't true. Records show there was no dangerous pillow or candle fire. The baby he described didn't exist.

Neither did the 9-week-old patient who Heinrich told California legislators died in a candle fire in 2009. Nor did the 6-week-old patient who he told Alaska lawmakers was fatally burned in her crib in 2010.

Heinrich is not just a prominent burn doctor. He is a star witness for the manufacturers of flame retardants.

His testimony, the Tribune found, is part of a decades-long campaign of deception that has loaded the furniture and electronics in American homes with pounds of toxic chemicals linked to cancer, neurological deficits, developmental problems and impaired fertility.

The tactics started with Big Tobacco, which wanted to shift focus away from cigarettes as the cause of fire deaths, and continued as chemical companies worked to preserve a lucrative market for their products, according to a Tribune review of thousands of government, scientific and internal industry

ashed the public's fear of fire and helped organize and steer an association of top fire officials that spent more than a decade campaigning for their cause.

Today, scientists know that some flame retardants escape from household products and settle in dust. That's why toddlers, who play on the floor and put things in their mouths, generally have far higher levels of these chemicals in their bodies than their parents.

Blood levels of certain widely used flame retardants doubled in adults every two to five years between 2070 and 2004, like recent studies show levels haven't declined in the U.S. even though some of the chemicals have been pulled from the market. A typical American baby is born with the highest recorded concentrations of flame retardant among infants in the world.

People might be willing to accept the health risks if the





# EASY WAYS TO MAKE A DIFFERENCE!

## **Wash your hands!**

Many exposure pathways from buildings are 'hand to mouth', so washing

Don't use antimicrobial soaps unless you're in a hospital or other very sensitive environment or have no other options.

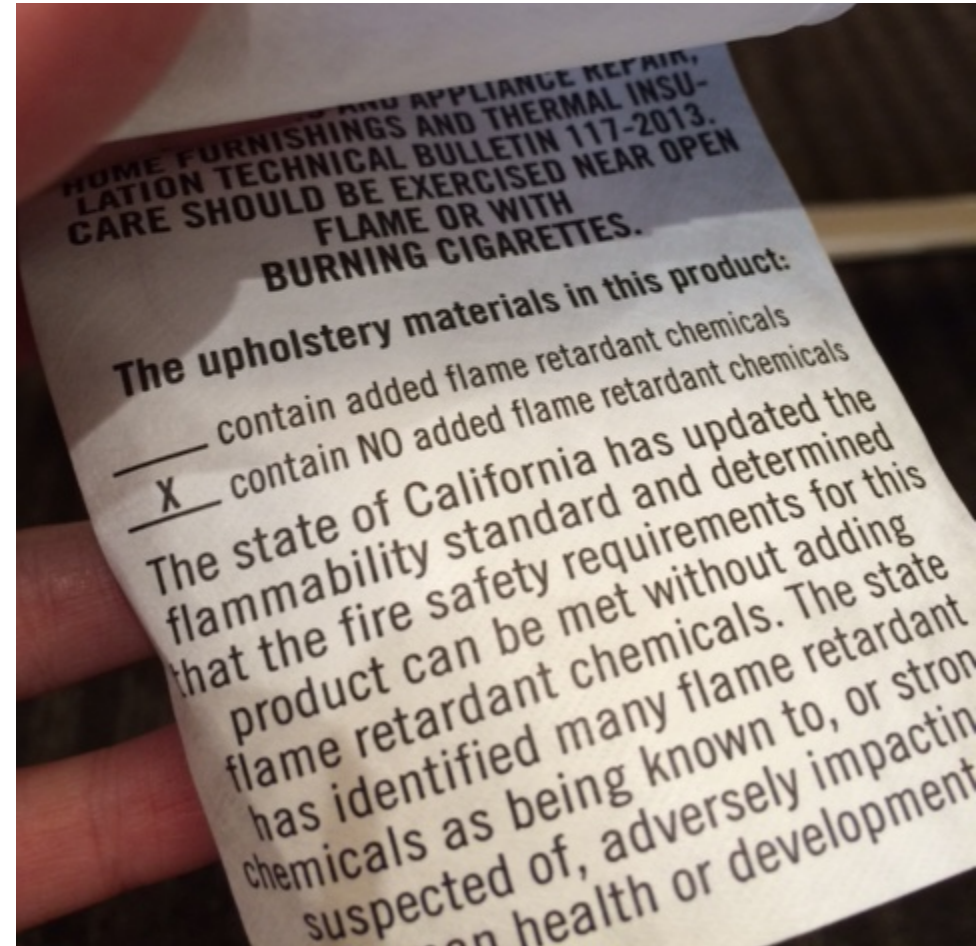


# EASY WAYS TO MAKE A DIFFERENCE!

## Buy Flame Retardant Free Furniture

It's now possible to purchase furniture that is 100% free of chemical flame retardants, but you must check the label!

Look for “Technical Bulletin 117-2013” compliance with “NO added flame retardant chemicals.”







Choose the type of product you are looking for



Flooring



Paint



Drywall

HomeFree is an easy to use, designed for the public resource that translates extensive research into simple guidance for common building products operated by the Healthy Building Network. The emphasis is finding healthy solutions that work for affordable housing projects with no cost premiums.

HBN also has much more detailed tools/research available for use by the Architect/Engineering community (e.g. Pharaos)

# A FRAMEWORK FOR BUILDING HEALTH

## Research and Impact

Toxins in Buildings

Ventilation and Air Quality

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# INDOOR AIR QUALITY AND HEALTH

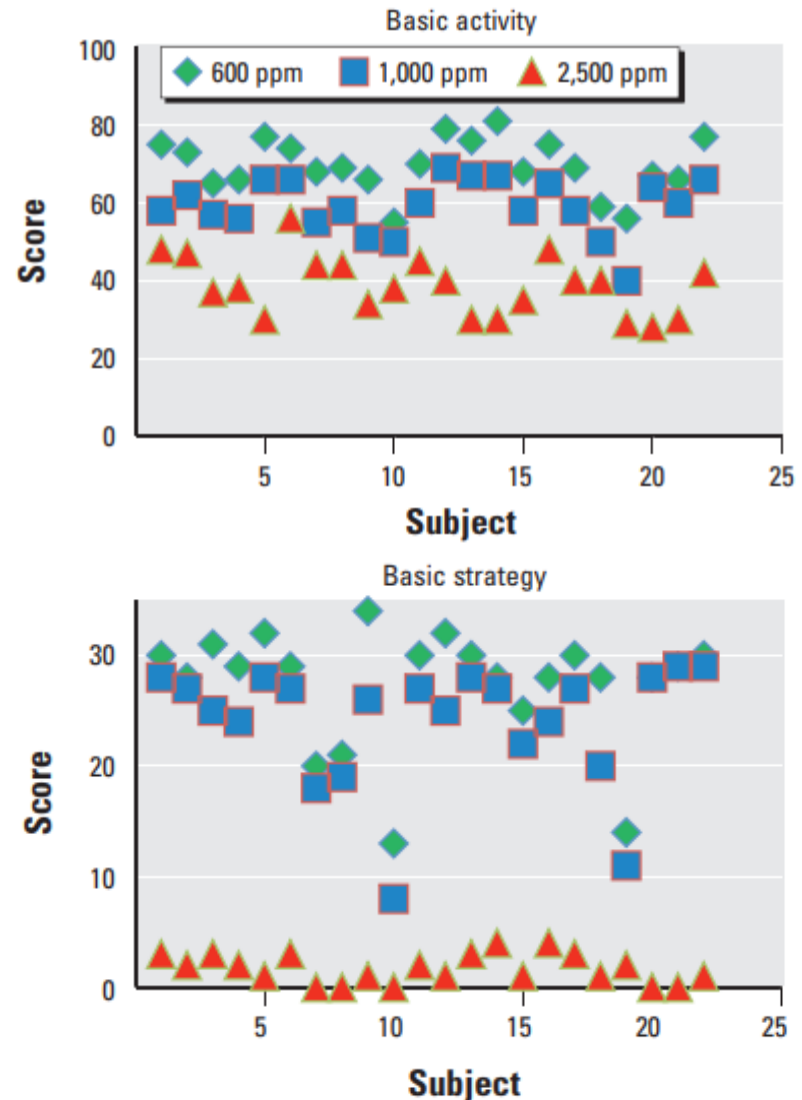
## Summary of Respiratory Illness Studies

INTERVENTION	NO. OF STUDIES	POPULATIONS	HEALTH IMPROVEMENTS
More ventilation	3	Army Recruits Students Office Workers	33%–41% less respiratory illness 15% less absence (1 study)
More space per occupant	2	Antarctic Scientists Office Workers	17%–50% less respiratory/ cold illness
More ventilation and more space	2	Nursing Home Residents Prisoners	49%–76% less flu or respiratory illness
Ultraviolet radiation of air	1	Navy Recruits	23% less respiratory illness
Air- conditioned vs. non air- conditioned	1	Armed Forces Troops	16%–27% less cold symptoms
Mold vs. no mold in residence	1	Apartment Dwellers	54% less respiratory illness

# AIR QUALITY AND VENTILATION

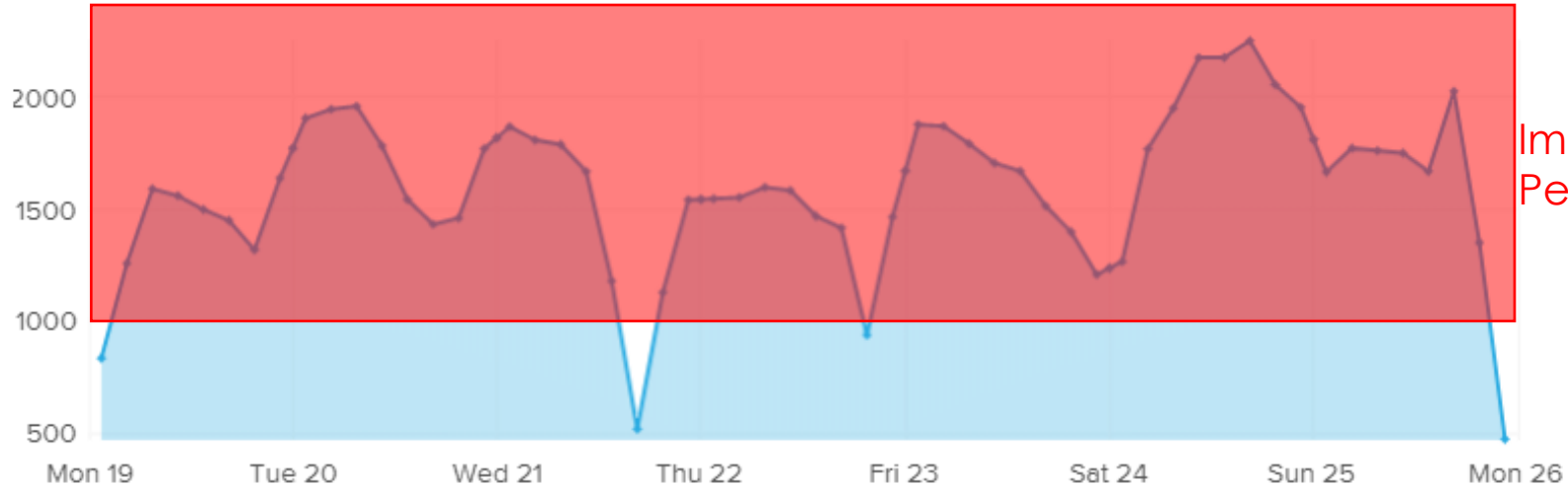
Recent research is finding that CO<sub>2</sub>, in addition to contributing to climate change, also can inhibit performance at concentrations previously deemed innocuous:

- 1,000 ppm levels found “significant decrements in six of nine scales of decision making performance.”
- 2,500 ppm levels found seven scales with decreased performance and even larger effects.



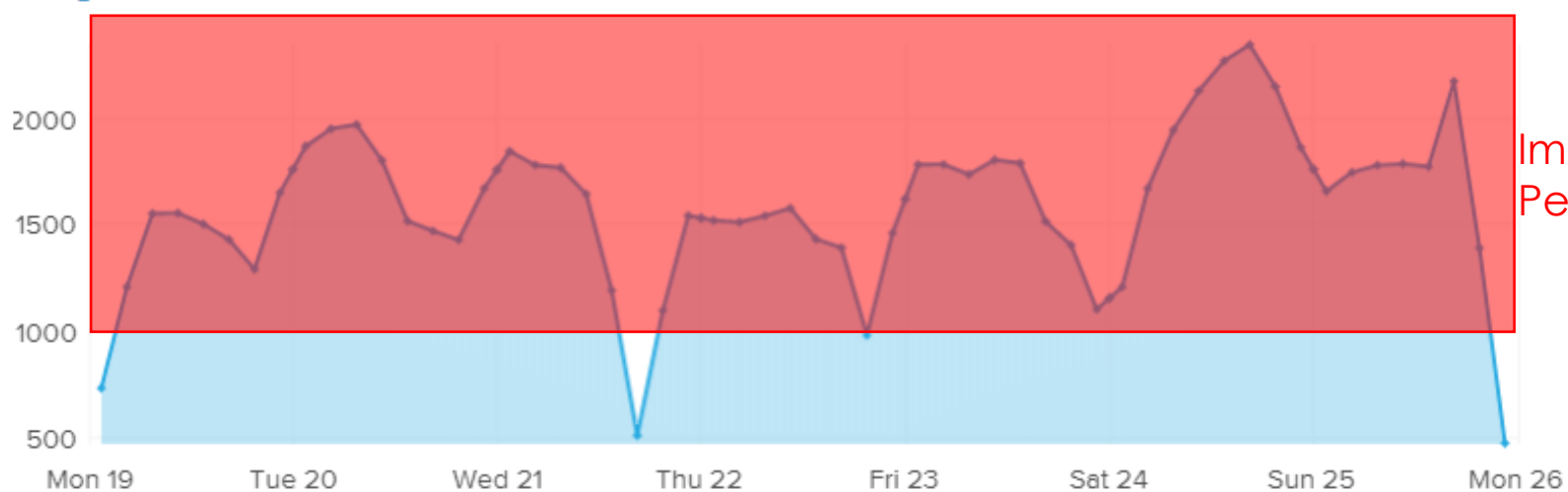
# CO<sub>2</sub> LEVELS AT HOME – JUNE 2017

CO<sub>2</sub> - LIVING ROOM



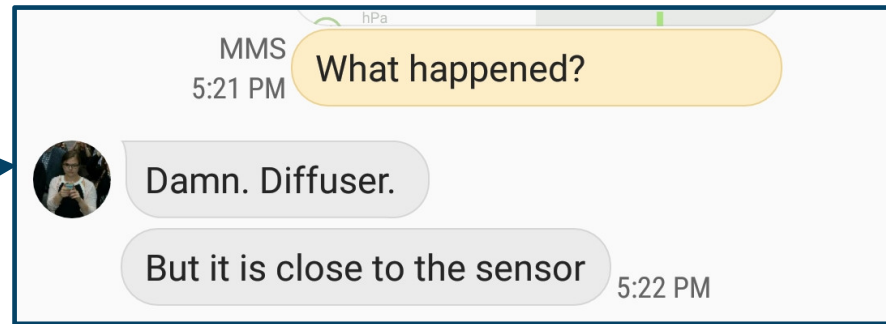
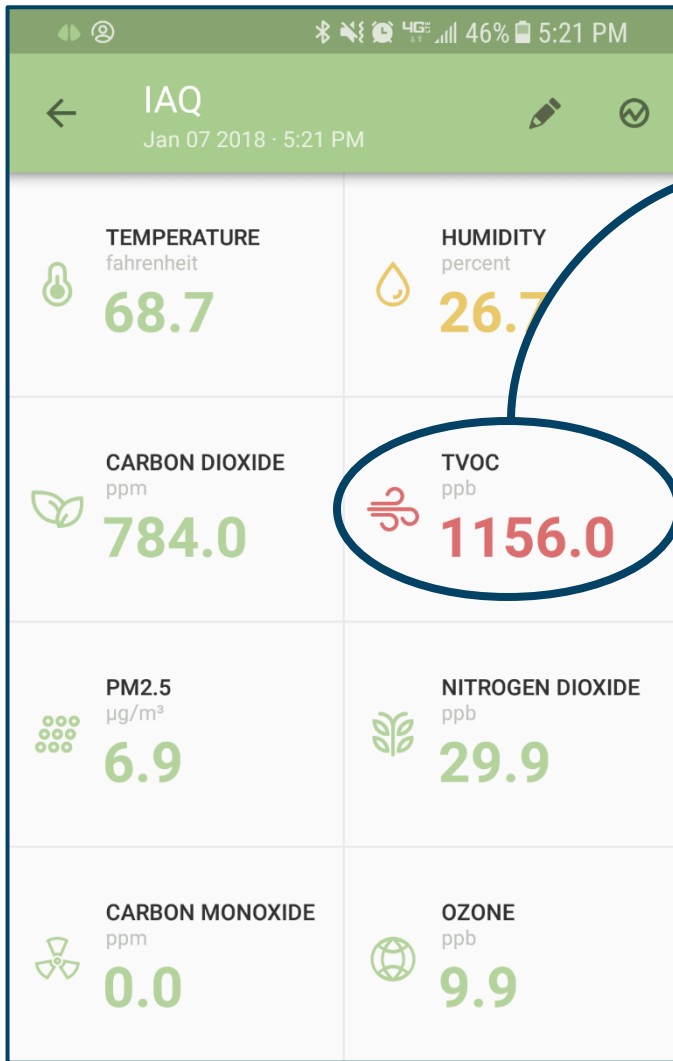
Impaired Performance

CO<sub>2</sub> - BEDROOM



Impaired Performance

# LEARNING FROM SENSORS!



# EASY STUFF THAT MAKES A DIFFERENCE!

## SPIDER PLANT -

filters out formaldehyde, xylene, and toluene



## GOLDEN POTHOS -

filters out benzene, formaldehyde, trichloroethylene, xylene, and toluene



## PEACE LILY -

filters out benzene, formaldehyde, trichloroethylene, xylene, toluene, and ammonia



## MOTHER-IN-LAW'S TONGUE -

filters out benzene, formaldehyde, trichloroethylene, xylene, and toluene



## ALOE VERA -

filters out benzene, and formaldehyde, and converts CO<sub>2</sub> to O<sub>2</sub> during the night instead of the day – Put one in your bedroom!









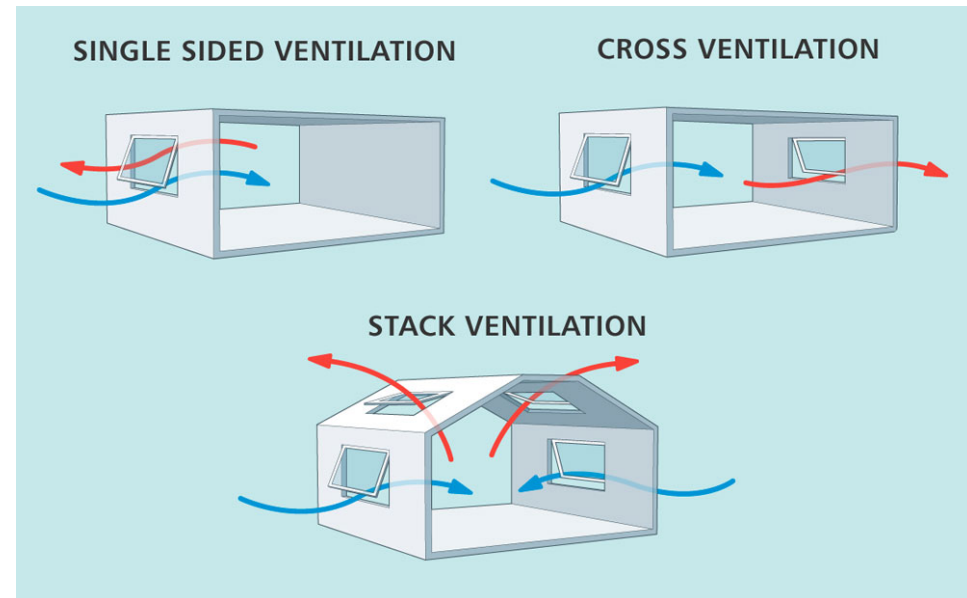
# EASY STUFF THAT MAKES A DIFFERENCE!

## Use your windows!

Most residences do not have ventilation systems (i.e. your home air conditioner is likely not providing any fresh air).

Commercial buildings are more likely to have ventilation, but if your window works, use it!

Many home monitors are now available for \$100-\$300 that could alert you when fresh air is needed.



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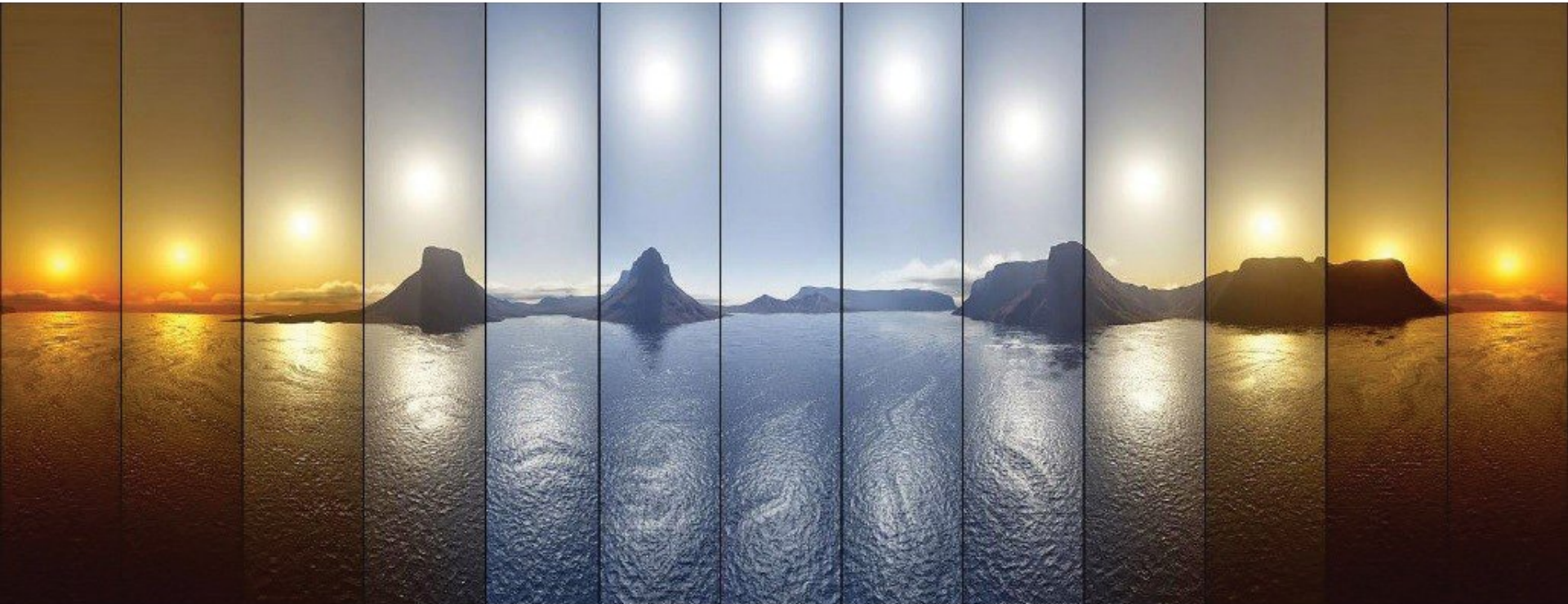
Comfort and Productivity

Looking Forward

# IMPACT OF DAYLIGHT EXPOSURE

The positive impacts of daylighting in commercial, educational, and residential spaces has been validated by research with a consistency and

# LIGHTING



Research is showing that the light reaching our eyes affects sleep cycles, alertness, concentration, mood, productivity and cognitive processing.

Lighting that does not match natural cycles can negatively affect all of the issues listed above.

# LIGHTING INFLUENCES PRODUCTIVITY

Evening exposure to blue-wavelength light:

- Causes suppression of melatonin
- Delays the timing of circadian rhythms
- Elevates alertness

All of the above make it harder to fall and stay asleep, resulting in poor performance over time.

**A CBRE study found a 12% improvement on a productivity test for people in spaces with circadian lighting.**

# SIMPLE SOLUTIONS

## Circadian Lighting

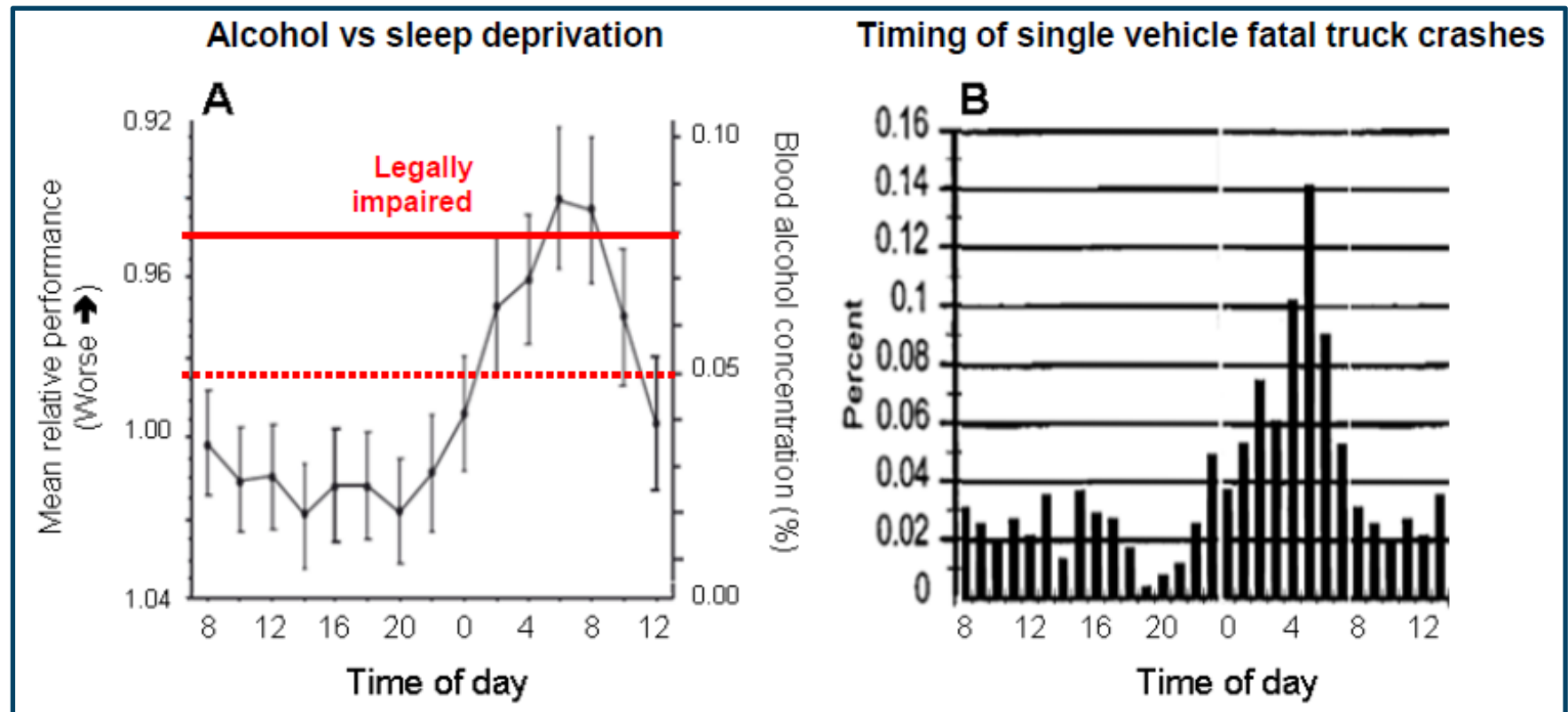
Many free and low cost strategies exist that enhance exposure to blue-wavelength lighting during the day and decreases this exposure during the evening:

- FREE - Enable phone and computer day/night settings
- FREE - Remove blue LEDs from the bedroom (e.g. alarm clocks)
- Purchase lamps that are tuned to day/night settings.



# LIGHTING AND SLEEP

Evening exposure to “bedside lamps, TVs, computer screens, tablets and other devices, causes suppression of melatonin, delays the timing of circadian rhythms, and elevates alertness, all of which make it harder to fall asleep, harder to wake up in the morning and restricts sleep.”<sup>1</sup>



Source 1: Stevens, Richard G. et al. "Breast Cancer and Circadian Disruption from Electric Lighting in the Modern World". CA Cancer J Clin. 2014 May;

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4038658/>

Image Source: Steven W. Lockley, Ph.D., Associate Professor of Medicine, Harvard Medical School referencing (A) Dawson and Reid, Nature 1997 and (B) Federal Motor Carrier Safety Administration, 2000

# EASY STUFF THAT MAKES A DIFFERENCE!

## Circadian Lighting

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# A FRAMEWORK FOR BUILDING HEALTH

## Research and Impact

Toxins in Buildings

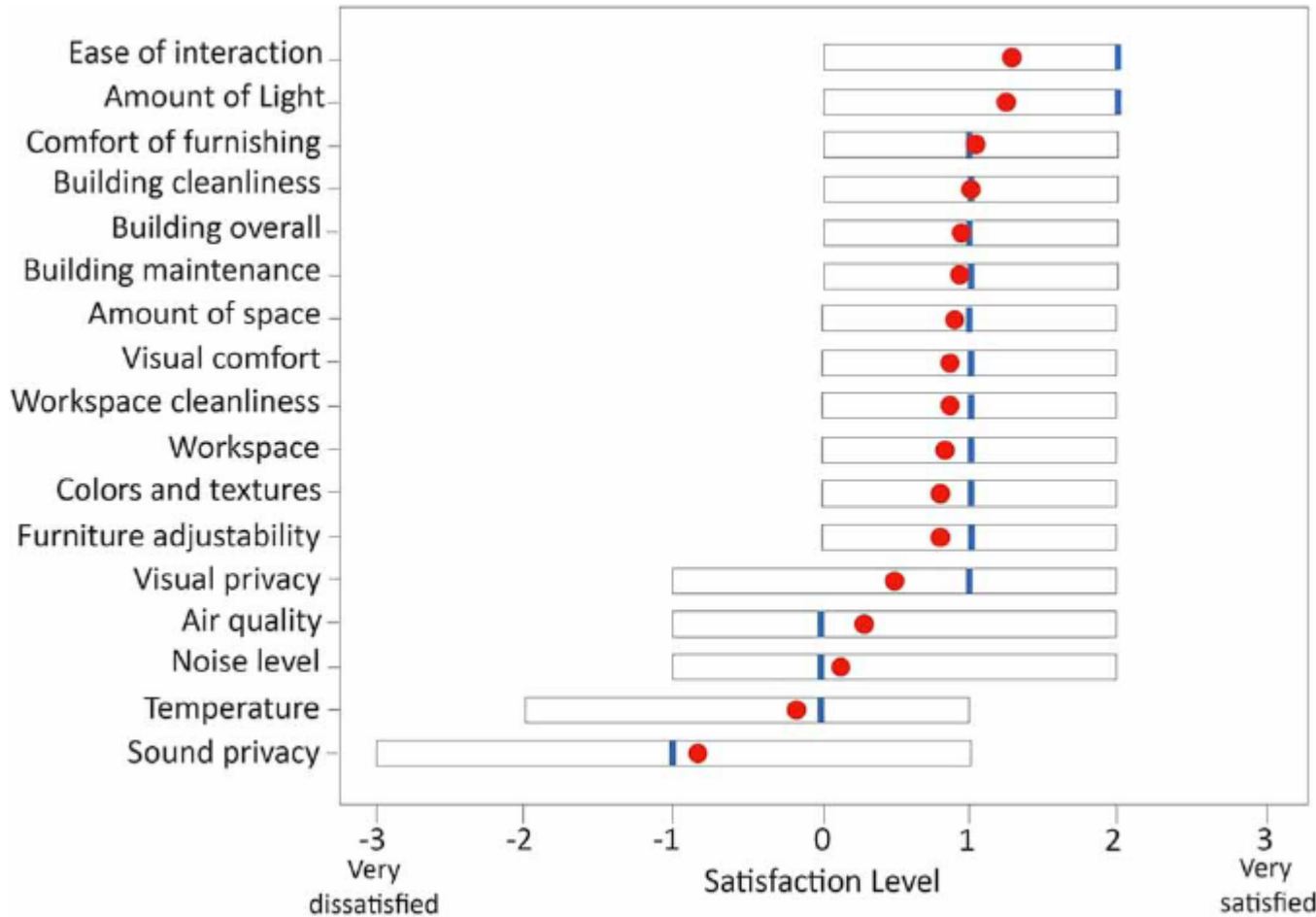
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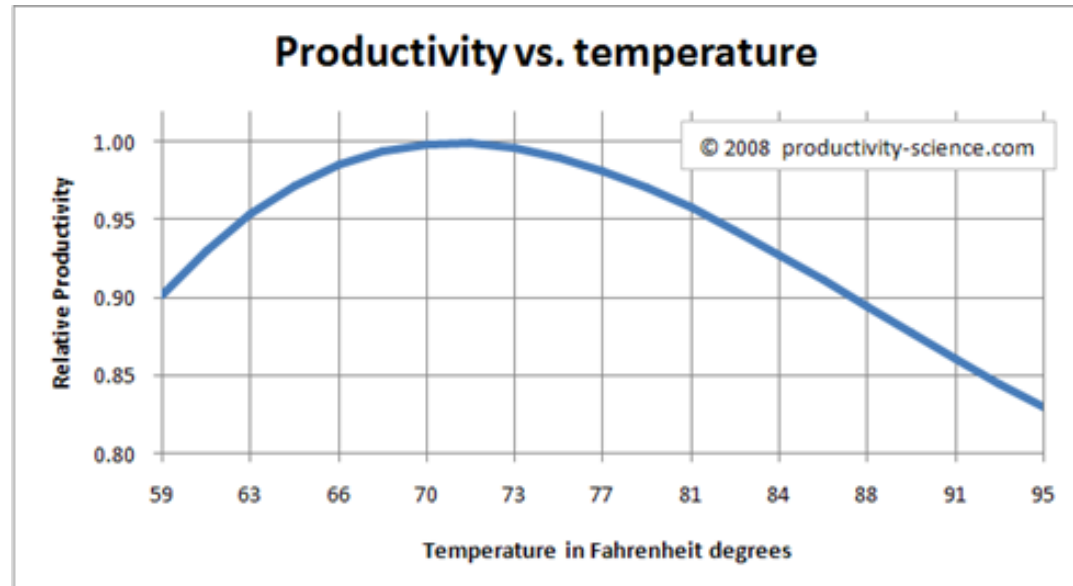
# COMFORT



A surveys of over 351 buildings with a combined 53,000 occupants found widespread discomfort, with sound/noise, temperature, and air quality showing the highest levels of dissatisfaction.

# TEMPERATURE

Increasing office temps from ~72°F to 87°F reduced performance on common workplace tasks by 10%.



Source: Seppanen, O., Fisk, W.J., & Lei, Q.H. 2006. Effect of temperature on task performance in office environment. Report LBNL-60946. Helsinki University of Technology, 1-9.

Image Source: <http://www.crockett-facilities.com/blog/how-your-hvac-system-can-impact-office-productivity/>

# NOISE

A survey of US Hospitals determined that noise complaints outnumber all others 2 to 1!  
Additional research found that noise leads to the following negative outcomes:

Disturbs patient rest	Decreases oxygen saturation in the blood	Elevates blood pressure in newborns	Increases heart rates in newborns	Reduces quality of sleep
Slows wound healing	Increases pulse amplitudes	Increases length of stay	Increased medication required	Reduces patient satisfaction
Fosters negative perceptions of patient comfort	Increases respiratory rates in newborns	Amplifies exhaustion and burnout of staff	Increases pressure and stress on staff	Increases levels of re-hospitalization

Source (Survey): Feck, Doug and Gary Vance. "Mind the Gap!" Healthcare Design. March 2008.

Source (Table): Anjali Joseph and Roger Ulrich. 2007. "Sound Control for Improved Outcomes in Healthcare Settings" The Center for Health Design.

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If we work to reduce risk factors for health and well-being, Charleston could save \$543 million in healthcare costs in 20 years.



# BLUE ZONES PROJECT OVERVIEW



## 42 COMMUNITIES

in nine states are currently involved in the Blue Zones Project.

There are

**1,685** participating organizations.

Previous Blue Zones initiatives have successfully lowered childhood obesity by **50 PERCENT.**

An estimated **2,250,000** lives have been impacted to date.

Based on **NINE** different pillars for longevity:  
**THE POWER 9.**

Charleston would be the **FIRST** Blue Zones Project on the East Coast.



# CONSUMERS MUST LEAD IN DEMANDING TOXIN-FREE PRODUCTS



The Healthier Hospitals Initiative has leveraged Safer Chemical Commitments from many large healthcare providers including MUSC, Tenet, HCA, and Bon Secours St. Francis.



Google developed a materials construction program that rewards manufacturers who provide product transparency and red-list chemical reductions.



IKEA has made many commitments to reduce the use of toxic substances in their furniture, including either limited (code-related) or full bans on Bisphenol A, brominated flame retardants, PVC, formaldehyde, and heavy metals.



# HEALTH IN BUILDING RATING SYSTEMS



Building rating systems are increasing focus on health and productivity. LEED and the Living Building Challenge feature health requirements as part of their standards.

Two new systems, WELL and Fitwel, that focus *exclusively* on health and well-being.

# WELL RATING SYSTEM



## AIR

14 FEATURES  
4 preconditions  
10 optimizations



## WATER

8 FEATURES  
3 preconditions  
5 optimizations



## NOURISHMENT

13 FEATURES  
2 preconditions  
11 optimizations



## LIGHT

8 FEATURES  
2 preconditions  
6 optimizations



## MOVEMENT

12 FEATURES  
2 preconditions  
10 optimizations



## THERMAL COMFORT

7 FEATURES  
1 precondition  
6 optimizations



## SOUND

5 FEATURES  
1 precondition  
4 optimizations



## MATERIALS

14 FEATURES  
3 preconditions  
11 optimizations



## MIND

15 FEATURES  
2 preconditions  
13 optimizations



## COMMUNITY

16 FEATURES  
3 preconditions  
13 optimizations

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# BUILDING HEALTH SERVICES

- Air Quality Testing
- Water Quality Testing
- Ventilation Testing and Balancing
- Building Retro-Commissioning
- Material Transparency Specifications and Policies
- Building Certifications



# WHAT SHOULD ASHRAE BE DOING

Open Discussion On:

- Collaborative Research
- Committees
- Position Documents
- Standards
- Guidelines
- Training
- Certification
- Advocacy

“We are all healthcare providers.”

- Joe Allen, Harvard T.H. Chan School of Public Health

# Q & A

