

Health and Wellness In The Built Environment – An Introduction

Presented By:

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Charleston, SC

Presented To:

CIBSE

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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 its 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

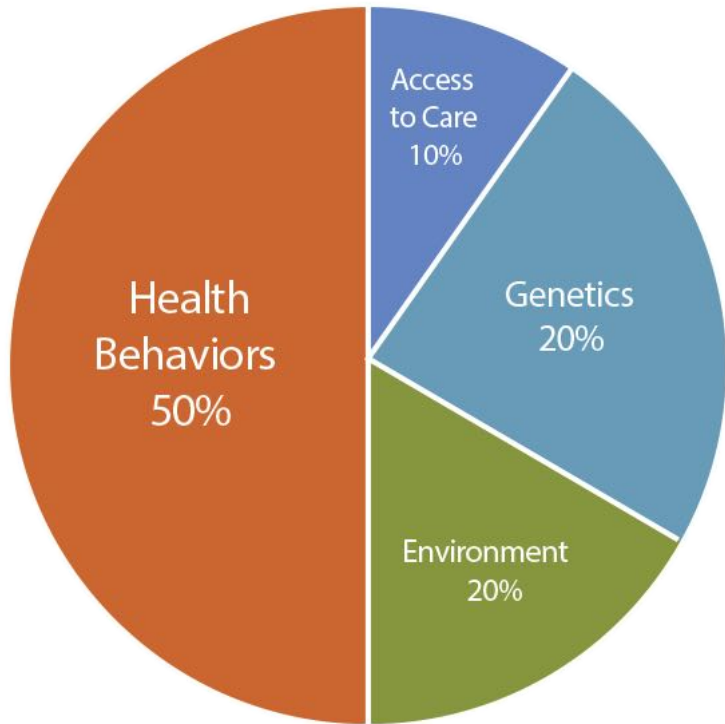
Toxins in Buildings

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.**²

 **10%**

OPERATING COSTS

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

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-](http://interfacereconnect.com/wp-content/uploads/2012/11/The-Economics-of-Biophilia_Terrapin-Bright-Green-2012e_1.pdf)

[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

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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.

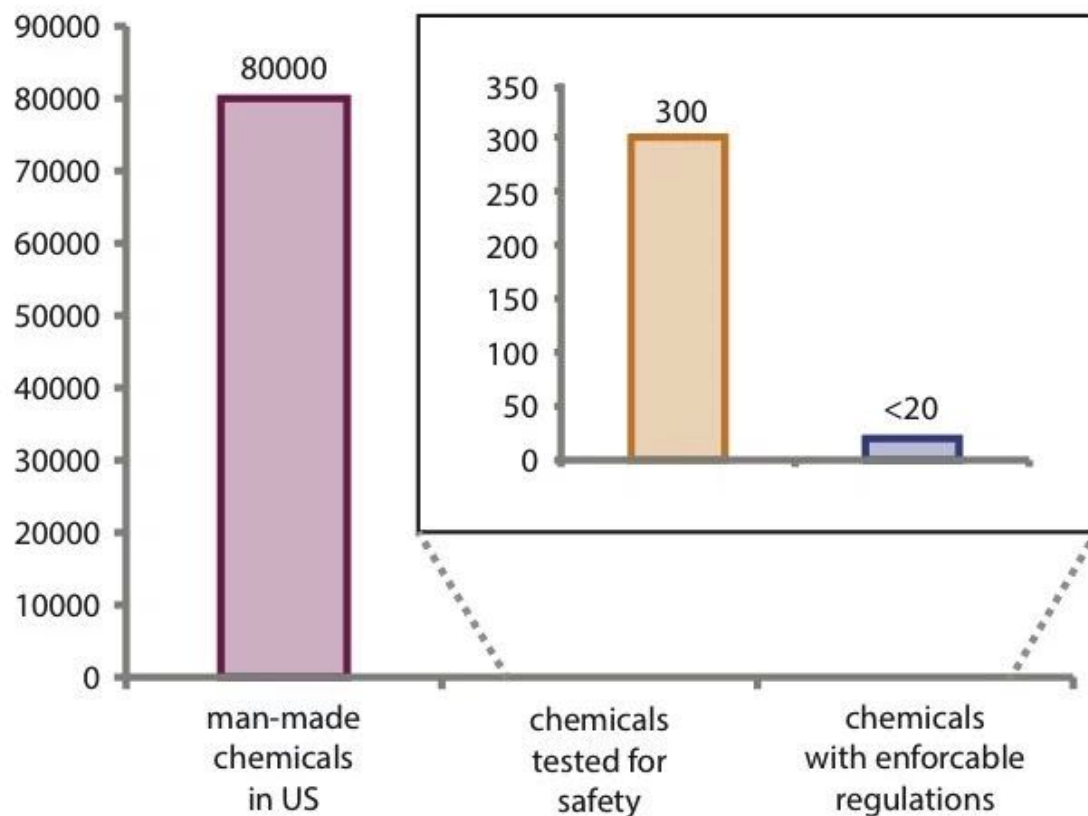
That is not true.”

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



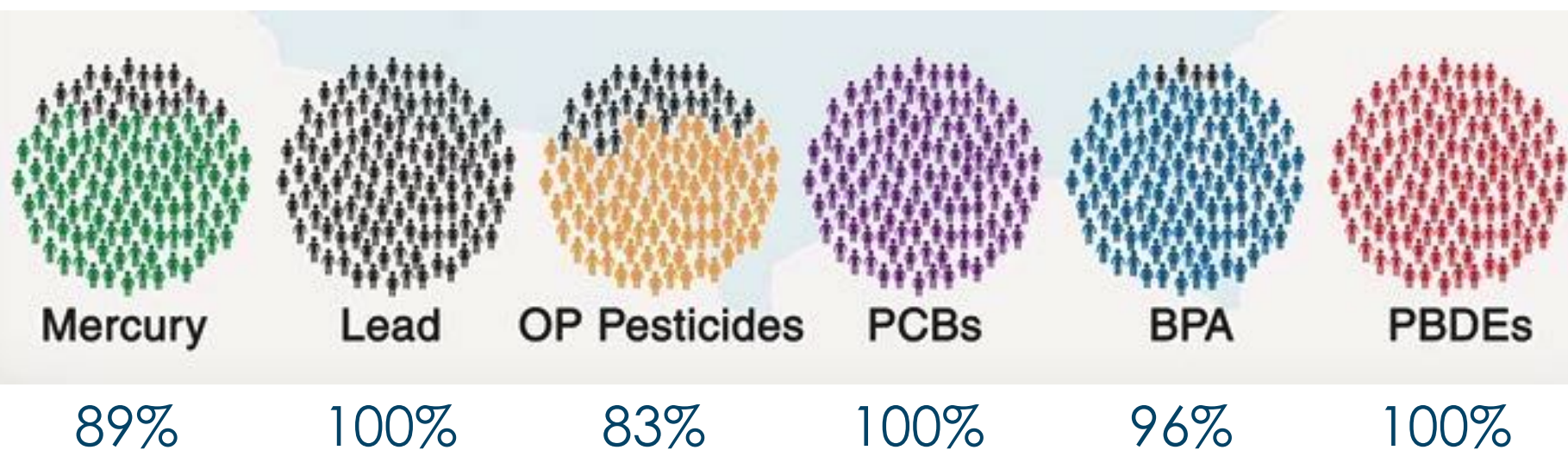
MANY COMMON BUILDING PRODUCTS CONTAIN TOXINS

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 P¹, Colaiácovo MP.

⊕ Author information

Abstract

Bisphenol A (BPA) is a highly prevalent constituent of many consumer products. It is a known endocrine disruptor and has been associated with an increased risk of miscarriages in humans. In mice, BPA exposure during development causes chromosomal lagging and has been particu

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, Joseph J. MacNaughton,¹ Usha Satish,² Suresh Santanam,³ Jose Vallarino,¹ and John D. Spengler¹

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

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

Hauser R¹, 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



The image shows a newspaper clipping from the Chicago Tribune, dated Sunday, May 6, 2012. The headline is "Playing with fire" and the sub-headline reads "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." The article is by Patricia Callahan and Sam Roe. The main text describes a case where a 7-week-old baby girl was burned in a fire started by a candle while she lay on a pillow that lacked flame retardant chemicals. The article mentions that the baby's parents were told the pillow was flame-retardant, but it was not. The article also discusses the broader issue of flame retardants in consumer products and the health concerns associated with them.

Chicago 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 ROE
Tribune reporters

Dr. David Heinbach 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 Heinbach, 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."

Heinbach'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 6-week-old patient who Heinbach 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.

Heinbach 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 industry

stoked the public's fear of fire and helped organize and over 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 2001 and 2004. More 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.

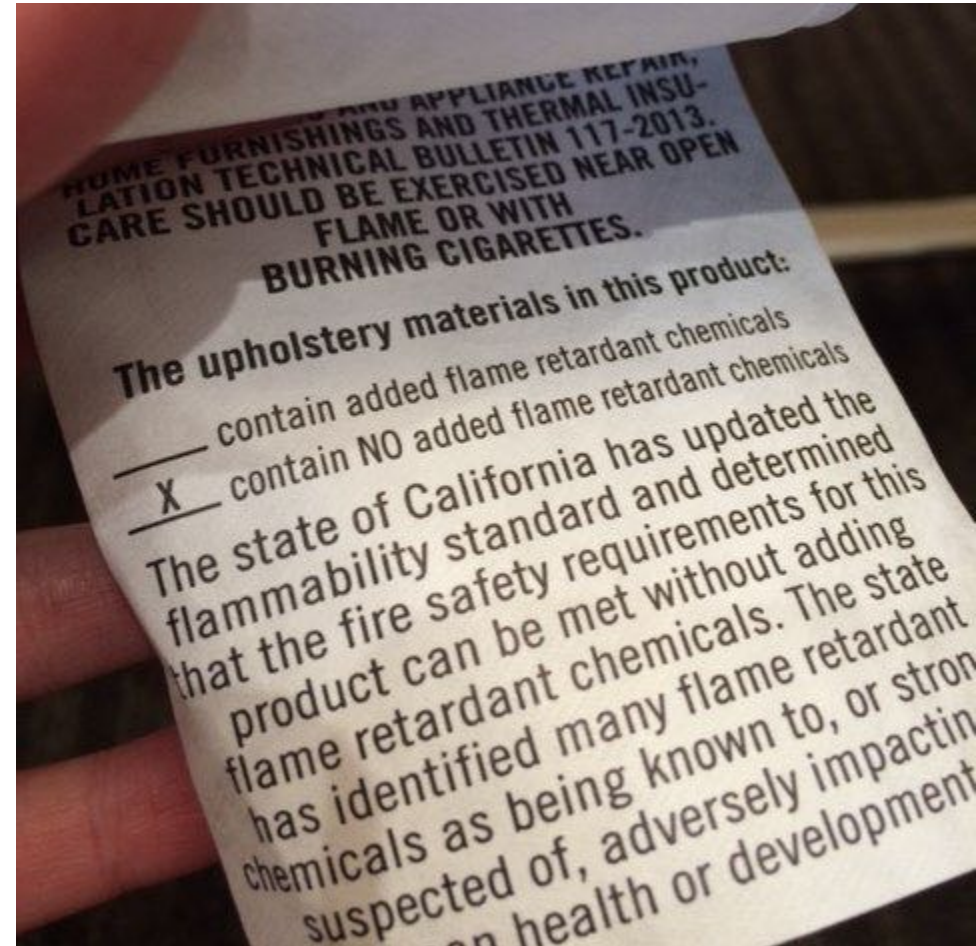
People might be willing to accept the health risks if the

EASY WAYS TO MAKE A DIFFERENCE!

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)

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.



A FRAMEWORK FOR BUILDING HEALTH

Research and Impact

Toxins in Buildings

Ventilation and Air Quality

Lighting and Daylight

Comfort and Productivity

Looking Forward

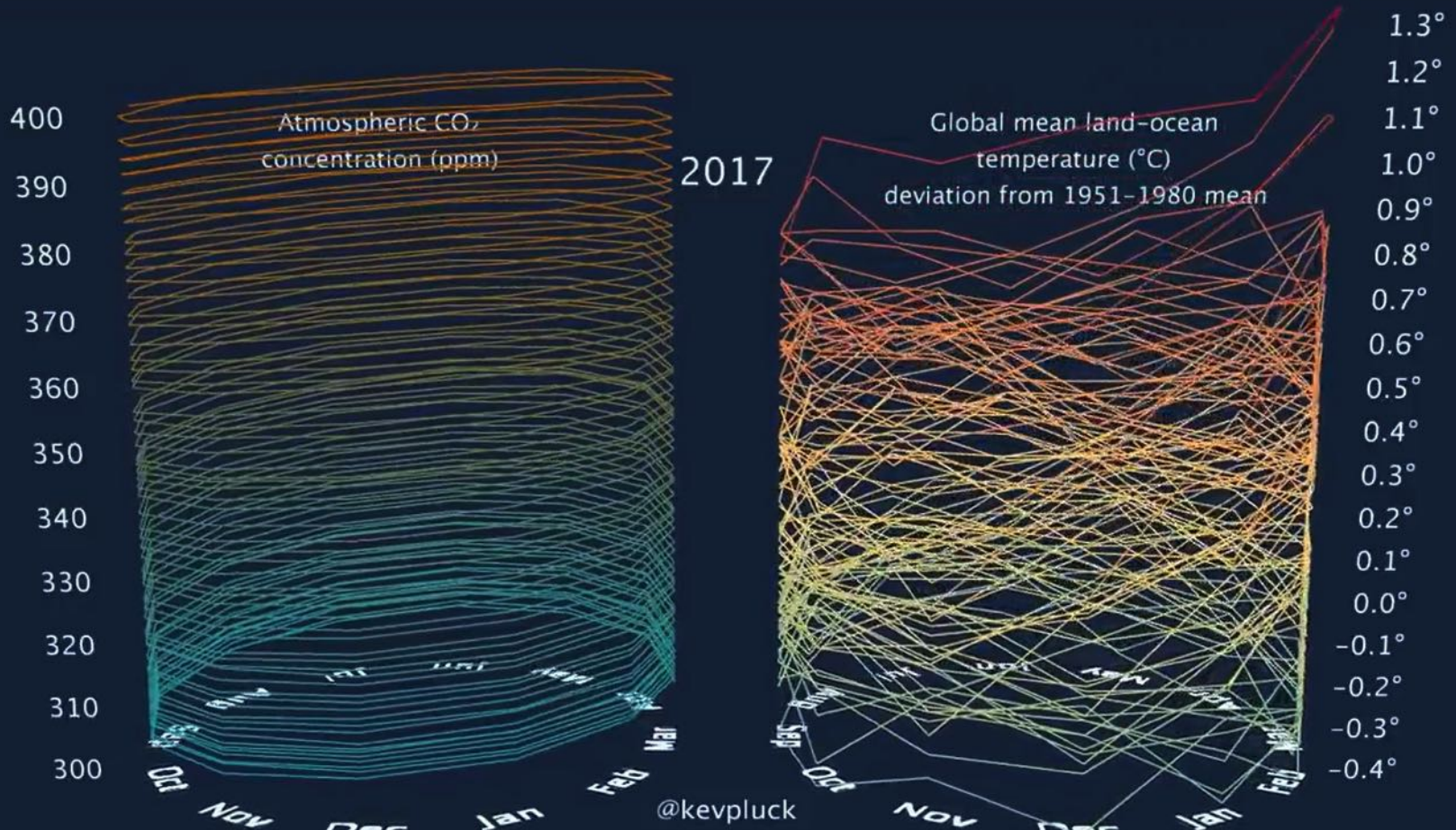
INDOOR AIR QUALITY AND HEALTH

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

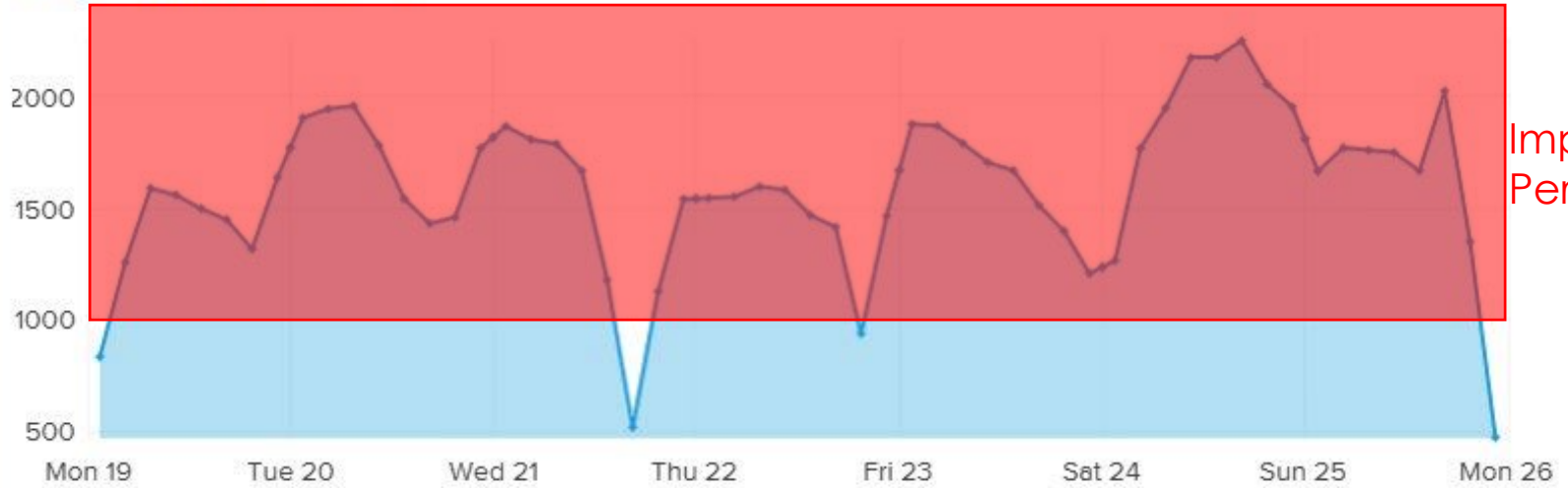
WHAT'S THE RIGHT AMOUNT OF CO₂?

CO₂ concentration and global mean temperature 1958 - present



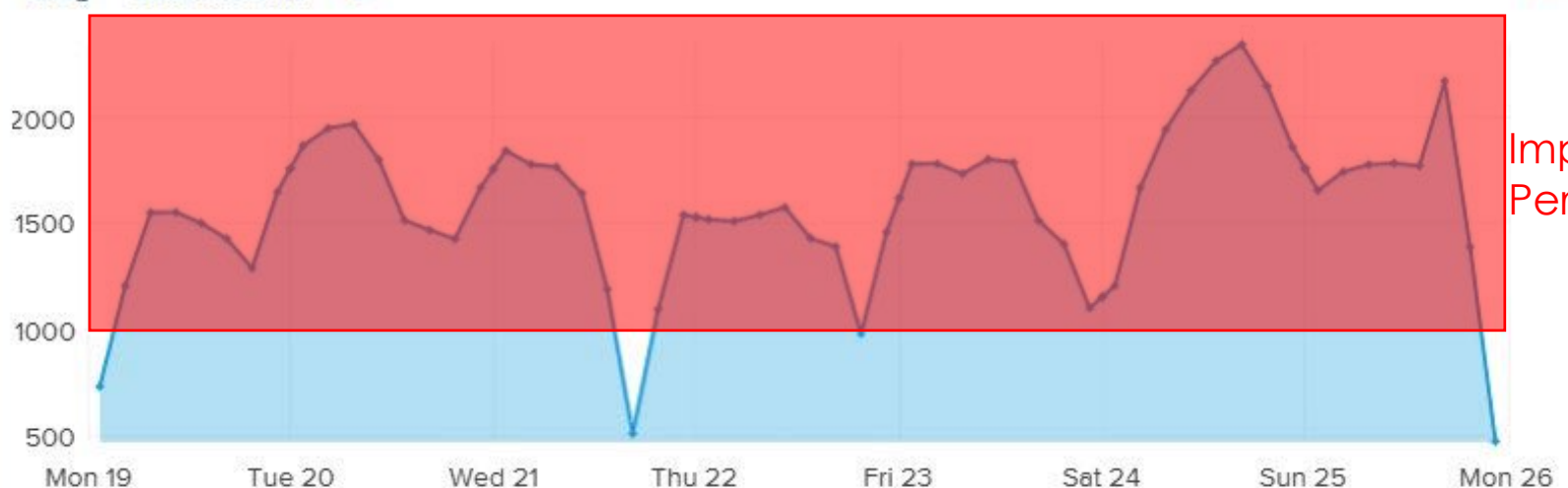
CO₂ LEVELS AT HOME – JUNE 2017

CO₂ - LIVING ROOM



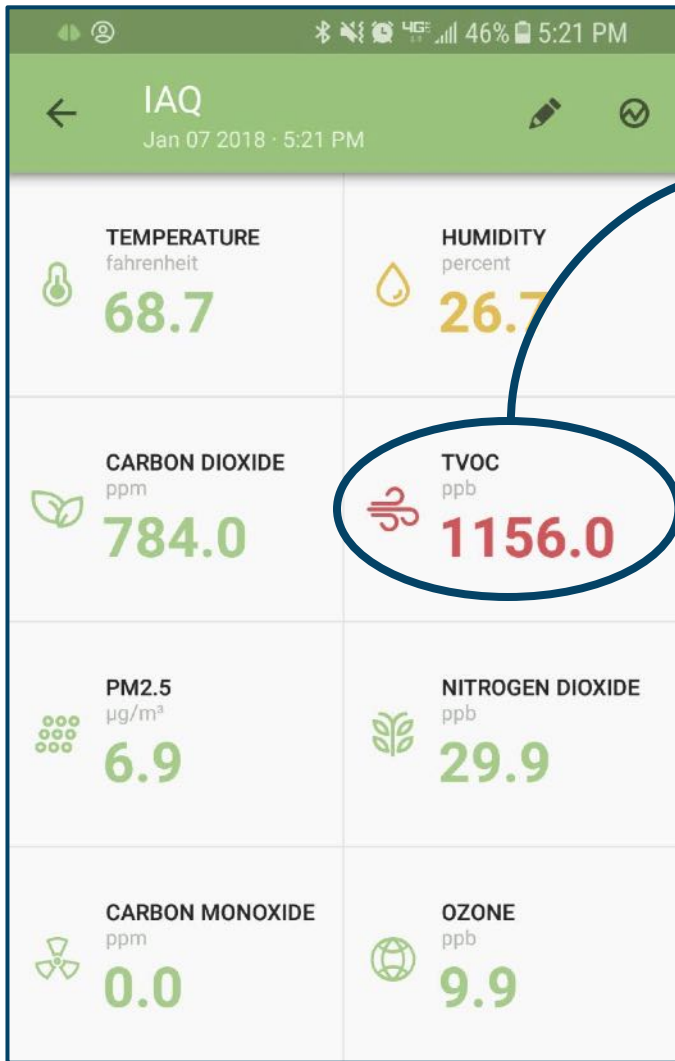
Impaired Performance

CO₂ - BEDROOM



Impaired Performance

LEARNING FROM SENSORS!





IMPACT OF PARTICULATE MATTER IN AIR

According to the EPA, exposure to fine particle pollution ($PM_{2.5}$, PM_{10}) may result in:

- Cardiac arrhythmias
- Heart attacks
- Respiratory effects such as asthma attacks and bronchitis
- Increased hospital admissions
- Increased emergency room visits
- Increased absences from school or work
- Restricted activity days, especially for those with pre-existing heart or lung disease, older people, and children.

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 CO₂ to O₂ during the night instead of the day – Put one in your bedroom!





Microsoft Word document content:

Off-Industrial

The first section of the document discusses the importance of maintaining a professional appearance in the workplace. It emphasizes the role of clothing in conveying a message of competence and reliability. The text suggests that well-maintained attire can significantly impact how colleagues and clients perceive an individual's capabilities and attention to detail.

The second section delves into the concept of "off-industrial" aesthetics, which refers to a style that is clean, functional, and devoid of unnecessary ornamentation. This approach is particularly relevant in professional settings where clarity and efficiency are paramount. The author argues that embracing this style can help create a more cohesive and productive work environment.

The final section provides practical advice on how to achieve an "off-industrial" look. It recommends focusing on quality over quantity, investing in well-tailored basics, and maintaining a consistent color palette. The text concludes by encouraging readers to view their wardrobe as a reflection of their professional identity and to strive for a balance between style and functionality.

Joel
Puzzle

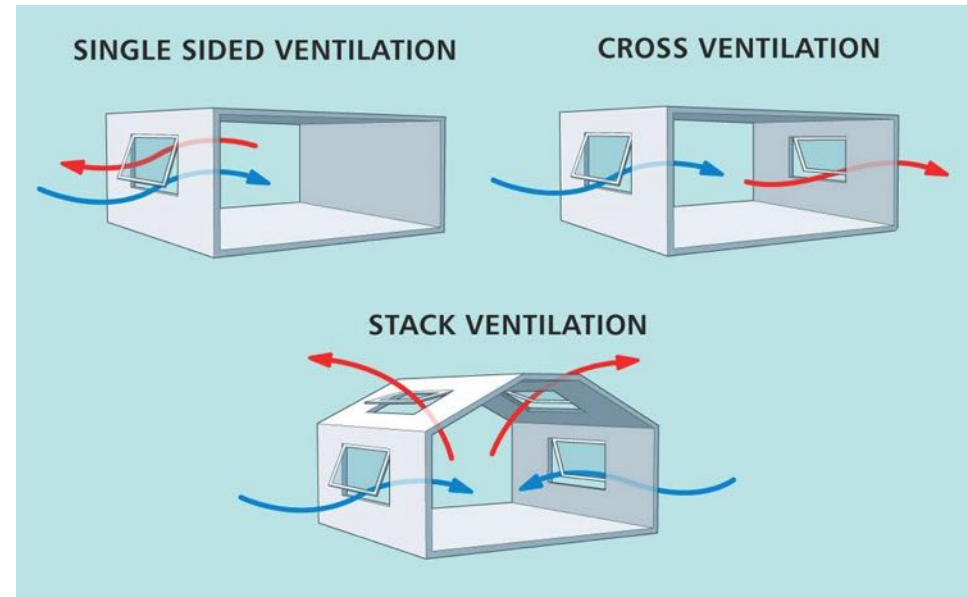
EASY STUFF THAT MAKES A DIFFERENCE!

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.



AGENDA

Building Health Overview

Research, Impacts and Solutions

Toxins in Buildings

Indoor Air Quality

Lighting

Comfort

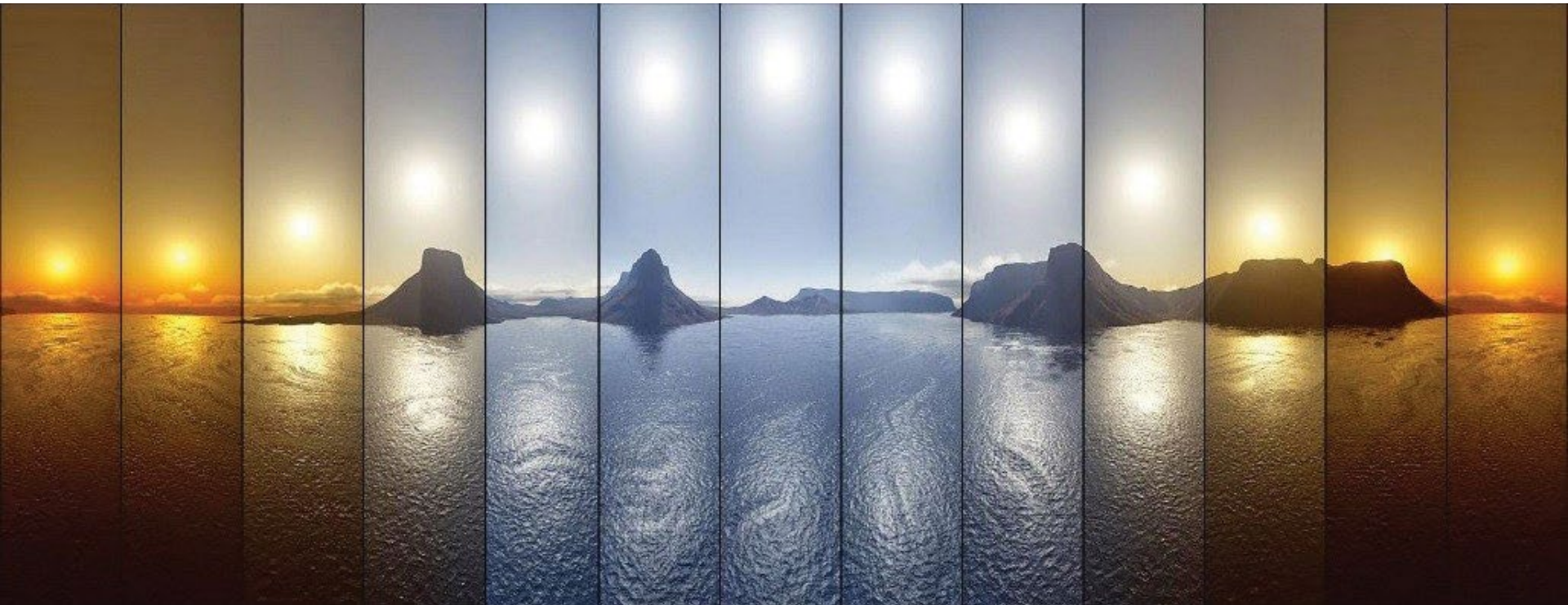
Community and Activity

Looking Forward



CIRCADIAN RESPONSIVE 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:

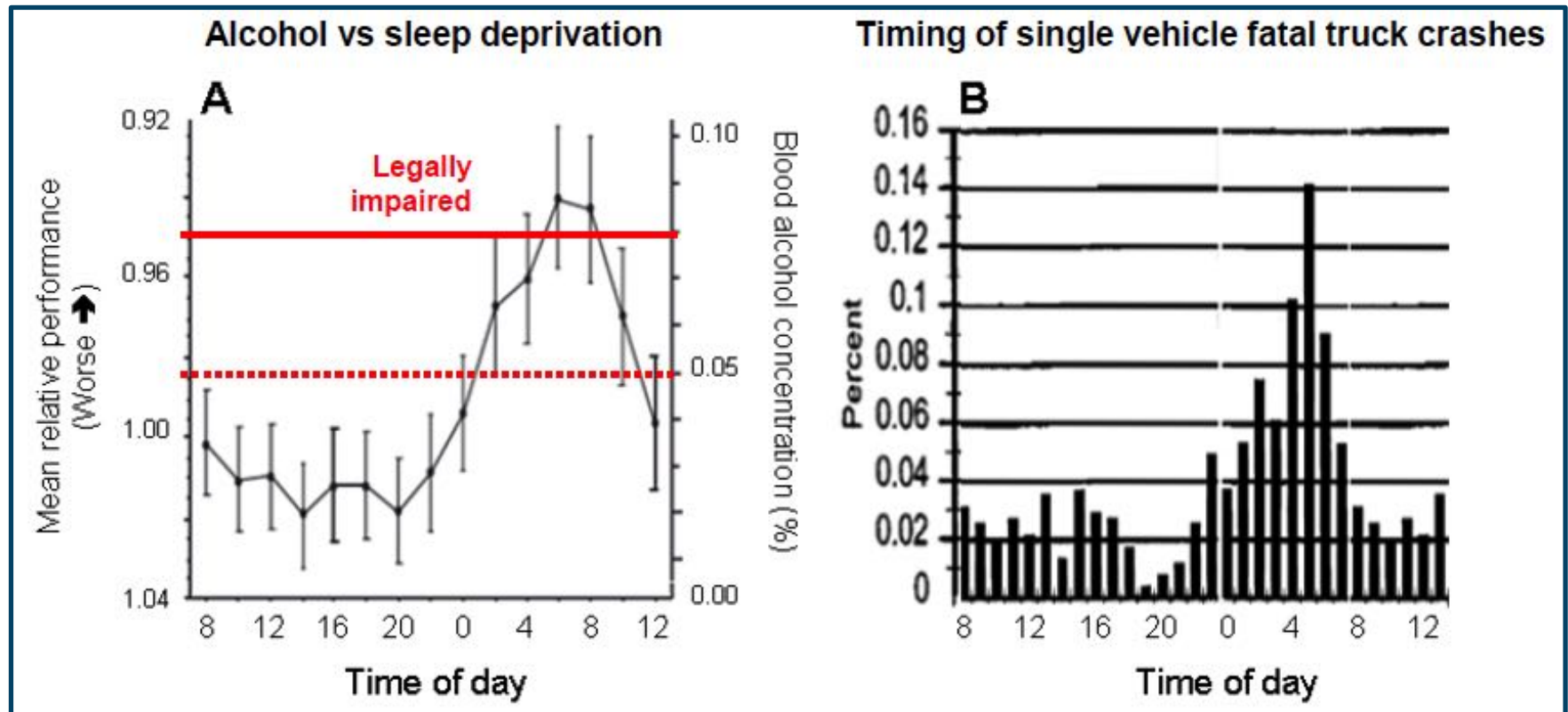
- Causes suppression of melatonin
- Delays the timing of circadian rhythms
- Elevates alertness

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.

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.”¹



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

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.



A FRAMEWORK FOR BUILDING HEALTH

Research and Impact

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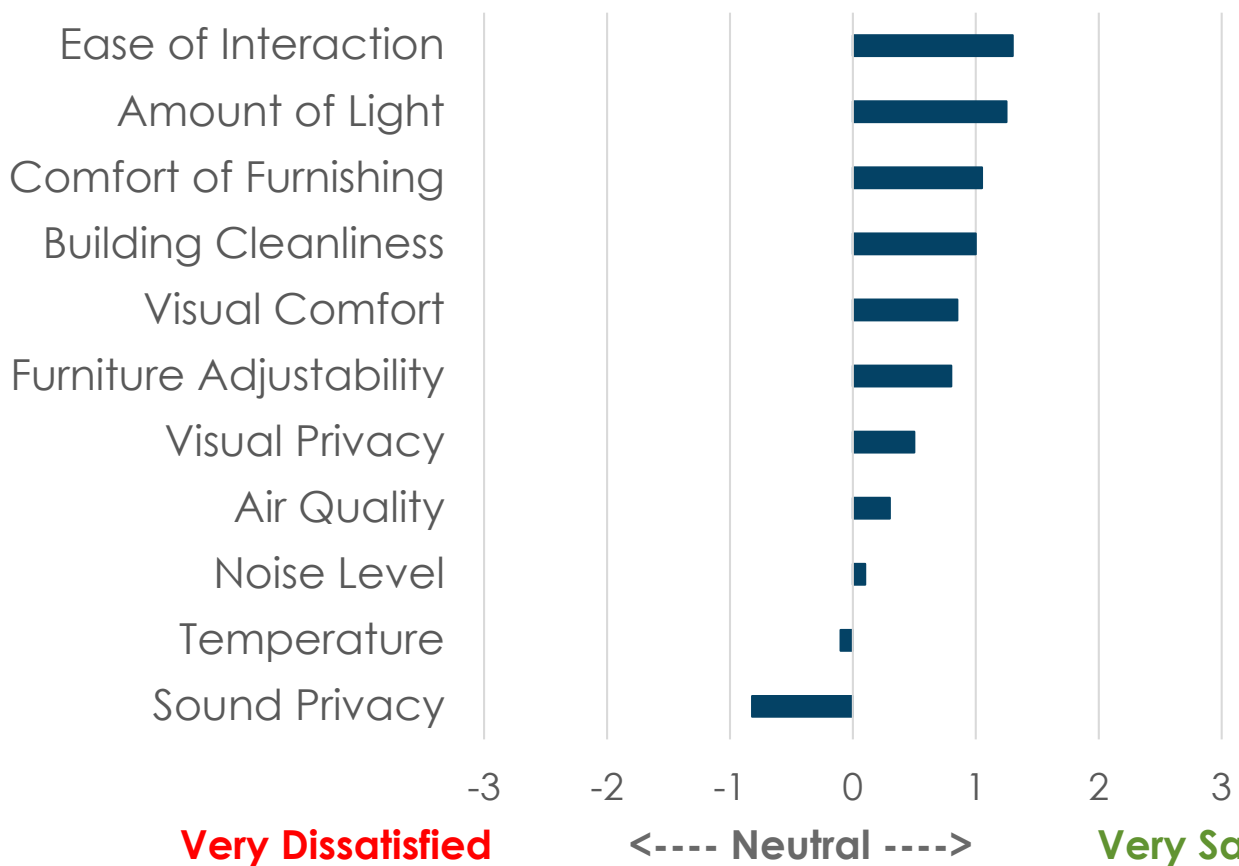
Lighting and Daylight

Comfort and Productivity

Looking Forward



COMFORT

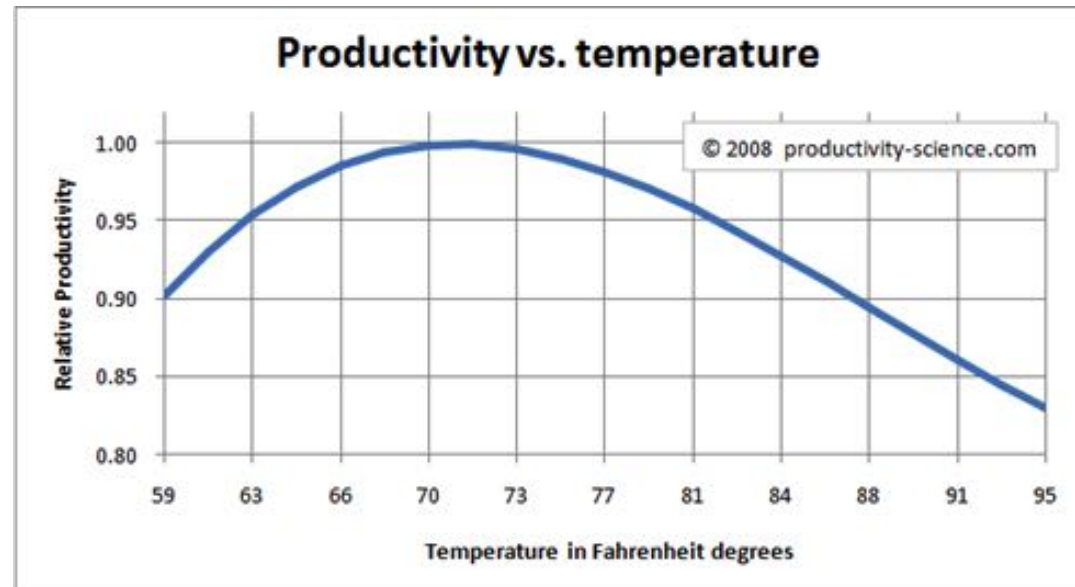


A survey of over 351 buildings with a combined 53,000 occupants found widespread discomfort, with only 2% of buildings meeting industry standards for occupant comfort.

Buildings generally perform worse in areas research shows to have greater health and/or productivity impacts.

TEMPERATURE

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



NOISE

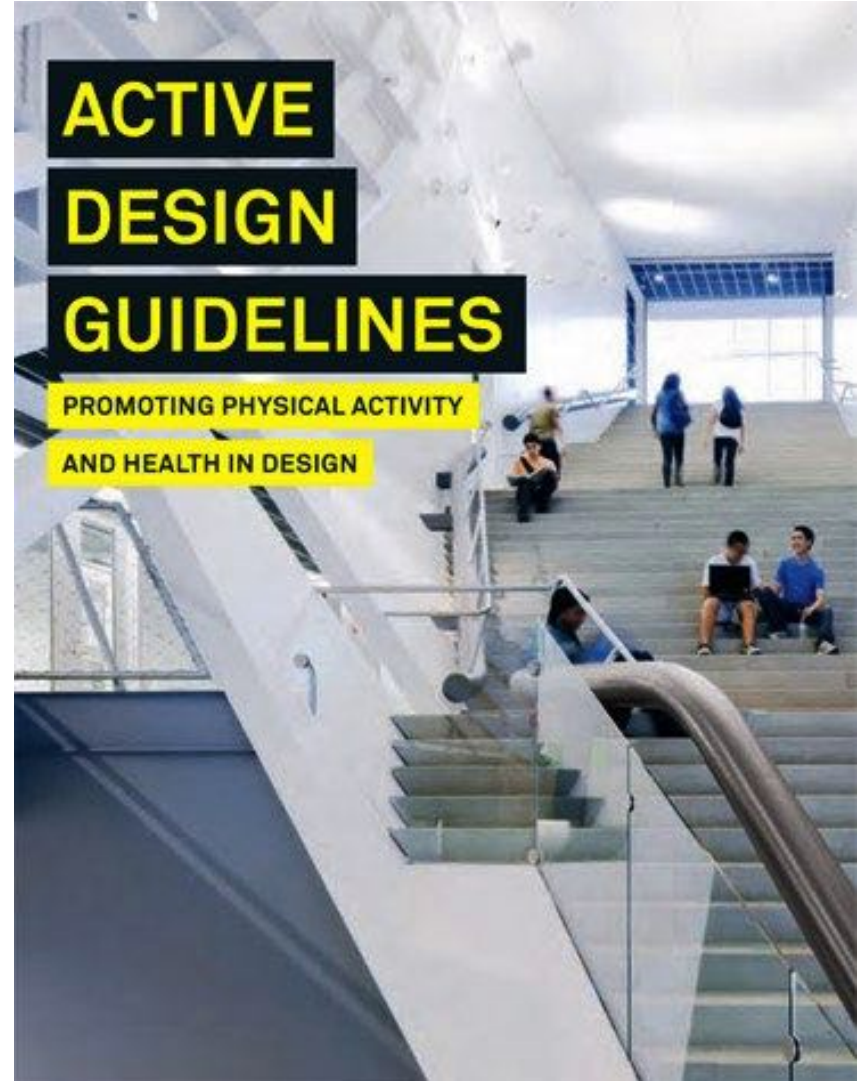
A survey of US Hospitals determined that noise complaints outnumber all others 2 to 1!
Additional research found that noise leads to the following negative outcomes:

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



CAN BUILDINGS MAKE PEOPLE PHYSICALLY ACTIVE?

The Active Design Guidelines are a set of voluntary strategies that architects, and facility managers can implement to increase physical activity within and around buildings.





SIMPLE SOLUTIONS

Stairwell Improvements

The CDC's "StairWELL to Better Health" program offers a number of low-cost interventions shown to increase the usage of stairwells in buildings:

- Improve appearance: paint, hang artwork, or change finishes
- Add motivational signs
- Add music/speakers
- Provide free fruits/vegetables at landings
- Hold a contest



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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.

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 & CIBSE BE DOING

Open Discussion On:

- Committees
- Position Documents
- Technical Memorandums (TM40)
- Standards
- Guidelines
- Training
- Certification
- Advocacy

Q & A

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