



Access to Nature for Human Health & Sustainability

Nature of Place Symposium

Phipps Conservatory

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Erich Fromm used **Biophilia** to describe the psychological orientation of being attracted to all that is alive and vital.

EO Wilson and Stephen Kellert described the links that human beings subconsciously seek with the rest of life as the **Biophilia Hypothesis**





Access to Nature for Human Health & Sustainability

Views

Circadian Light

Solar Heat

Thermal Variability – Alliesthesia

Natural Ventilation

Access to Nature – Active Design

Sounds of Nature

Smells of Nature

Sensory Feel of Nature

Natural Materials

Nature's Complexity and Order

Community

Biophilia and Human Health?

Cardiovascular S



Endocrine System



Integumentary S



Skeletal System



Muscular System



Digestive System



Immune System



Respiratory Sys



Urinary System



Nervous System



Reproductive Sys



**How important are
Views of Nature and Community
to human health?**

Views = Health

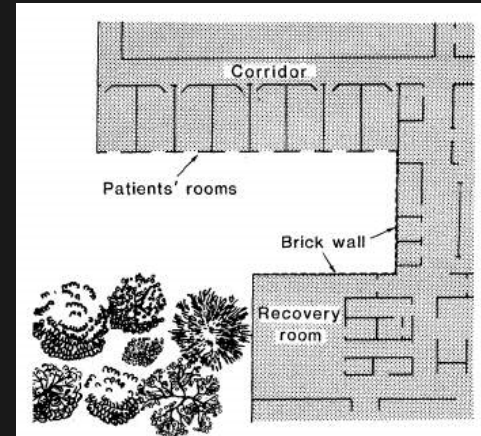
Pennsylvania Hospital / Ulrich 1984

In a 1984 observational field study at a Pennsylvania hospital, Ulrich identifies an **8.5% reduction in post-operative hospital stay** (7.96 days vs 8.7) for gall bladder surgery patients who had a **view of a natural scene** from their hospital room, as compared to those with a view of a brick wall. Patients with a view of nature also received fewer negative evaluations from nurses and took fewer strong analgesics.

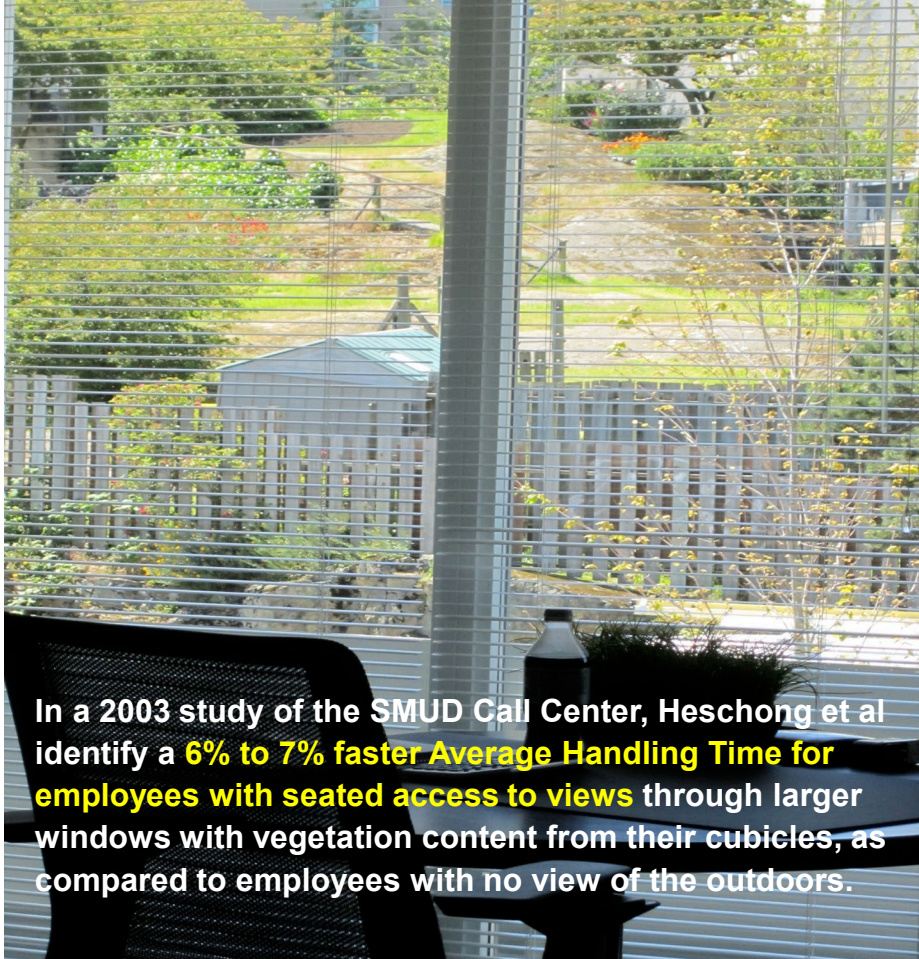
First cost increase: \$1,000 / bed

Annual productivity savings: \$884 / bed

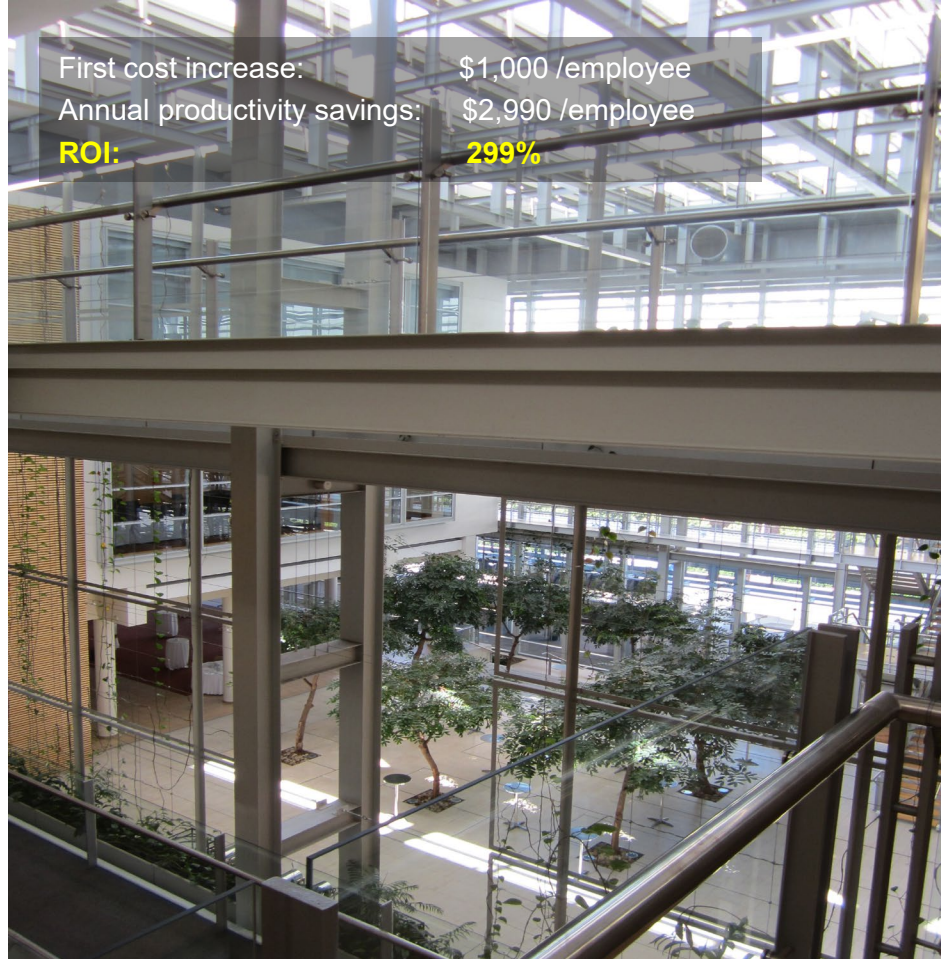
ROI: 88%



Evidence Based Design/ Pebbles Project: Ulrich, R. (1984) View Through a Window May Influence Recovery From Surgery. Science, 224(4647), pp.420-421.



In a 2003 study of the SMUD Call Center, Heschong et al identify a **6% to 7% faster Average Handling Time for employees with seated access to views** through larger windows with vegetation content from their cubicles, as compared to employees with no view of the outdoors.



First cost increase: \$1,000 /employee
Annual productivity savings: \$2,990 /employee
ROI: 299%

Maximize Views



**How important is
Circadian Daylight and Sunshine
to human health?**

Daylight circadian spectrums and intensity, sunshine
heat, sterilization and (bad) microbial reduction?



First cost increase:	\$1,000 / bed
Annual health savings:	\$10,000 / bed / year
ROI:	1,000%

In a 2005 building case study of Inha University Hospital in Korea, Choi identifies a **26% reduction in average length of stay** among surgery ward patients **in SE daylight rooms**, as compared to those in low daylight rooms, during spring and fall seasons.

Make Daylight Dominant





daylight is circadian and hormonal

+28% Alertness

+36% Concentration

+14% Mental Wellbeing

In a 2005 4-month longitudinal study, researchers identified statistically significant improvements in self-reported alertness (28.1%), work performance (19.4%), vitality (28.4%), and mental well-being (13.9%), (Mills, Tomkins, & Schlangen, 2007).

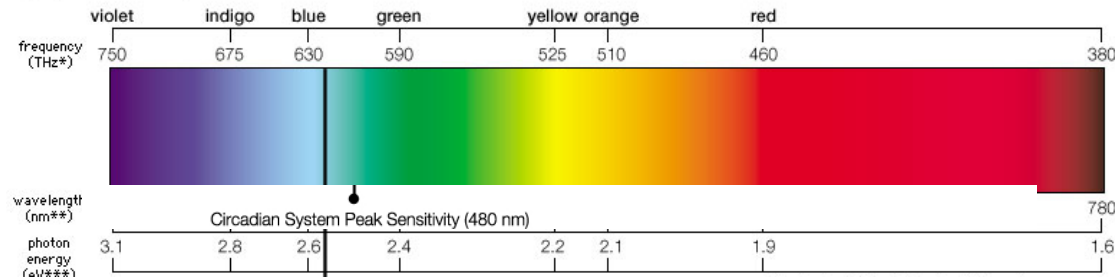
+6.8% Typing Speed

A 2013 study discovered “subjects performed significantly better in terms of typing speed under CW light and Daylight than WW light”, typing an average 269 words per minute under WW light conditions and 287 words per minute under DL conditions. (Shamsul, Nur Sajidah, & Ashok, 2013).

+3.3% Information Processing

A study in Germany measured a 3.3% increase in speed of information processing after switching from yellowish to bluish light (Lehrl, et al., 2007).

Light, the visible spectrum

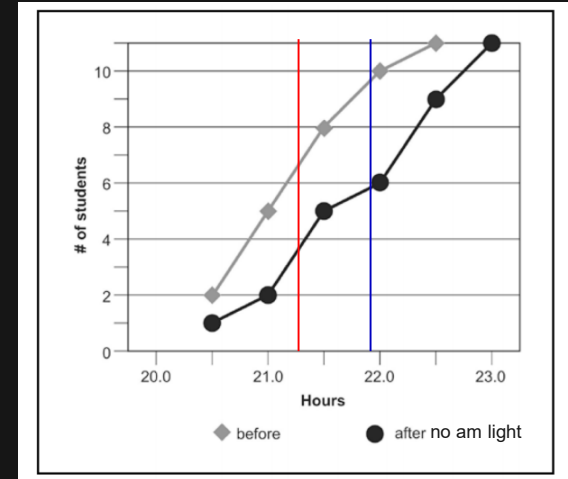


Daylight = Sleep Cycles (and Performance)

North Carolina School/ Figueiro and Rea 2012

In a 2010 study of sleep cycles of 8th grade students in the Smith Middle School in Chapel Hill, Figueiro and Rea identify that student exposure to short-wavelength **morning light significantly regulates their circadian clock and improves sleep times by as much as 30 minutes.**

Wolfson and Carskadon (1998) identified that poor performing students obtained about 25 minutes less sleep per night and went to bed on average 40 minutes later on school nights than those who were good performers.



Dim Light Melatonin Onset DLMO
● (after – no morning light)

In a 2005 study of 89 patients undergoing elective cervical and lumbar spinal surgery at Montefiore Hospital in Pittsburgh, PA, Walch et al identify a **22% reduction in analgesic medication use** after surgery among patients **in bright, sunny rooms**, as compared to patients located in dim rooms.



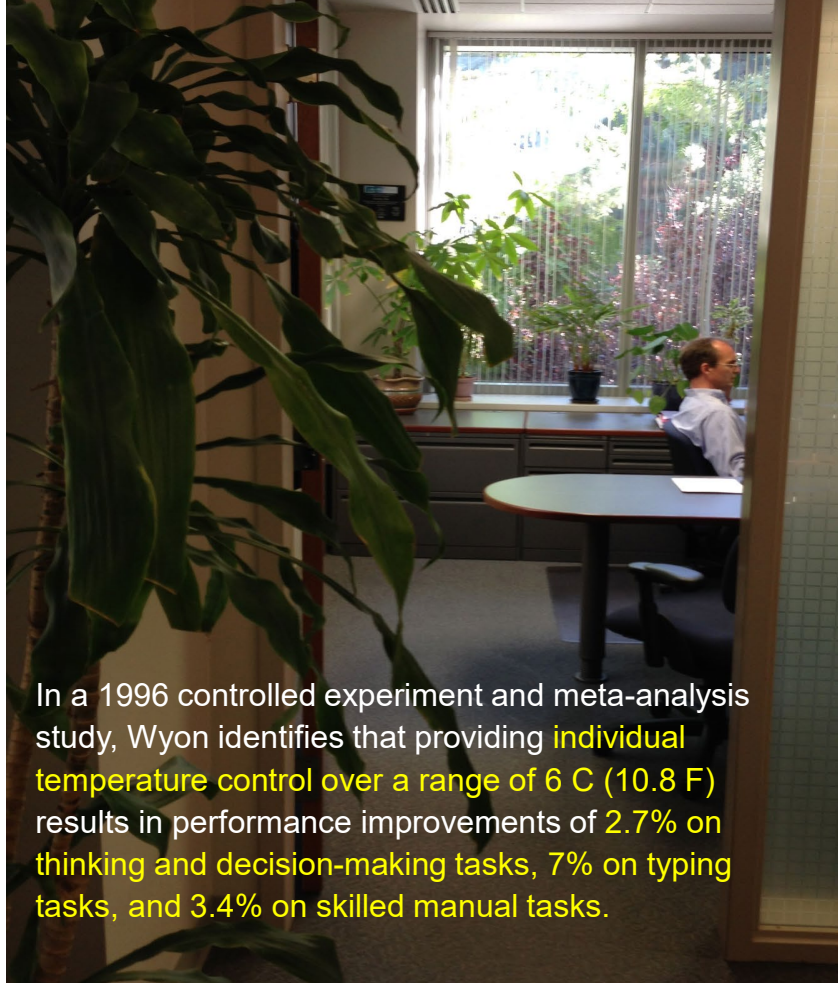
First cost increase: \$1,000 / bed
Annual health savings: \$28 / bed
ROI: 3%

Celebrate Sunshine

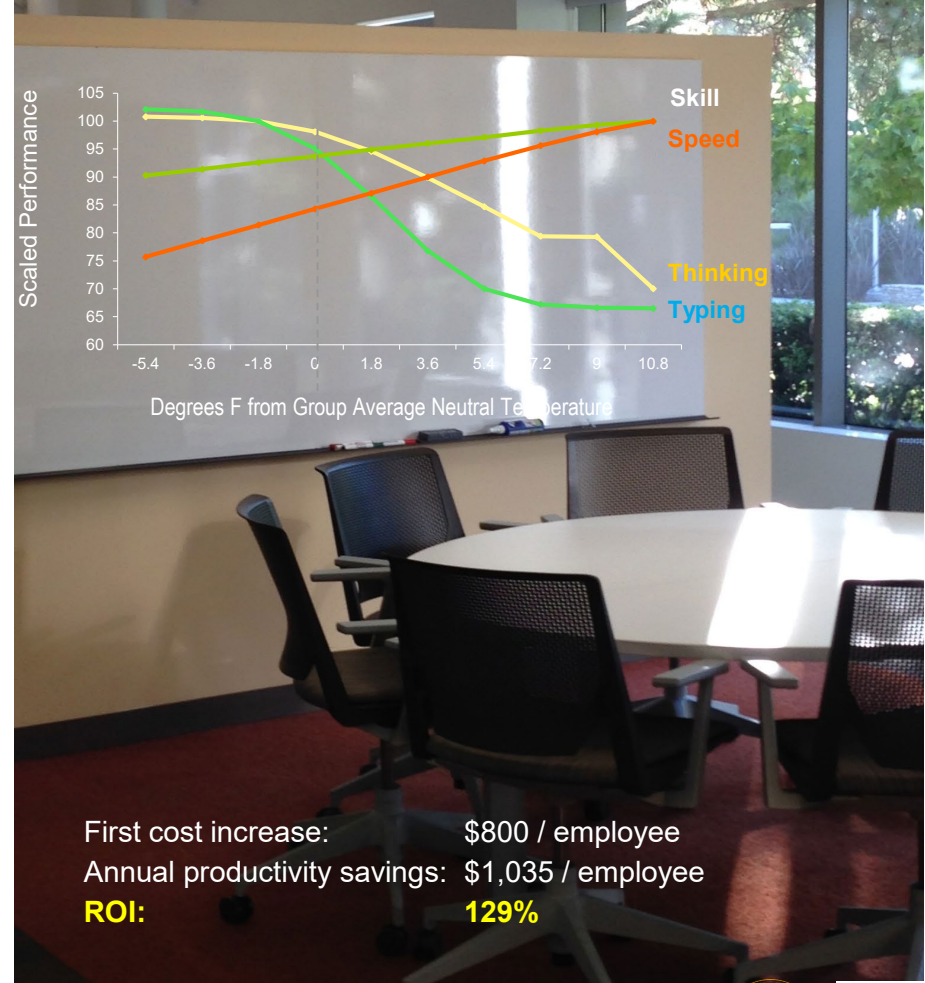


**How important is
Dynamic Thermal Conditions
(Alliesthesia)
to human health?**

Outside air circadian temperatures, radiant temperature variability,
relative humidity and vapor pressure variability for human health



In a 1996 controlled experiment and meta-analysis study, Wyon identifies that providing **individual temperature control** over a range of 6 C (10.8 F) results in performance improvements of **2.7% on thinking and decision-making tasks**, **7% on typing tasks**, and **3.4% on skilled manual tasks**.

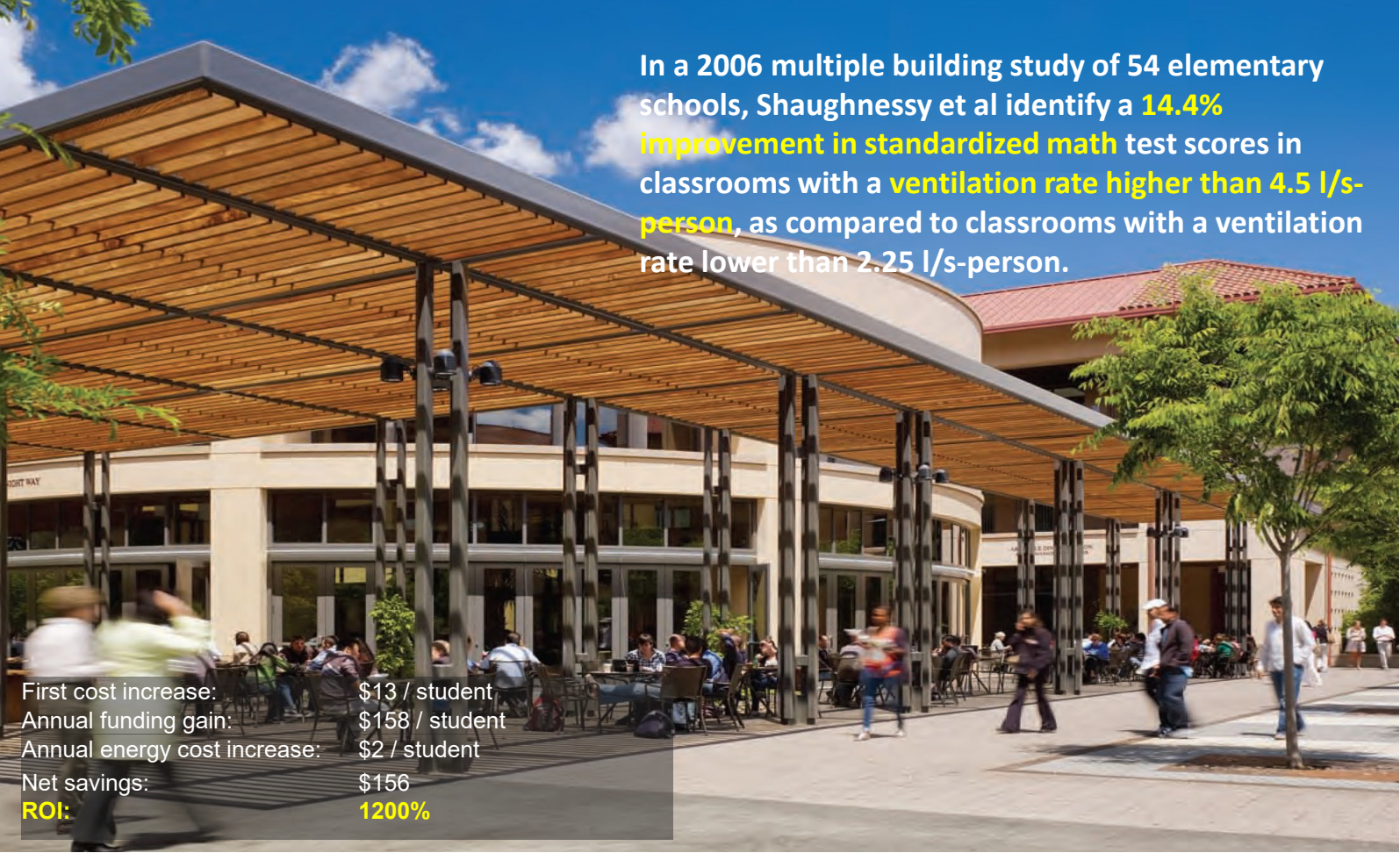


Give Back Temperature Control



How important is Natural ventilation and increased outside air to human health?

Outside Air (OA) variability and content
(is outdoor air microbially worse than indoors?)
Do outdoor fine particulates increase indoor microbials?
(Is dilution key to reducing human bacteria and viruses)

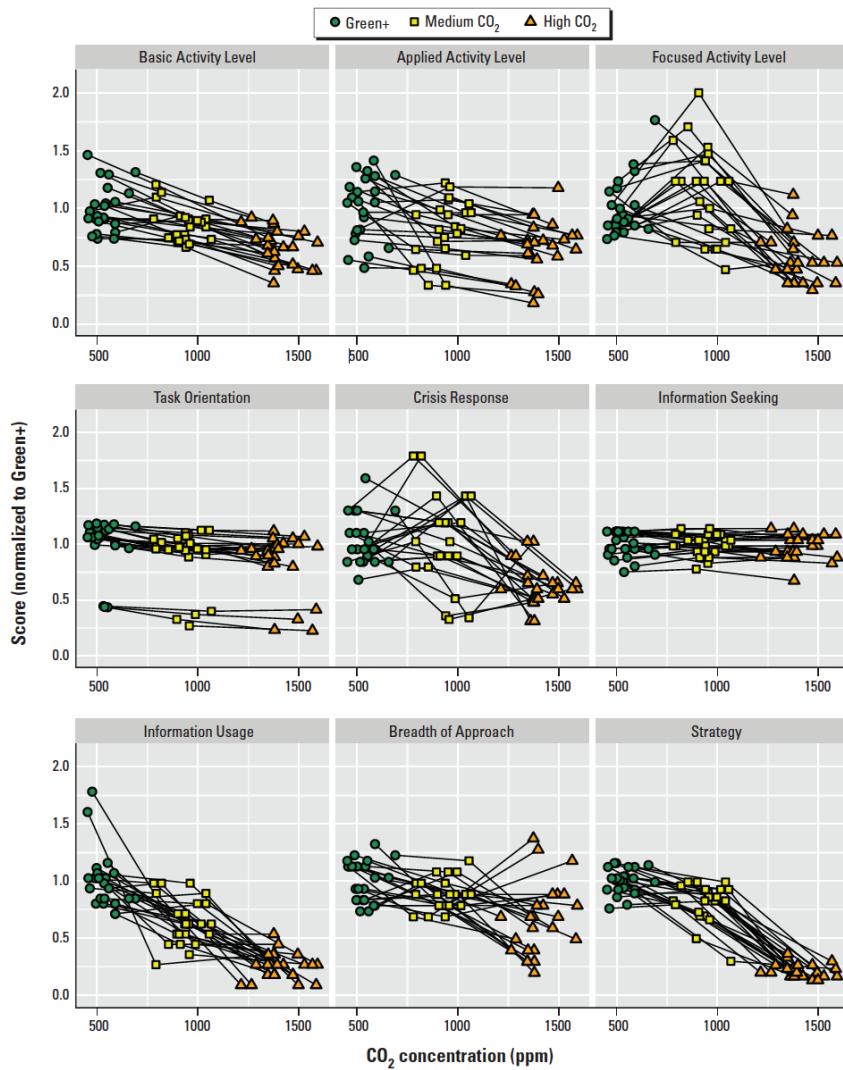


In a 2006 multiple building study of 54 elementary schools, Shaughnessy et al identify a **14.4% improvement in standardized math** test scores in classrooms with a **ventilation rate higher than 4.5 l/s-person**, as compared to classrooms with a ventilation rate lower than 2.25 l/s-person.

First cost increase:	\$13 / student
Annual funding gain:	\$158 / student
Annual energy cost increase:	\$2 / student
Net savings:	\$156
ROI:	1200%

Increase Outside Air





Outdoor air is cognitive and strategic

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 G. Allen, Piers MacNaughton, Usha Satish, Suresh Santanam, Jose Vallarino, and John D. Spengler, Environmental Health Perspectives • volume 124 | number 6 | June 2016

In a 2004 multiple building study in France, Preziosi et al identify a **57.1% reduction in sickness absence** and a 16.7% reduction in doctor visits among workers with **natural ventilation** in their workplace, as compared to those with air conditioning.



First cost increase:	\$1,000 / employee
Annual health savings:	\$181 / employee
Annual productivity savings:	\$85 / employee
ROI:	27%

Open Windows



**How important is
increased access to outdoor spaces
and community
to human health?**

Microbial diversity and probiotics of the outdoors?

Lung activity and outdoor exercise?

Biophilia as air cleaner, humidifier, thermal regulator...

Dynamic sounds, smells, biophilic and sensory cues

Landscape design = Individual Productivity

Georgia Schools / Tanner 2000 (School)

In a 2000 multiple building study of 14 schools in Georgia, Tanner identifies a statistically significant relationship between quality and functionality of a school's outdoor space and students' academic achievement, indicating a **14.5-point (7%) increase in standardized test scores for each one-point improvement in rating of outdoor space on a scale from 1-10.**

First cost increase:	\$84 / student
Annual O&M cost increase:	\$5 / student
Annual productivity savings:	\$176 / student
ROI:	204%



Image: Wisconsin Green and Healthy Schools Program



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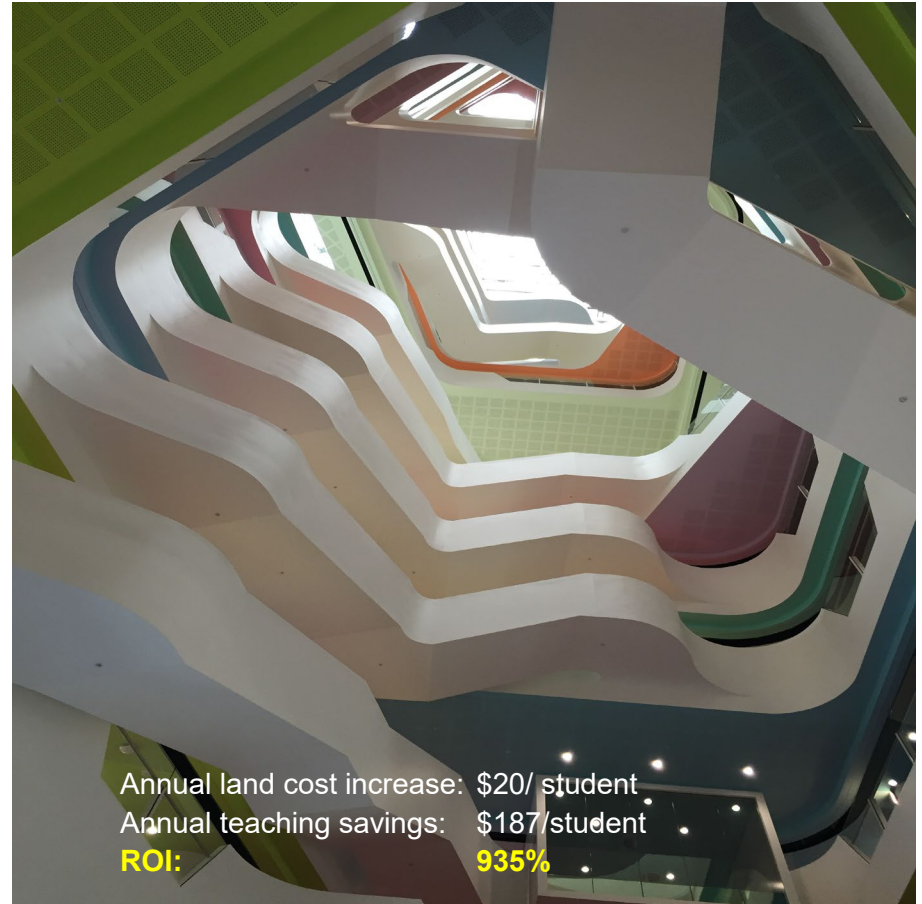
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Ensure Access to Nature





In a 2004 Chicago field study of 17 children professionally diagnosed with ADHD, Kuo and Faber Taylor et al identified a **17% improvement in performance (digit span backwards test) after a 20 minute walk in a park** as compared to built urban settings.



Annual land cost increase: \$20/ student
Annual teaching savings: \$187/student
ROI: 935%

Design for Active and Fit

Unknowns?

Sounds of Nature

Smells of Nature

Sensory Feel of Nature

Natural Materials

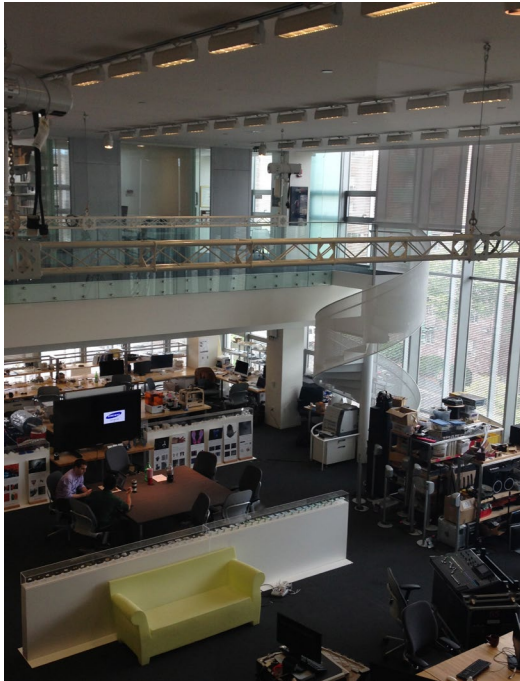
Nature's Complexity and Order

Craft – the Human Hand

Art – Nature's Imagery

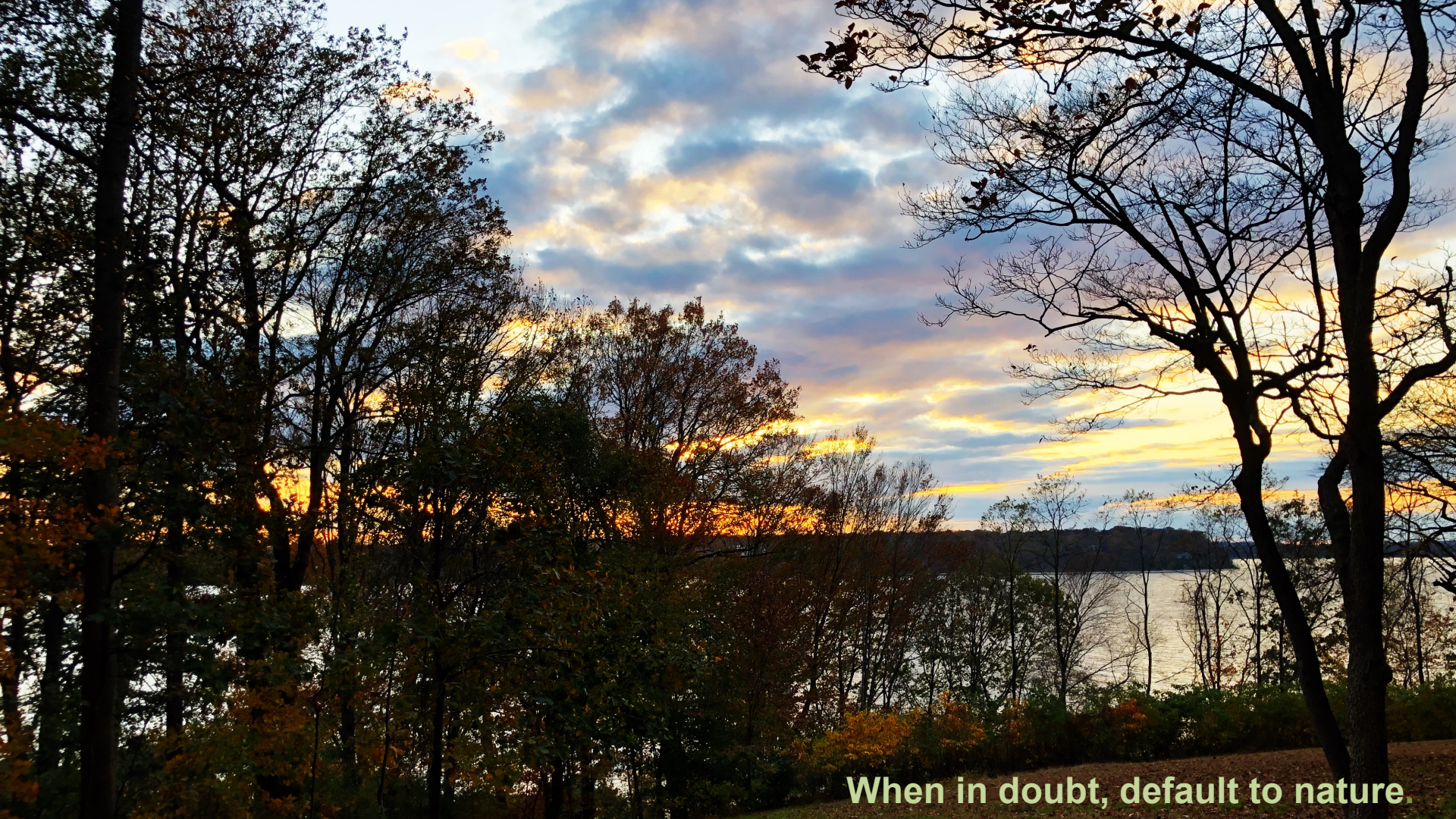
Community

Dynamics of Culture, Time and Place



Support Community & Collaboration





When in doubt, default to nature.



GHD Theater - Daylit & Naturally Ventilated **Theater**, University of Queensland Australia (Richard Kirk, Hassell)



Bullitt Center Daylit & Naturally Ventilated **Offices**, Seattle (Miller Hull, PAE Eng)

Mixed Mode: Daylight & Electric Light

Terry Thomas **Offices** in Seattle (SmithGroup and DPR)
Natural Cooling only with demand controlled ventilation



H.E.B. **Retail** in Texas (Lake Flato and Arup)
Natural Cooling + A.C. (Side by Side & Changeover)

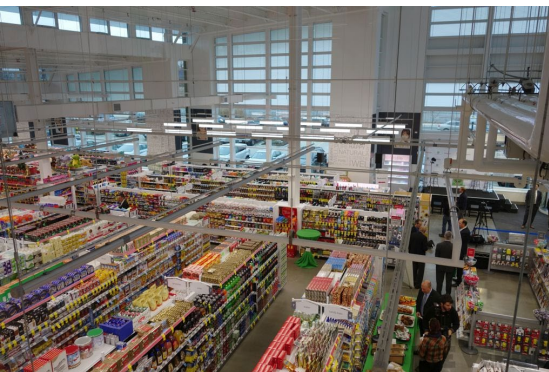


Mixed Mode: Natural Cooling & Mechanical

The Leala **Hotel** in Kovalam India (Charles Correa)
Natural Ventilation + A.C. (Side by Side or Zoned)



Walgreens **Retail** in Illinois (Camburus, GI Energy)
Natural Ventilation + A.C. (Changeover)



Mixed Mode: Natural Ventilation & Mechanical



The sixth floor "Garden in the Sky" is used frequently for formal and informal meetings and events.

Institute of Building Research **Offices** in Shenzhen, China (Ye Qing)
Natural Cooling + A.C. (Changeover)



Ng Teng Fong **Hospital** in Singapore (Studio 505, HOK, CPG Eng)
Natural Cooling 70% patient rooms, each bed with garden



Mixed Mode: Outdoor & Indoor Work/Learn/Play/Heal



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Circadian Light

Solar Heat

Thermal Variability – Alliesthesia

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Access to Nature – Active Design

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1. PERMANENT ABANDONMENT
2. CUT-OFF RIVER FRONT PROPERTY
3. LAST TRACT IS IN PUBLIC
4. REAL ALTERNATIVES
5. P.T.O.D. NOT FULLY FINANCED
6. CONSERVATION OF RESOURCES
7. ADDITIONAL RIGHTS TO THE PROPERTY
8. INCORPORATE UNLAWFUL

Vivian Loftness, FAIA

The Intelligent Workplace – A living laboratory at Carnegie Mellon University