

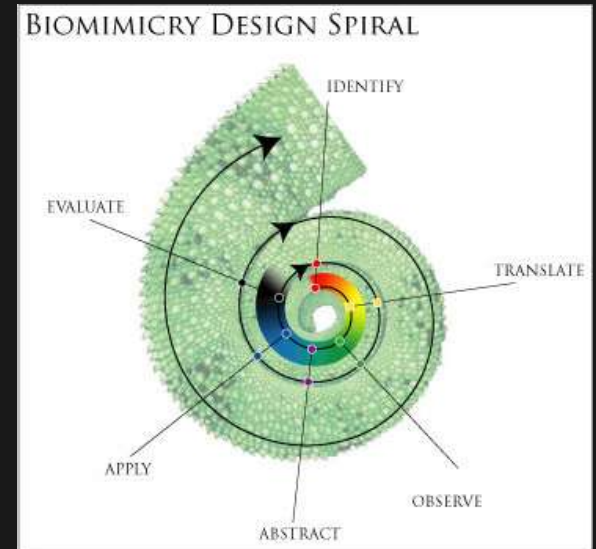
Biophilia, Human Health and Productivity

Pittsburgh Biophilia Network
November 7, 2013

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Biomimicry or biomimetics is the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems....Jeanine Benyus



Biomimicry Jeanine Benyus



Super trees Grant Associates UK

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

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



Views

Daylight

Solar Heat

Natural Ventilation

Access to Nature

Sounds of Nature

Smells of Nature

Sensory Feel of Nature

Material and Craft

Art and Ornament

Community

Elements of Time and Place



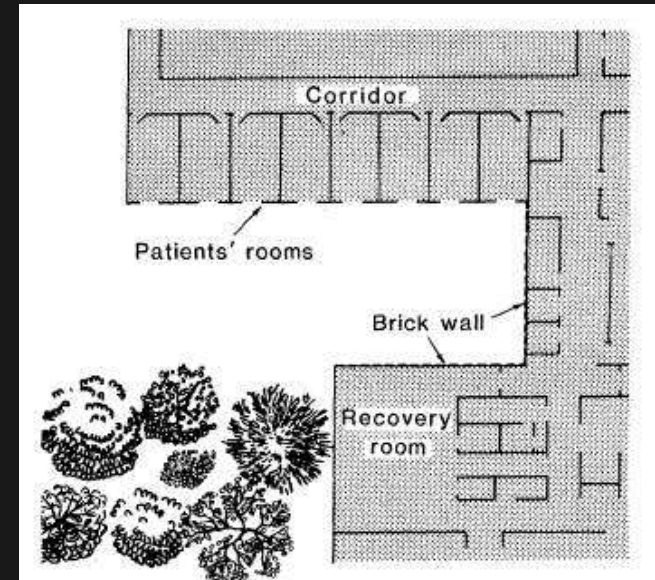
View

Views = Health

Pennsylvania Hospital / Ulrich 1984

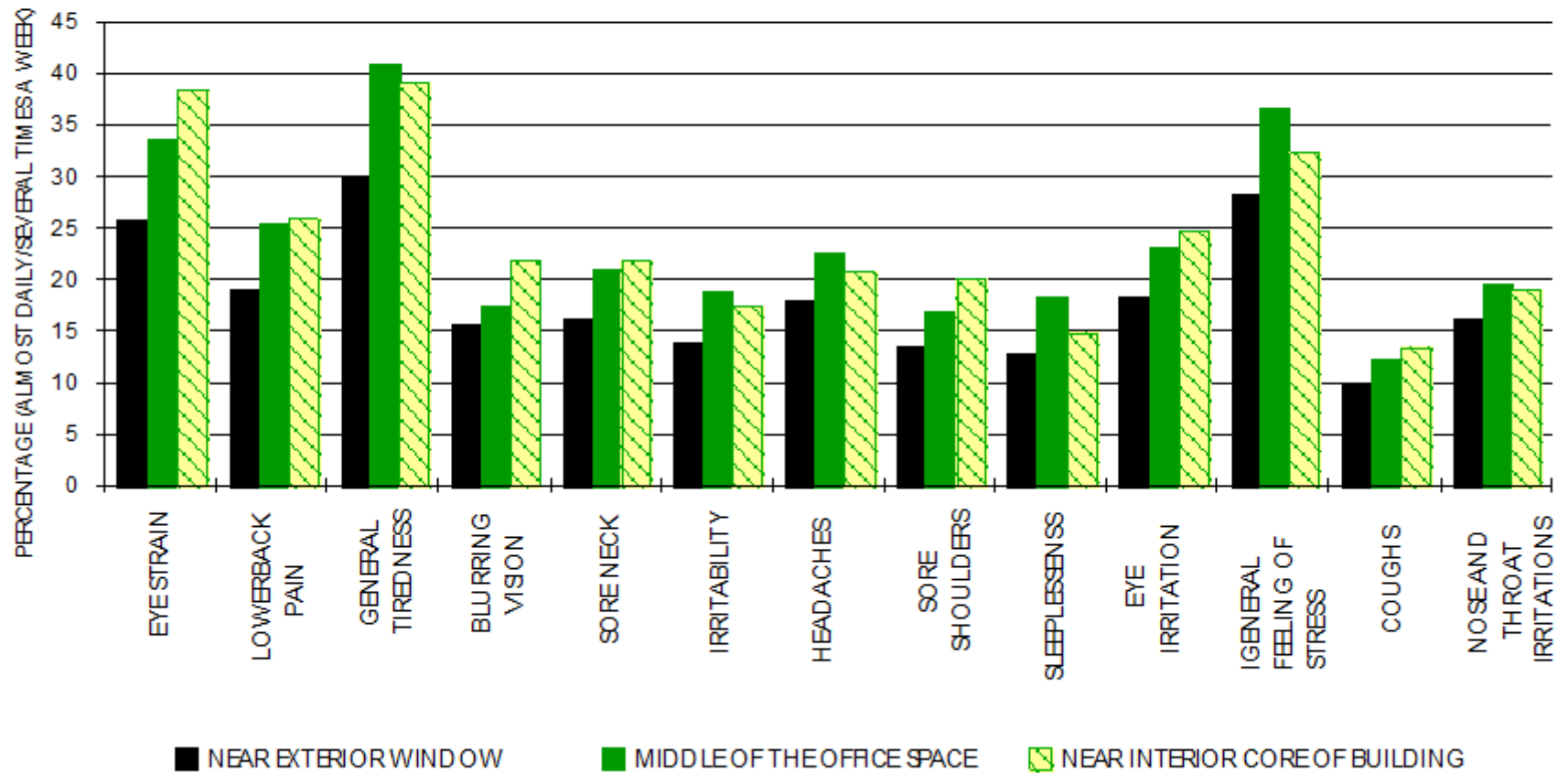
In a 1984 observational field study at a Pennsylvania hospital, Ulrich identifies an **8.5% reduction in post-operative hospital stay** (8.7 vs 7.96 days) for gall bladder surgery patients who had a **view of a natural scene** from their hospital room, as compared to those with a view of a brick wall.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

Comparison between Window Proximity and Health Complaints (Forrestal and Germantown)



Seated Views = Individual productivity

SMUD Call Center /Heschong Mahone Group, Inc. 2003

In a 2003 building case study of the Sacramento Municipal Utility District (SMUD) Call Center, Heschong et al identify a **6% to 7% faster Average Handling Time (AHT) 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.





Towers Gold landscape architects



View content matters: Cool Roofs and “Cool Community” developments reduce annual cooling loads by 10% and peak cooling by 5% with carbon sequestration, storm runoff management, and a 6-8% reduction in smog.



Daylight



Daylight

Daylight = Health

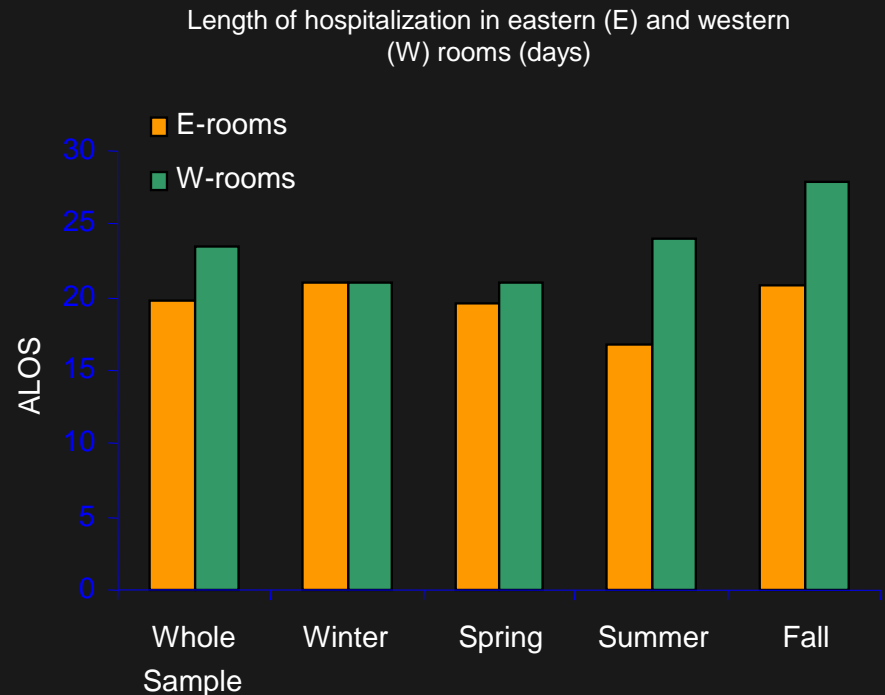
San Raffaele Hospital / Benedetti et al 2001 (Hospital)

In a 2001 building case study at San Raffaele Hospital in Milan, Italy, Benedetti et al identify **30% and 26% reductions in length of stay among bipolar inpatients in eastern rooms** (exposed to direct sunlight in the morning) as compared to bipolar patients in western rooms (exposed to direct sunlight in the evening), in the summer and fall, respectively.

First cost increase: \$1,000 / bed

Annual health savings: \$7,714 / bed

ROI: 771%

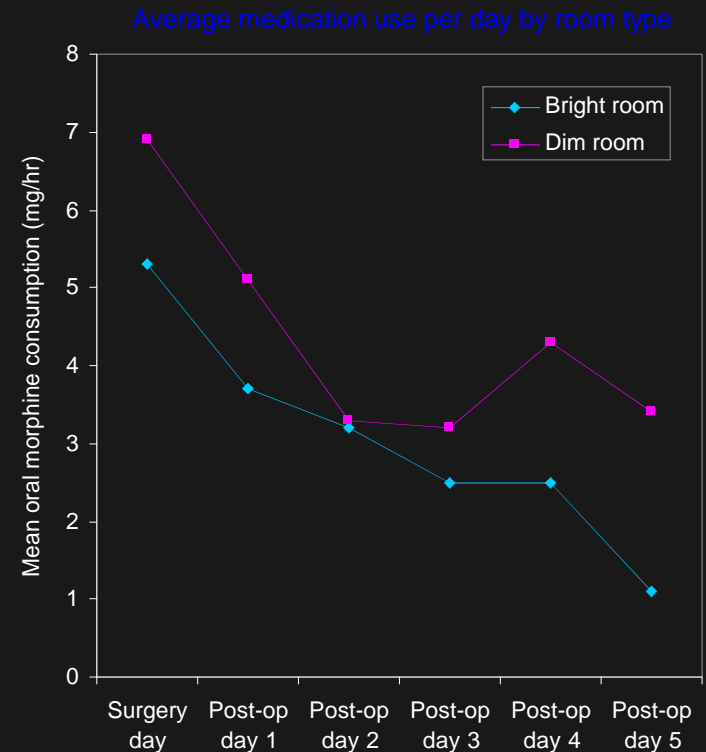


Daylight = Health

Montefiore Hospital / Walch et al 2005 (Hospital)

In a 2005 study of pain medication use among 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 among patients in bright rooms** who were exposed to more natural sunlight after surgery, as compared to patients located in dim rooms after surgery.

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

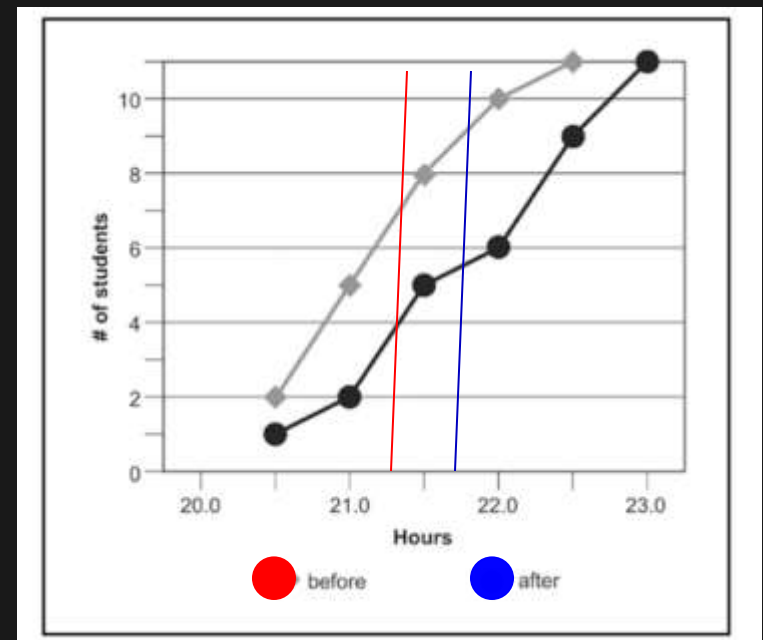


Daylight = Sleep Cycles (and Alertness)

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 min.

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.

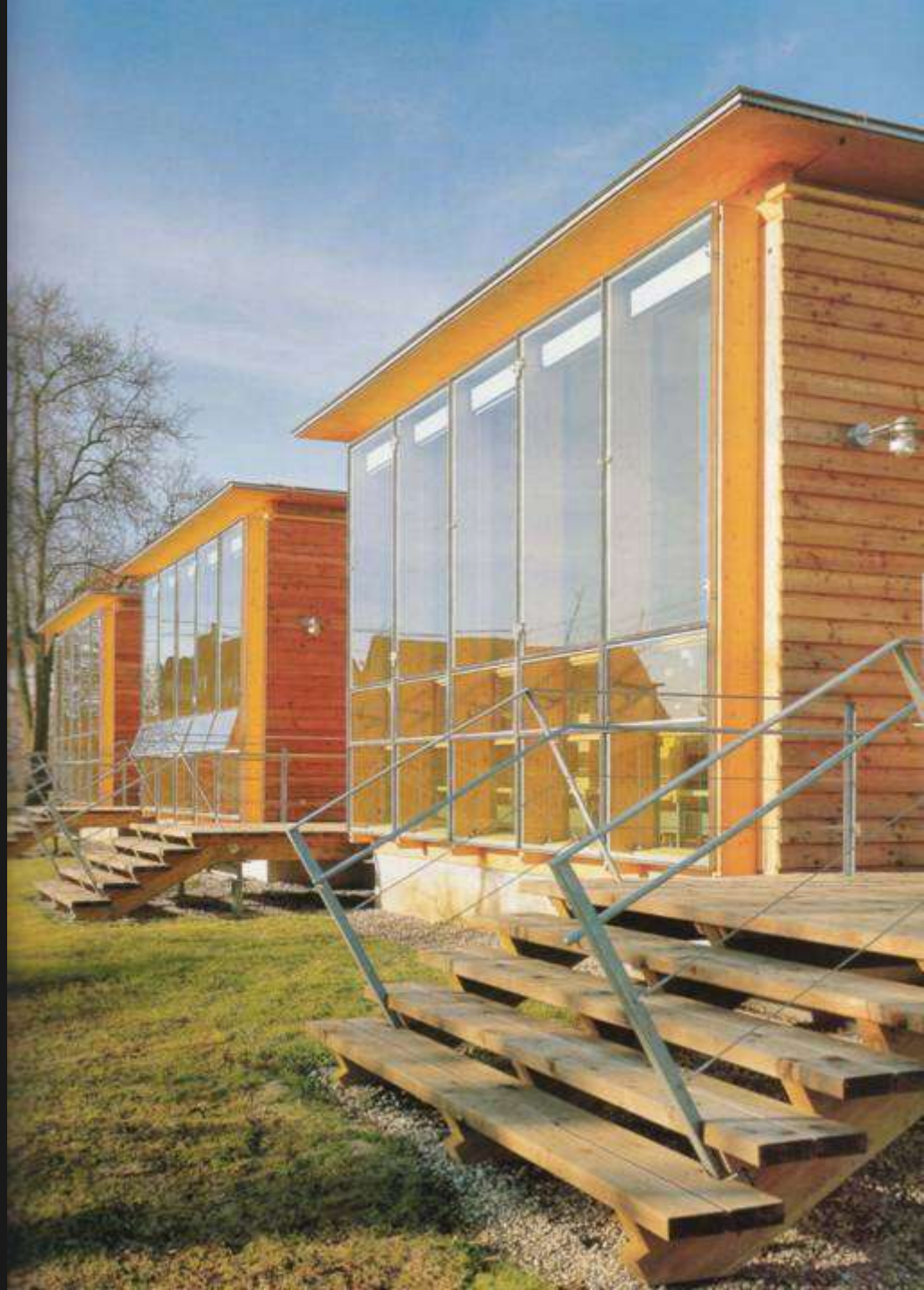


Dim Light Melatonin Onset DLMO
● (after – no morning light)



Solar Heat (& Sterilization)

***Sunshine may be one of the
best strategies to
reduce mold growth,
provide photocatalytic disinfection,
and ensure affordable thermal
comfort in winter.***





Natural Ventilation

Natural Ventilation = Health + Individual Productivity

Preziosi et al 2004

In a 2004 multiple building study of professional middle-aged women in France, Preziosi et al identify a **57.1% reduction in sickness absence**, a **16.7% reduction in medical services use (doctor visits)**, and a **34.8% reduction in hospital stays among subjects with natural ventilation in their workplace**, as compared to those with air conditioning.

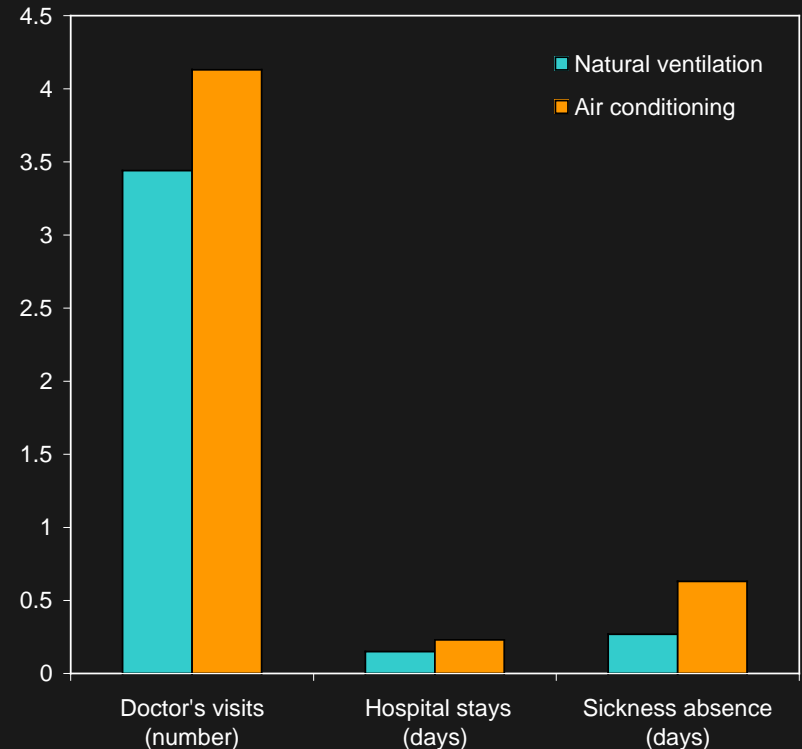
First cost increase: \$1,000 / employee

Annual health savings: \$181 / employee

Annual productivity savings: \$85 / employee

ROI: 27%

Per capita health services use and absenteeism in naturally ventilated vs. mechanically ventilated buildings



Natural Ventilation = Health + Individual Productivity

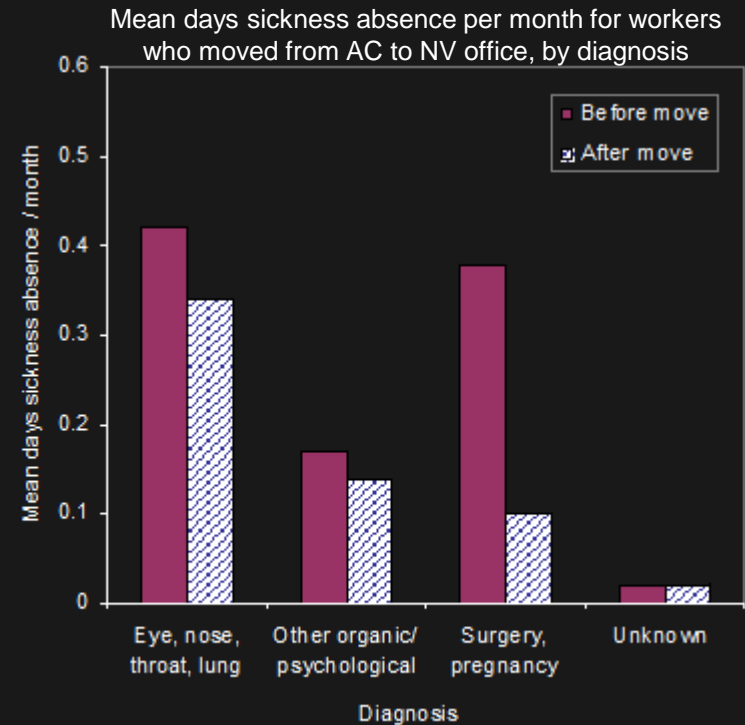
Robertson et al 1990 (Office)

In a 1990 multiple building study of 86 workers in 43 office buildings in the UK, Robertson et al identify a **9% reduction in sickness absence** and a **59% reduction in sick building syndrome (SBS) symptoms among workers in naturally ventilated buildings**, as compared to workers in air conditioned buildings.

First cost increase: \$1,000 / employee

Annual productivity savings: \$127 / employee

ROI: 13%





Should Windows Open?

No

Avoid outdoor pollution

Avoid outdoor humidity

Avoid outdoor noise (traffic, HVAC, mowers)

Well designed/maintained HVAC provides better control

Avoid rain penetration

Yes

Increase local ventilation rates w/o heat recovery

Dilute indoor pollution from HVAC itself

Dilute indoor pollution from materials/ activities

Diffuse indoor humidity

Increase local thermal control in cool periods

Connect to nature – feel of the air, nature's sounds, smells

(Design windows to shed rain)



**Natural Ventilation and
Radiant Cooling**



**Natural Ventilation
& Access to Nature**



Access to Nature

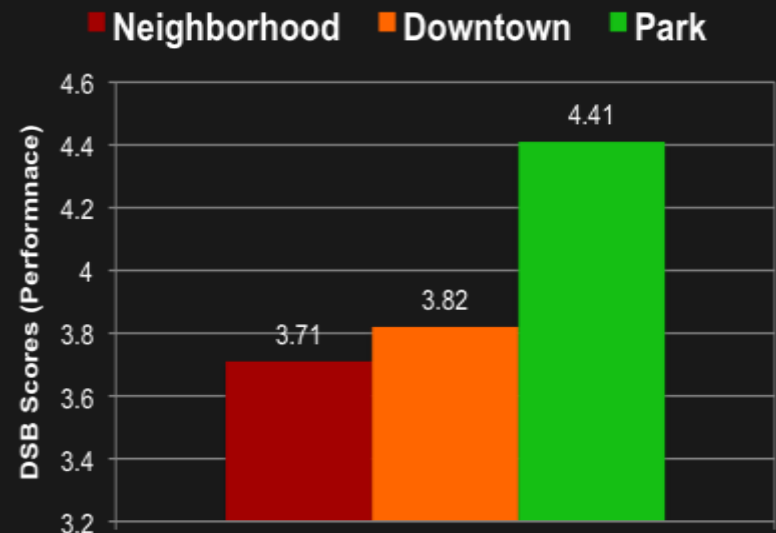
Natural Environment = Concentration and Performance Levels

Taylor and Kuo 2008

In a 2004 field study of 17 children professionally diagnosed with ADHD (Attention Deficit Hyperactivity Disorder) in Chicago, Illinois, Taylor and Kuo identify a **17% improvement in performance after a 20 minute guided walk in a natural environment setting**, as compared to a walk in a residential and downtown setting.

First cost increase:	\$16.80 /student
Annual maintenance cost increase:	\$1.01 / student
Annual funding gains:	\$187.00 / student
ROI:	1,107 %

Mean Postwalk Scores on Digit Span Backwards Test After 20 minute guided walks in different settings



Downtown walk ($P=0.0229$)
Neighborhood walk ($P=0.0072$)

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

Indoor plants = Health + Individual productivity

Fjeld et al 1998

In a 1998 controlled field experiment at a Norwegian oil company, Fjeld et al identify an average **21% reduction in SBS symptoms among occupants of offices with indoor plants**, as compared to those without plants.

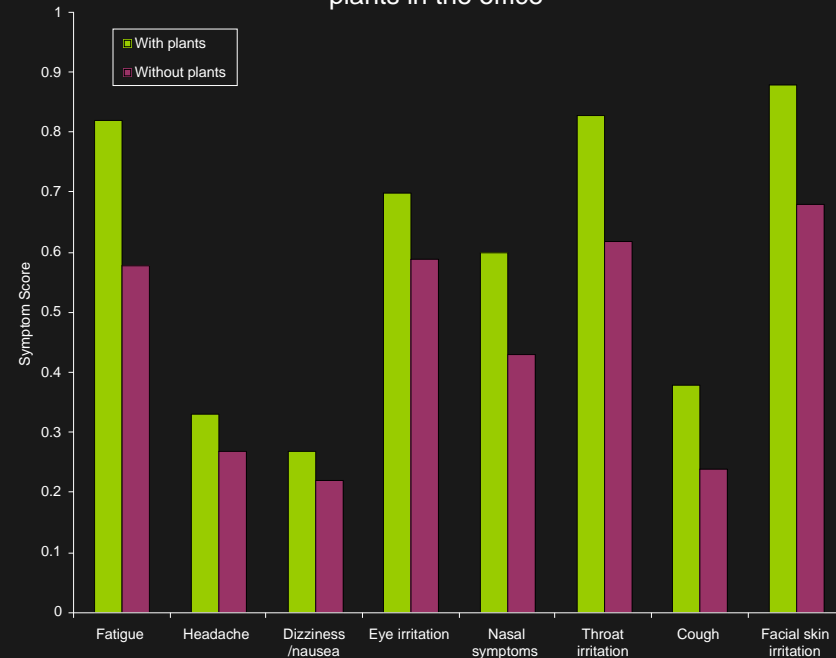
In a 2000 study, Wargocki et al identify a 1.1% increase in productivity for every 10% reduction in SBS complaints, indicating a 2.3% productivity gain due to the presence of plants in the office.

First cost increase:	\$98 / employee
Annual productivity savings:	\$1,035 / employee
Annual maintenance cost increase:	\$60 / employee

ROI: 995%



Self-reported symptom scores with and without plants in the office



Fjeld, T, et al (1998) The effect of indoor foliage plants on health an discomfort symptoms among office workers. *Indoor & Built Environment*, 7, pp. 204-209.

Wargocki, P, et al. (2000) Pollution Source Control and Ventilation Improve Health, Comfort and Productivity. In *Proceedings of Cold Climate HVAC 2000, Sapporo, Japan, November 1-3, 2000*



Sounds of Nature



Smells of Nature



© Jeff Conner

Smells of Nature :
Raydon's Favorite Asters - Natures Perfume
Lance Hosey NYT Oct. 27, 2013



Sensory Feel of Nature



Material & Craft



Art & Ornament



Art & Ornament



Community



Community



Community



Elements of
Time and Place

