



# **To Your Good Health:** **exploring metro nature, remote sensing,** **and economics**

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# Ecosystem Services

ECOSYSTEM SERVICES	
<b>Supporting Services</b>  Nutrient cycling Soil formation Primary production	<b>Provisioning Services</b>  Food (crops, livestock, wild foods, etc...) Fiber (timber, cotton/hemp/silk, wood fuel) Genetic resources Biochemicals, natural medicines, pharmaceuticals Fresh water
	<b>Regulating Services</b>  Air quality regulation Climate regulation (global, regional, and local) Water regulation Erosion regulation Water purification and waste treatment Disease regulation Pest regulation Pollination Natural hazard regulation
	<b>Cultural Services</b>  Aesthetic values Spiritual and religious values Recreation and ecotourism

**Millennium  
Ecosystem  
Assessment**

**2005**

# The Ancient Tree Forum

## Windsor Great Park tour























## Ted Green Ancient Tree Guardian











# Ecosystem Services

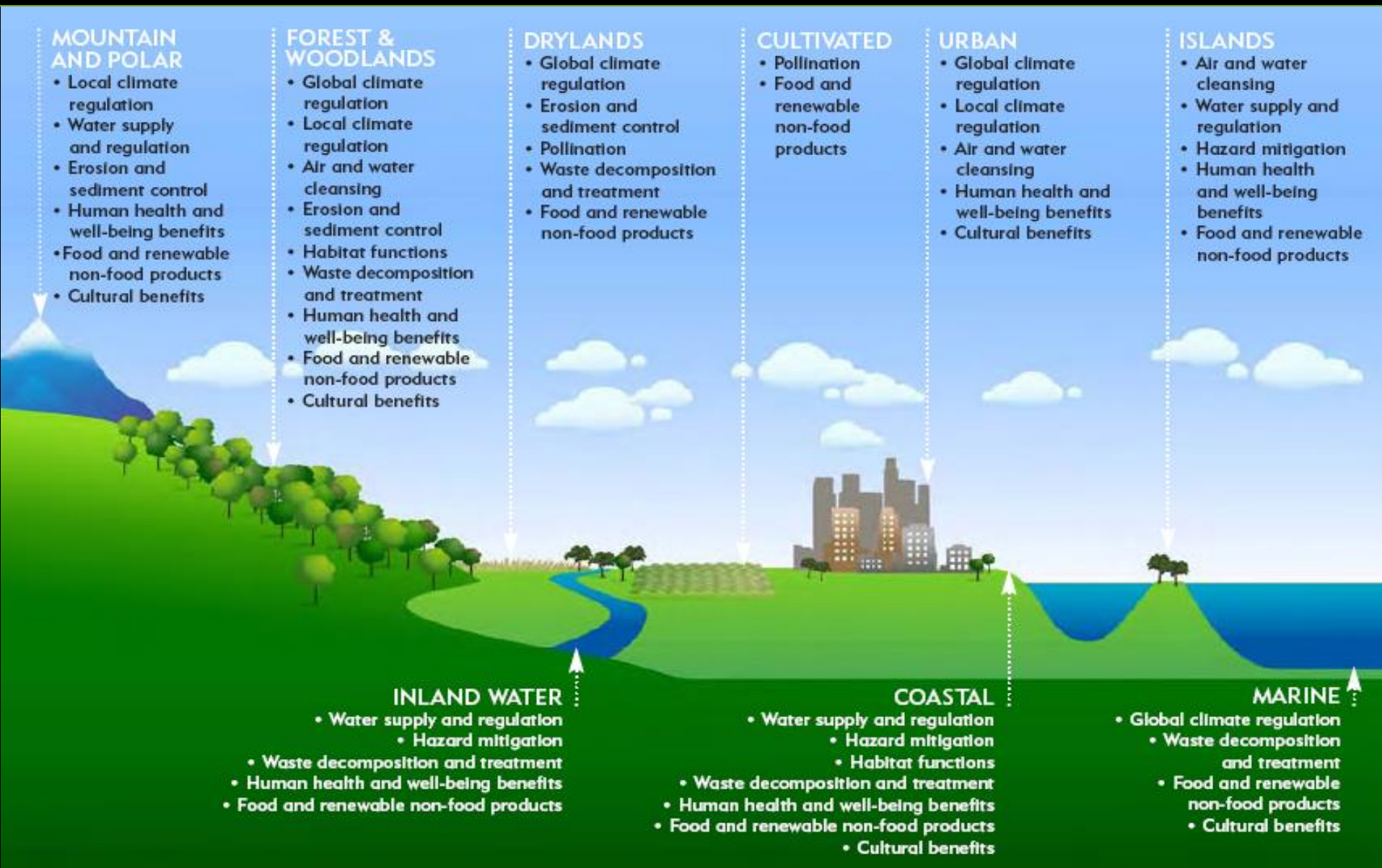
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# Landscape Gradient :: *Ecosystem Services*



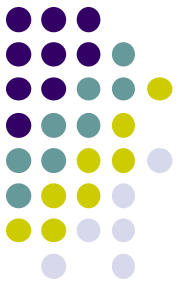


# Nature Benefits Only Beyond the City?





# Health & Well Being Cultural Ecosystem Services





# evidence about the importance of 'nearby nature'







# **City Trees, Metro Nature for Health . . . . Habitat**

scientific evidence

health & well being benefits

life course concept

‘cradle to grave’

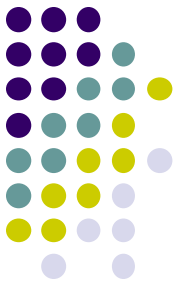






# Urban Forests and Newborns

the natural environment may affect  
pregnancy outcomes . . .



10% increase in tree-canopy cover  
within 50m of a house  
= lower number of low weight births  
(1.42 per 1000 births)

*Donovan et al., Health & Place 2011;  
Hystad et al., Env Health Perspectives 2014*



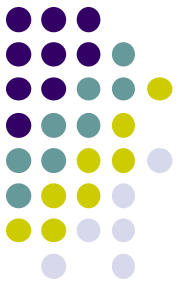
# Nature & Psych Development children's play & imagination



**Richard  
Louv -  
Last  
Child in  
the  
Woods**



# School & Learning





# Green High School Campuses

- cafeteria & classroom window views with greater quantities of trees and shrubs
- positively associated with:
  - standardized test scores,
  - graduation rates
  - %s of students planning to attend a four-year college
  - fewer occurrences of criminal behavior





## the nature advantage

- College students with more natural views from their dorm windows
  - scored higher on tests of capacity to direct attention
  - rated themselves as able to function more effectively

Tennessen & Cimprich. 1995.  
Journal of Environmental Psychology 21



# Trees & Crime Reduction

- trees in the public right of way are associated with lower crime rates
  - smaller, viewobstructing trees are associated with increased crime
  - larger trees are associated with reduced crime

Donovan & Prestemon. 2012.  
*Environment and Behavior*







# EAB Tree Loss & Public Health

**1990 to 2007, 1,296 counties in 15 states**

**infected areas vs. no bugs**

**15,000 more deaths from cardiovascular disease**

**6,000 more deaths from lower respiratory disease**

**controlled for demographic, human mortality, and forest health data at the county level**

**Toledo, Ohio in 2006, pre EAB**



**2009, EAB in neighborhood**



**photos: Dan Herms, Ohio State University**


# *Shinrin-yoku* Forest Bathing



- extended forest walks
  - reduced ‘fight or flight’ nervous system activity
  - lower cortisol – a stress indicator
  - increased immune function
  - lower pulse rate & blood pressure







Extensive Evidence?  
How Do I Learn More?

# Finding that study . . . . .





# Research Review and Summaries



**Sponsors:**

**University of Washington**

**USDA Forest Service, U&CF Program**

**NGO partners**

**thanks!**

**to U of WA students:**

**Katrina Flora**

**Mary Ann Rozance**

**Sarah Krueger**



**[www.greenhealth.washington.edu](http://www.greenhealth.washington.edu)**

# Green Cities: Good Health



**INTRODUCTION   RESOURCES   FUTURE RESEARCH   REFERENCES**

Community Building

Local Economics ▶

Place Attachment & Meaning

Crime & Fear ▶

Safe Streets ▶

Active Living ▶

Reduced Risk

Wellness & Physiology

Healing & Therapy

Mental Health & Function ▶

Work & Learning

Culture & Equity

Lifecycle & Gender

## Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions! This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums.<sup>1,2</sup> Then, it shows how nonmarket valuations can support local decision-making.

### Fast Facts

- The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.
- Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of \$1.35 billion, potentially increasing annual property tax revenues \$15.3 million.<sup>9</sup>
- A study found 7% higher rental rates for commercial offices having high quality landscapes.<sup>14</sup>
- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.<sup>34</sup>
- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.<sup>34</sup>

[RSS Feed](#)

[Print](#)

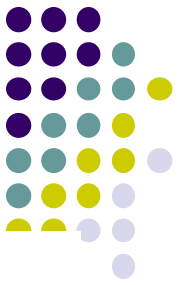


*street trees boost market value of houses, providing tax revenue for communities*





# Metro Nature & Health Evidence Framework





# Summary

nearly 40 years of health evidence  
diverse health benefits  
associated with diverse nearby nature

consider a habitat outlook  
expand partnership & collaboration

**back to life course . . . . .**



# Physical Activity & Depression Reduction



- Review of 13 high quality studies
  - exercise recommended for mild to moderate depression
  - people who are willing & motivated
  - associated meditation and mindfulness are important

Josefsson et al. 2013.  
Physical Exercise Intervention  
in Depressive Disorders.  
Scandinavian Journal of  
Medicine & Science in Sports





parks, recreation, active transit



## • CANINE CONSTITUTIONAL

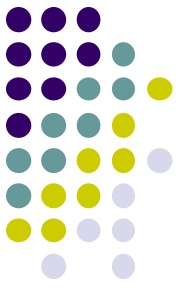


Tom Saville / Chicago II

A brisk walk in the park keeps Macey B in shape between dog shows. His owner, Columbus resident Cathy Stumbo, got up early

to give her 3-year-old Doberman his regular workout. They typically log 18 miles in Berliner Park.

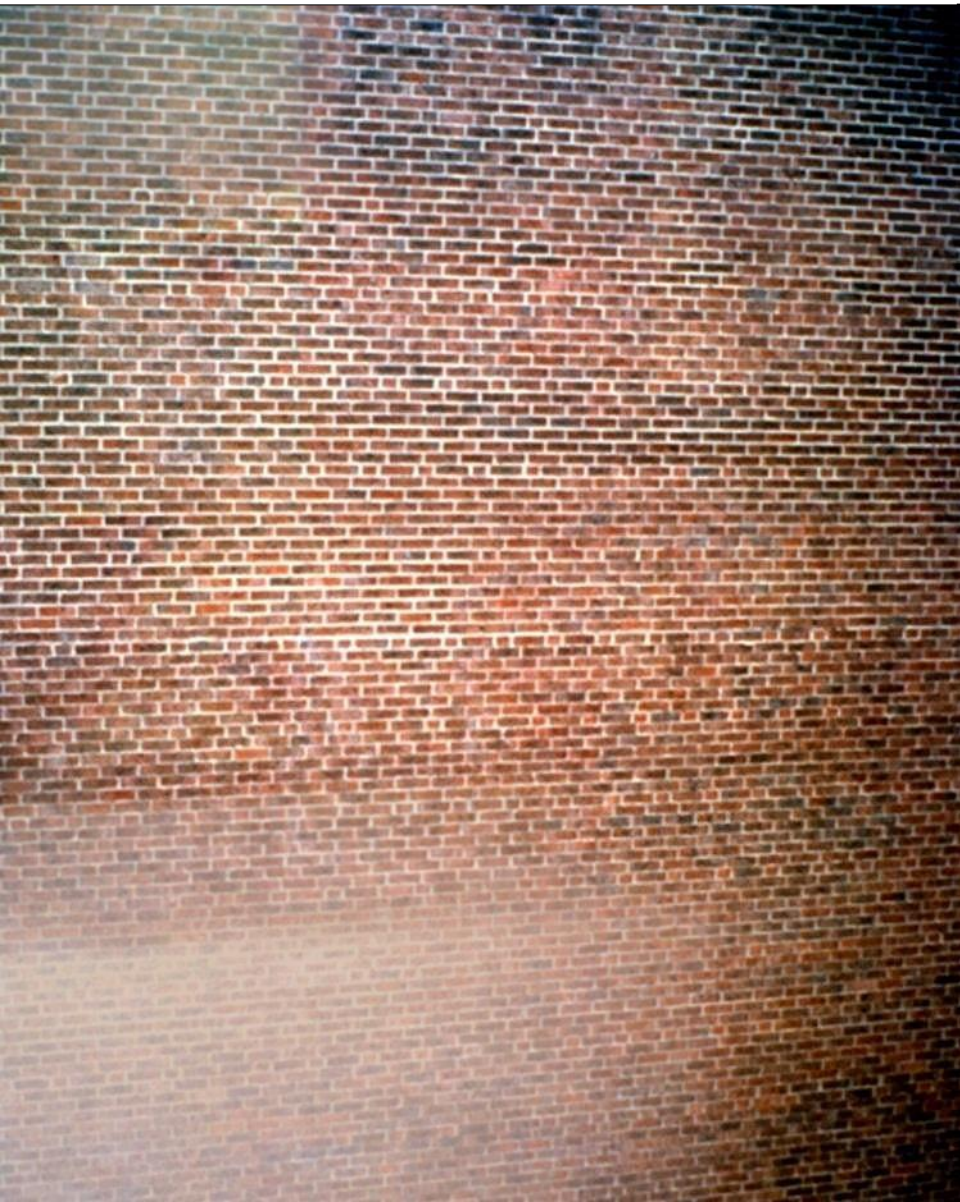
# hospital healing gardens: patients; family and friends; professional staff



**health  
care \$\$  
savings**



# Effects of nature window view on recovery from surgery (Roger Ulrich, 1984)



- Shorter stays
- Less pain
- Fewer minor complications
- Better emotional well-being



Legacy Good Samaritan Medical Center  
Stenzel Healing Garden 1997  
Rehabilitation Institute of Oregon





# Hospital Staff – Respite and Support



## Nature: A stress coping resource for employees 24-7



thanks to  
Teresa Hazen  
Legacy, Portland  
for slides



# Elders: mobility & social connections





Evidence about Metro Nature,  
City Trees, Health, Wellness

new work!





**urban forest benefits**

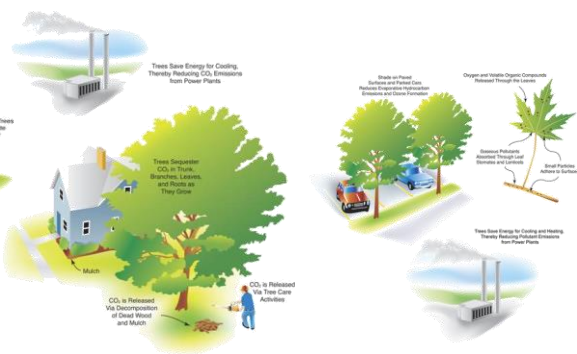
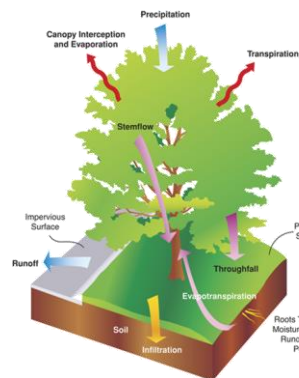




Eco  
Streets  
Hydro  
Vue

future?  
Health/  
Anthro

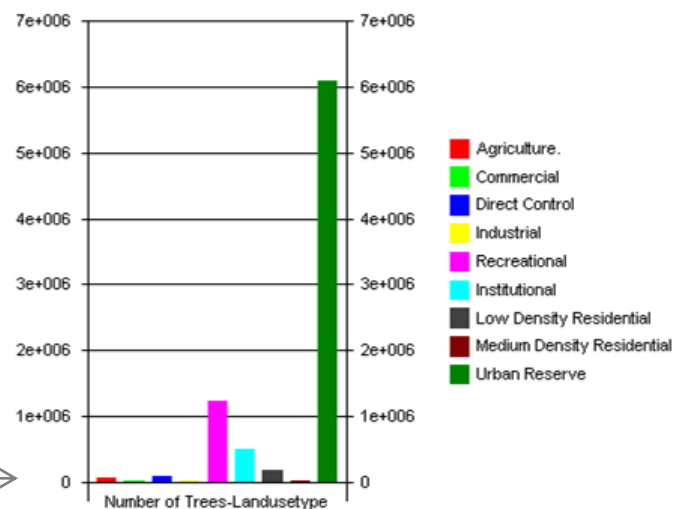
## STRUCTURE FUNCTION/BENEFIT



## ECONOMIC VALUE



## MANAGEMENT





**more than trees . . . nature & health evidence**





# Urban Tree Canopy Assessment

## i-Tree analysis

City of Seattle



vegetation and land use map for Seattle

image credit: UW Remote Sensing and Geospatial Lab



**Top Down  
Mapping**

**plus  
understory  
vegetation**

**for human  
habitat**



**school yard landscapes**



A photograph of a forest with snow on the ground and several yellow markers on tree trunks. The forest is composed of tall, thin trees, likely spruce or fir, with green needles. The ground is covered in a layer of snow, with some green vegetation visible. Several yellow markers are attached to the trunks of the trees, indicating a managed forest. The text "forest = silviculture" is overlaid on the image in a bold, white font.

**forest = silviculture**

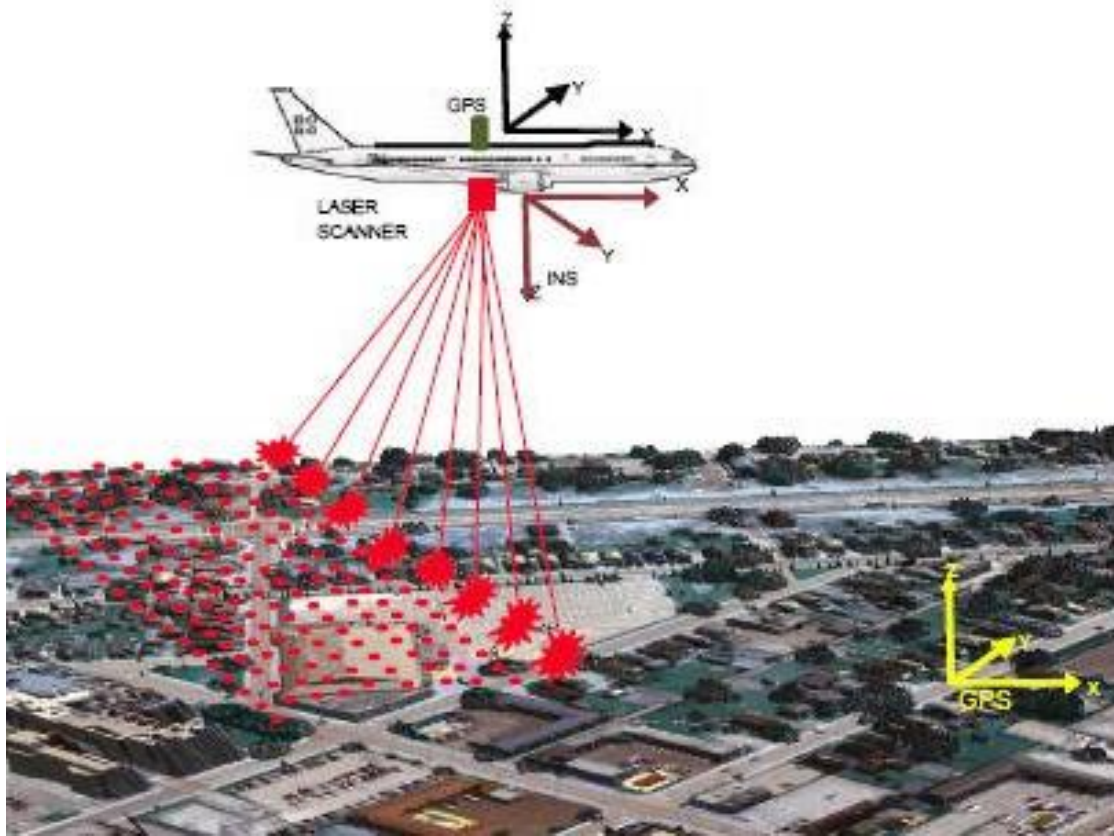


A photograph of a dense forest. Tall, slender trees with light-colored bark stand vertically, their trunks creating a rhythmic pattern. The canopy is thick with green leaves, and sunlight filters through in soft, hazy beams, creating a dappled light effect on the forest floor. The overall atmosphere is serene and natural.

**forest = ecosystem**



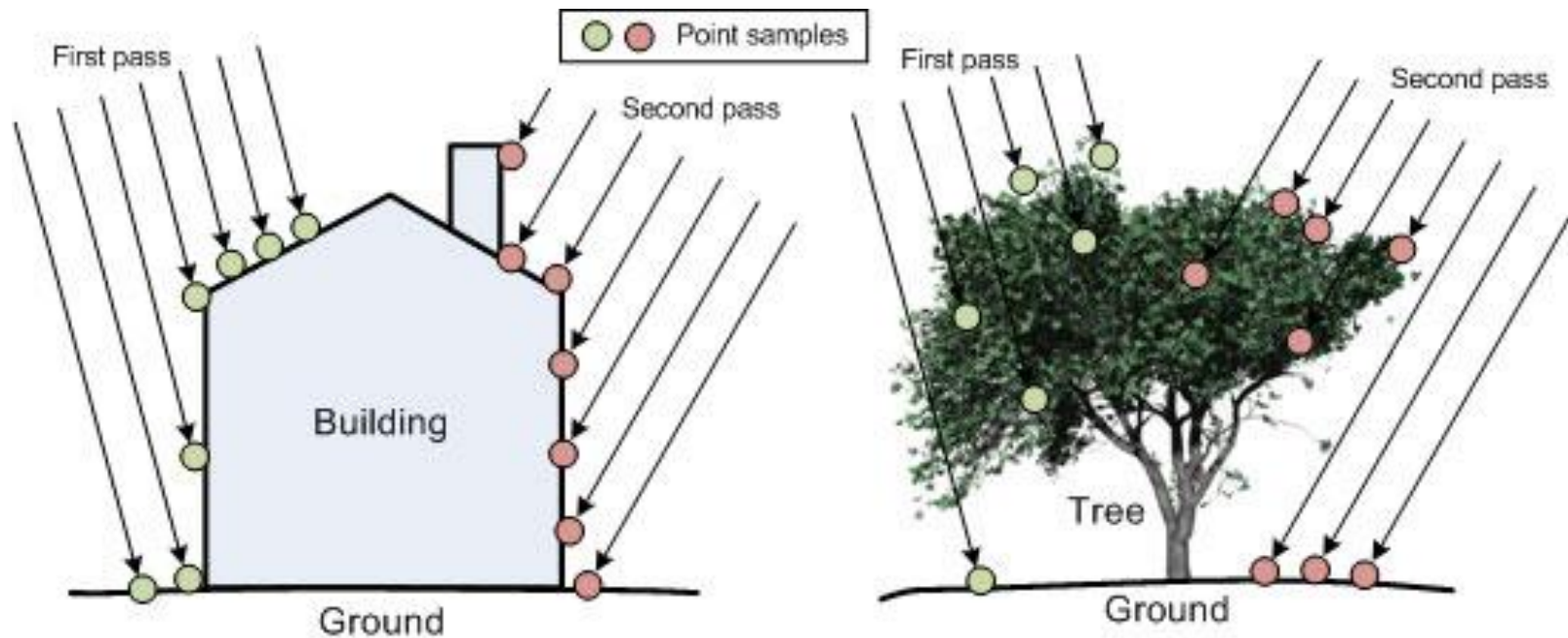
# Remote Sensing-LIDAR



Wolf, K.L., and C. Vondrasek. 2014.  
Technologies for Metro Nature  
Health Benefits Mapping.  
Seattle: University of Washington.

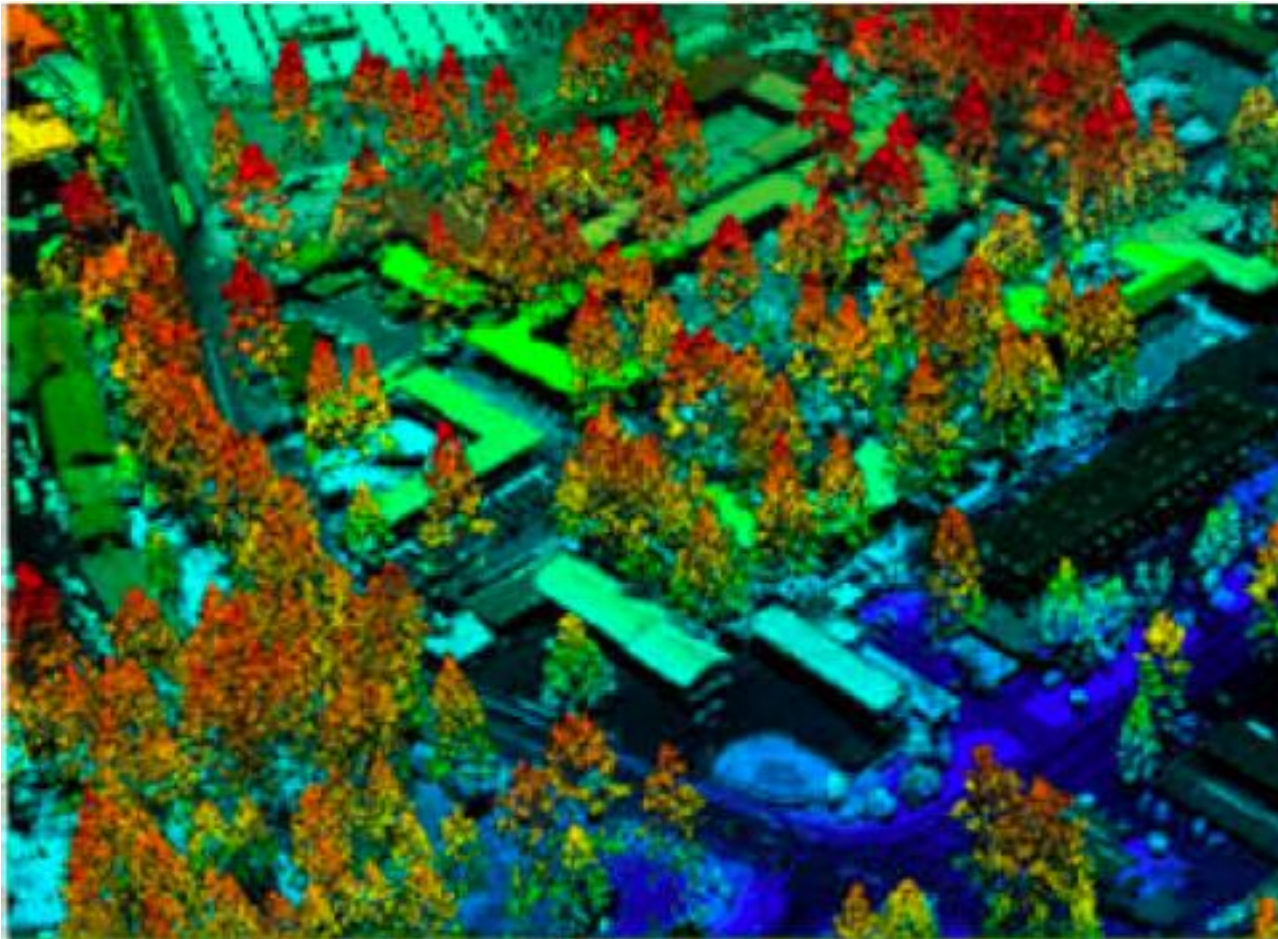


# Remote Sensing-LIDAR



*LiDAR response to built versus vegetative surfaces.*  
credit: Qian-Yi Zhou, Stanford University

# Veg Assessment Explorations

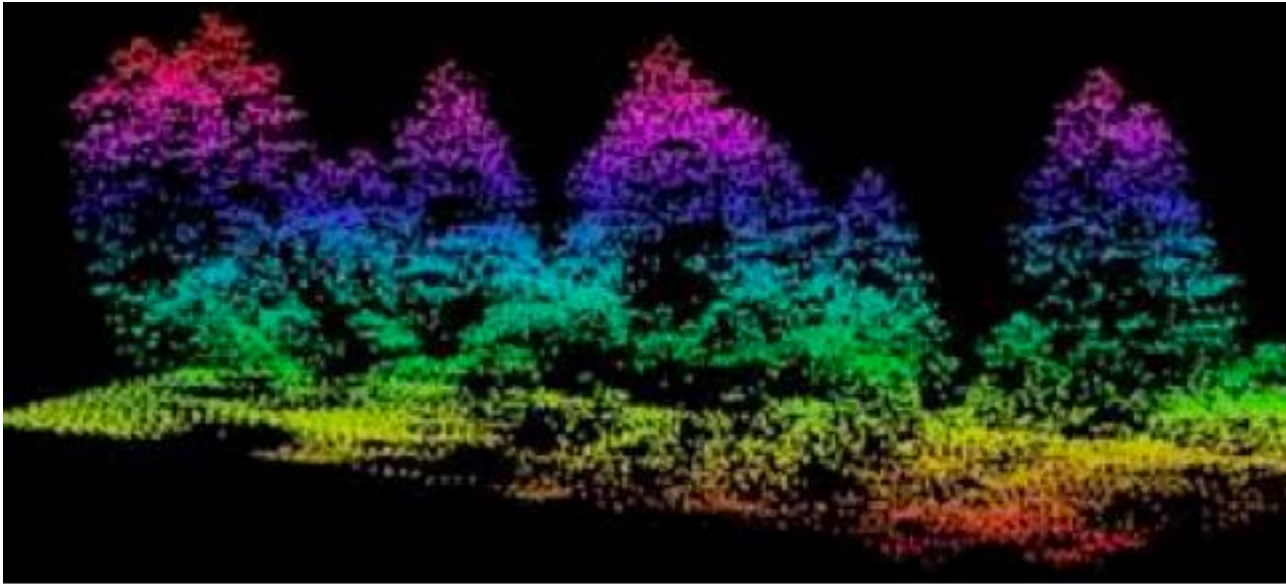
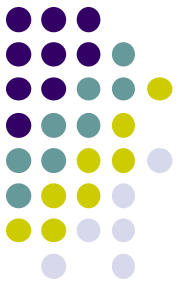


oblique  
aerial  
view

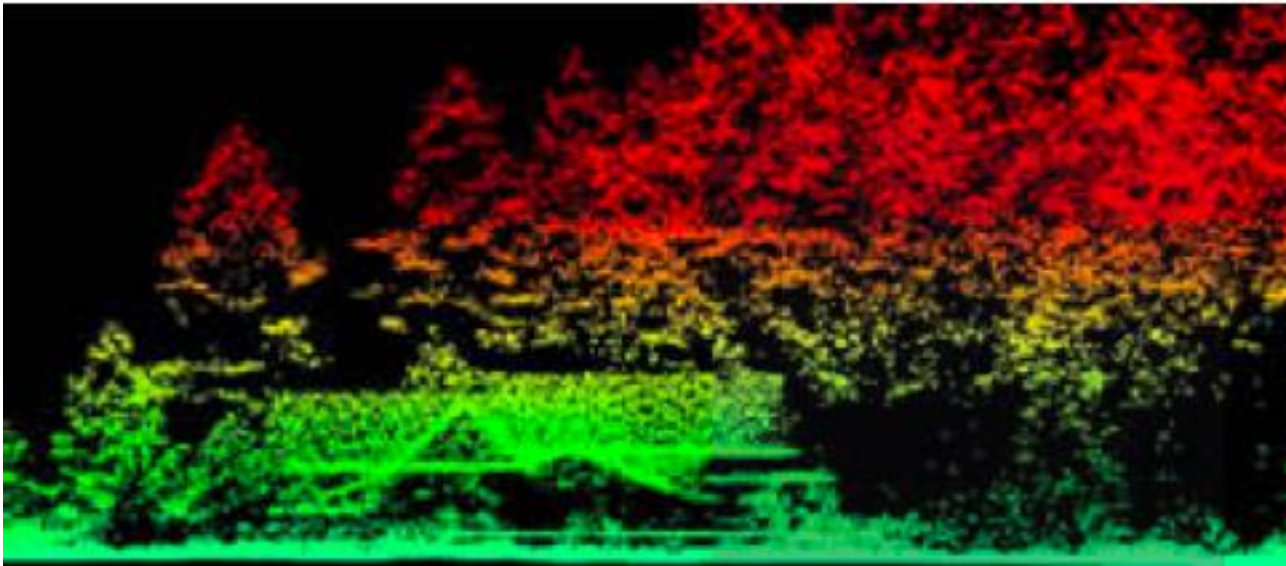
LIDAR  
point  
cloud



# Veg Assessment Explorations



ground  
view



LIDAR  
point  
cloud



**What is the Economic Value?**





# Economic Value Exploration

Benefit	Metro Nature	Outcome
Newborn Birth Weight	canopy cover and birth weight	more tree canopy-fewer small for gestational age babies
Attention Deficit Hyperactivity Disorder	greener play areas vs built outdoor or indoor settings	reduced symptoms potentially reducing medication
School Performance	green views from classrooms and cafeteria	reduced dropout rate - average annual income
Crime Reduction	trees and lawn in outdoor common areas	reduced violent and non-violent incidence and costs
Cardiovascular Disease	presence of residential tree canopy	reduced incidence or severity of cardiovascular disease
Alzheimer's Disease	wander garden in care facility	reduced medications for patients

**value = degree of benefit x public/personal costs**

**Total Value (2012, U.S.) – annual \$1.8 to \$5.9 billion**



# Caveats and Conditions


- shhh! still under peer review for publication
- life course focus
- subset of all metro nature findings
- the best current valuation prospects
- numbers rather small – why?



# Valuation Challenges . . . .



- little crossover of natural resources and public health methods
- spotty local health data sources
- equivalent geographic scale of datasets:
  - < 1m for vegetation
  - neighborhood or block for health
- precision of vegetation assessment . . .  
(may need more than canopy)



# Summary & Conclusions





**in the  
background**

**trees &  
forests for  
human  
health &  
well-being**

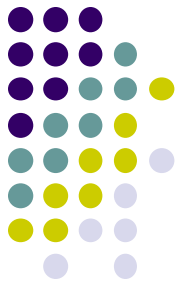




# Summary

- urban forests/metro nature provide habitat for human health
- throughout human life course!
- evidence! Green Cities: Good Health
- vegetation assessment – more ecosystem structure
- economic implications – preliminary





## Human Dimensions of Urban Forestry and Urban Greening

featuring research on peoples'  
perceptions and behaviors  
regarding nature in cities

### *Green Cities: Good Health*

human health & well-being research

Projects Director  
**Kathleen L. Wolf, Ph.D.**



### *What's New?*

#### **Nature and Consumer Environments**

Research about how the urban forest influences business district visitors.

#### **Trees and Transportation**

Studies on the value of having quality landscapes in urban roadsides.

#### **Civic Ecology**

Studies of human behaviors and benefits when people are active in the environment.

#### **Policy and Planning**

Integrating urban greening science with community change.

#### **Urban Forestry and Human Benefits**

More resources, studies and links . . .

#### Sponsors



[www.naturewithin.info](http://www.naturewithin.info)

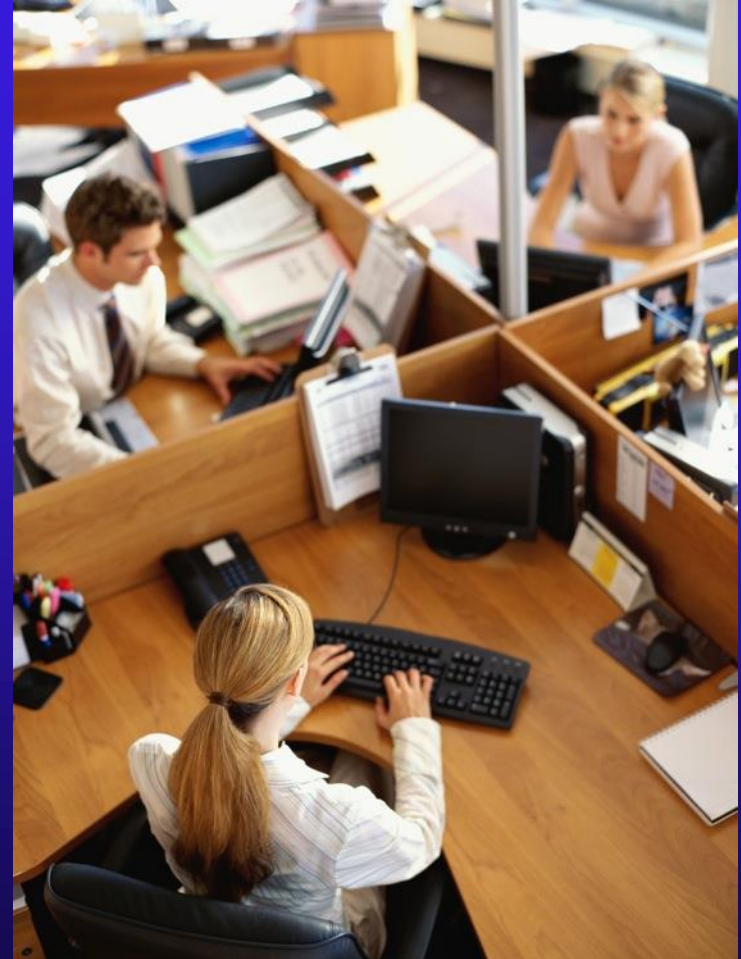
our evolution?!





# Attention Restoration Theory

Rachel & Stephen Kaplan U of MI



# directed attention fatigue . . . .





Kaplan, R. 1993. Landscape  
and Urban Planning.

## Workplace Nature Views

---

- Well-being

- desk workers without view of nature reported 23% more ailments in prior 6 months

- Job Satisfaction

- less frustrated and more patient
- higher overall job satisfaction and enthusiasm

# ART Design Elements

- being away
- 'soft' fascination
- extent
- compatibility







the  
better  
office  
cubicle!

bottom line =  
\$\$ benefits of trees & nature

# Green & Crime Reduction

- vacant lot greening in Philadelphia (4 sections)
  - consistent reductions in gun assaults across 4 sections
  - consistent reductions in vandalism in 1 section




Branas et al.  
2011.  
*American  
Journal of  
Epidemiology*



# Oregon Burn Center Garden



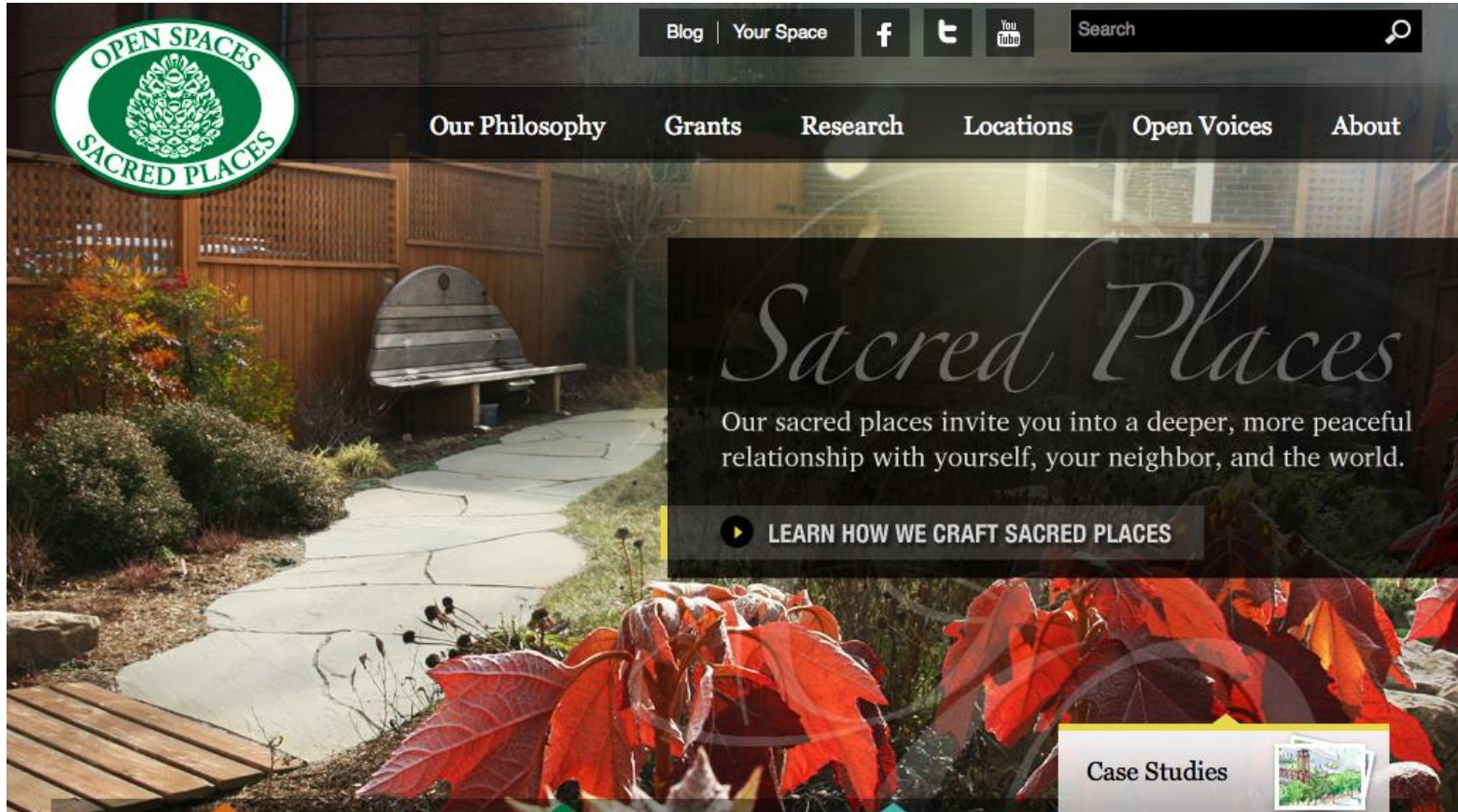


# **Science and the Sacred for Better Human Habitat?**

another dimension

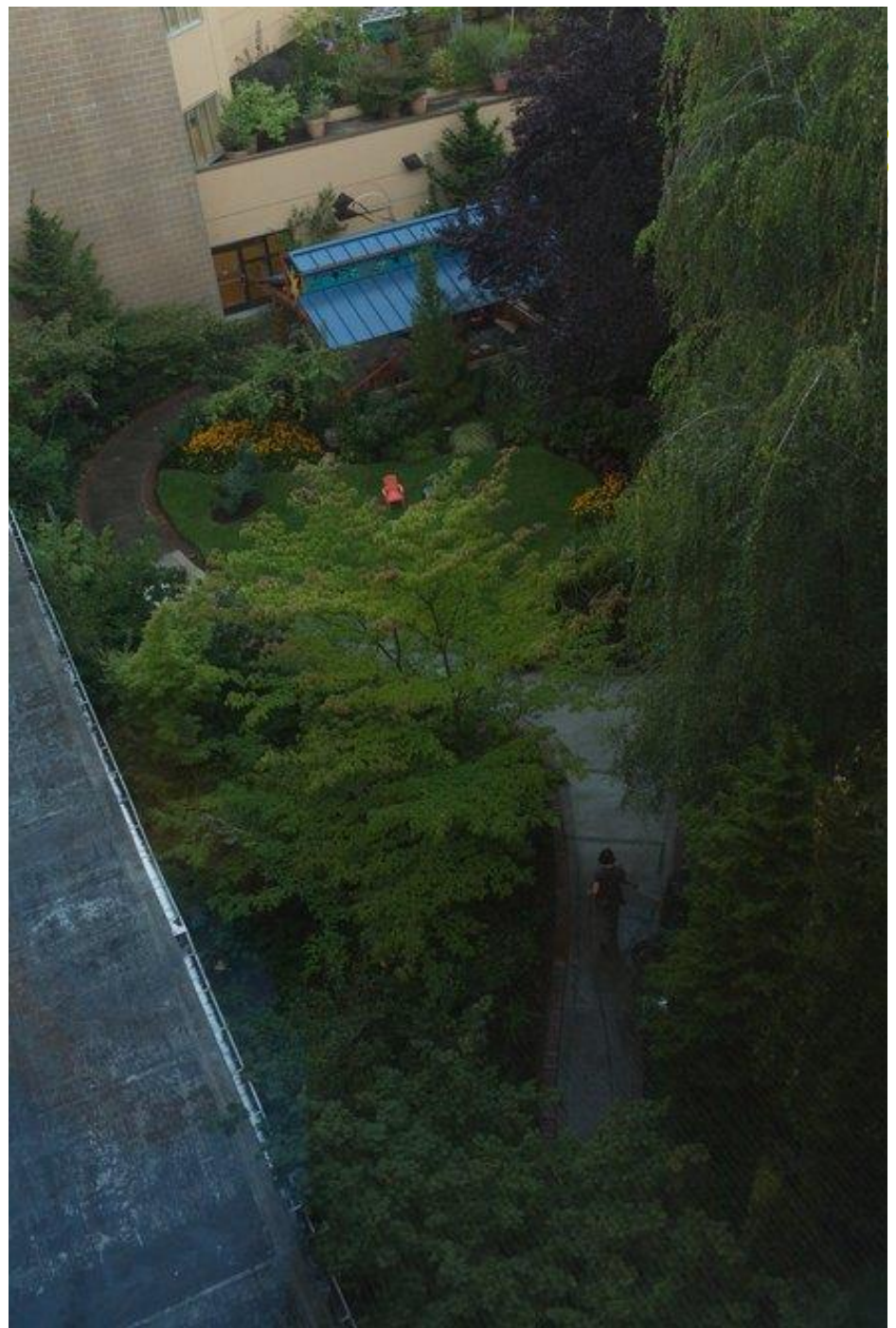


# TKF Foundation Annapolis MD



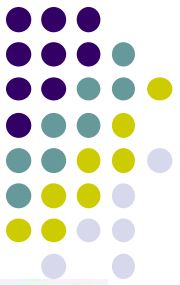
public green spaces that please the eye,  
nourish the soul, and help renew communities

**healing gardens**  
**soothing**  
**distracting**  
**calm focus**





# Design Elements



 Portal




 Path



 Destination

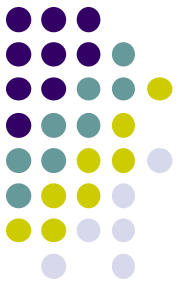


 Surround

NatureSacred :: Open Spaces Sacred Places

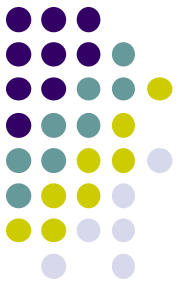


**portal :: path :: surround :: destination**





**portal :: path :: surround :: destination**





**science & sacred intersection?**





**place, design & mindfulness**

# Nature and Mindfulness

- focus
- soft fascination
- undirected attention



credit: Michael Hellgren





# Mindfulness/Meditation Training



- meta analysis; clinical/non situations
- focus on moment-to-moment experience and mental awareness
- more veridical perception (reality check)
- reduce negative affect
- improve vitality and coping
- medical symptoms & sensory pain

Grossman et al. 2004. Mindfulness-based Health Benefits. J. of Psychosomatic Research



# Mindfulness/Meditation Training

- healthy workplace employees
- 8 week mindfulness training
- brain electrical activity – positive affect
- brain activation – reduce stress event response
- more antibodies after influenza vaccine = better immune function

Davidson et al. 2003. Alterations in Brain and Immune Function Produced by Mindfulness Meditation. Psychosomatic Medicine