



Kings Road House - Schindler



SRG Architects with UO ESBL, Mt. Angel, OR



EX3 – Weinstein AU, Photo: Mee



Miller Hull Partnership – Environmental Services Building, Photo: Meek & VDW



Courtesy: Bullitt Foundation



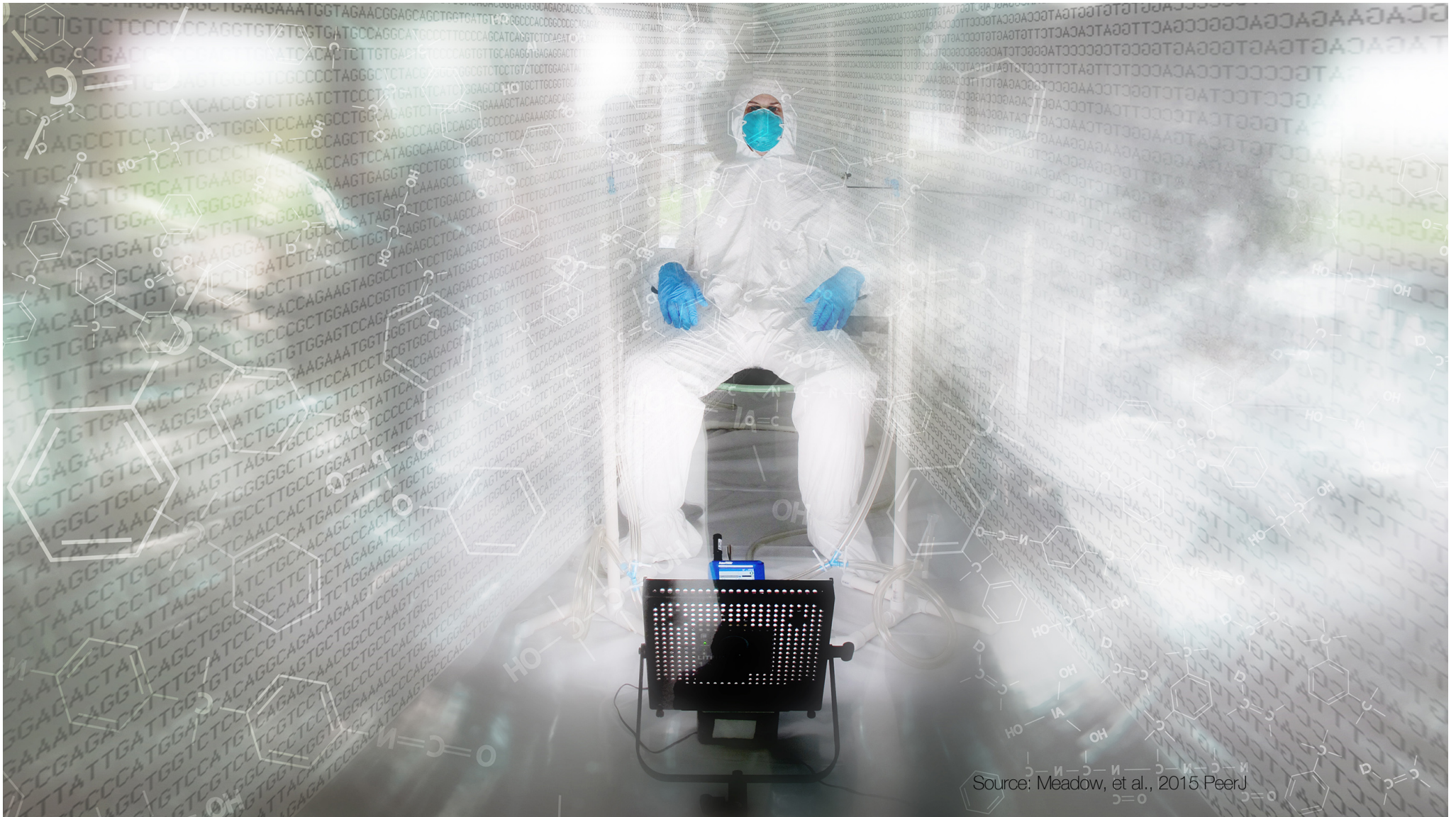
Bellingham Technical, HKP Architects, Photo: Meek



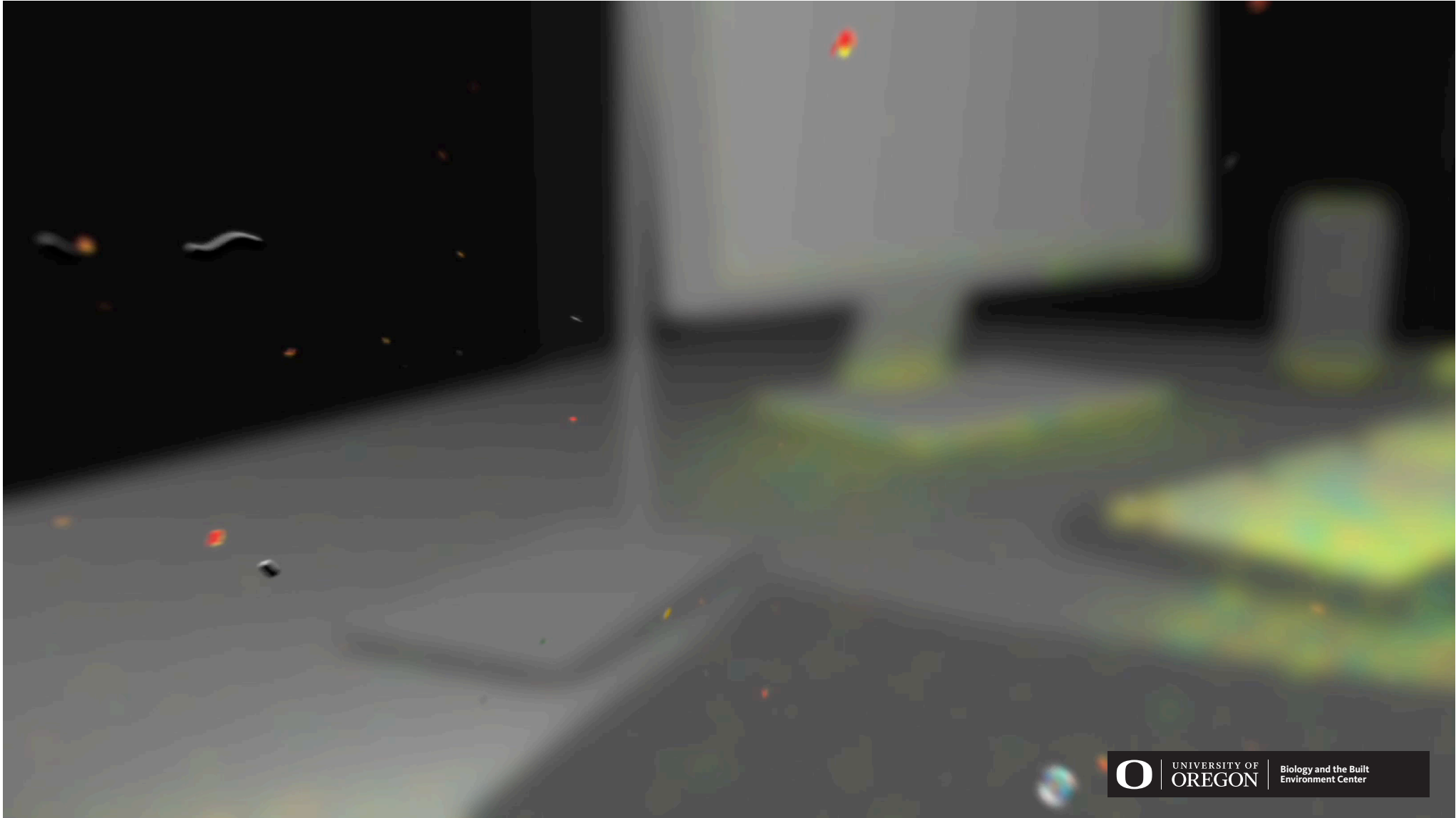
Terry Thomas , Weber Thompson, Photo: Meek & VDW



Portland Community College - SRG Architects






Source: Meadow, et al., 2015 PeerJ

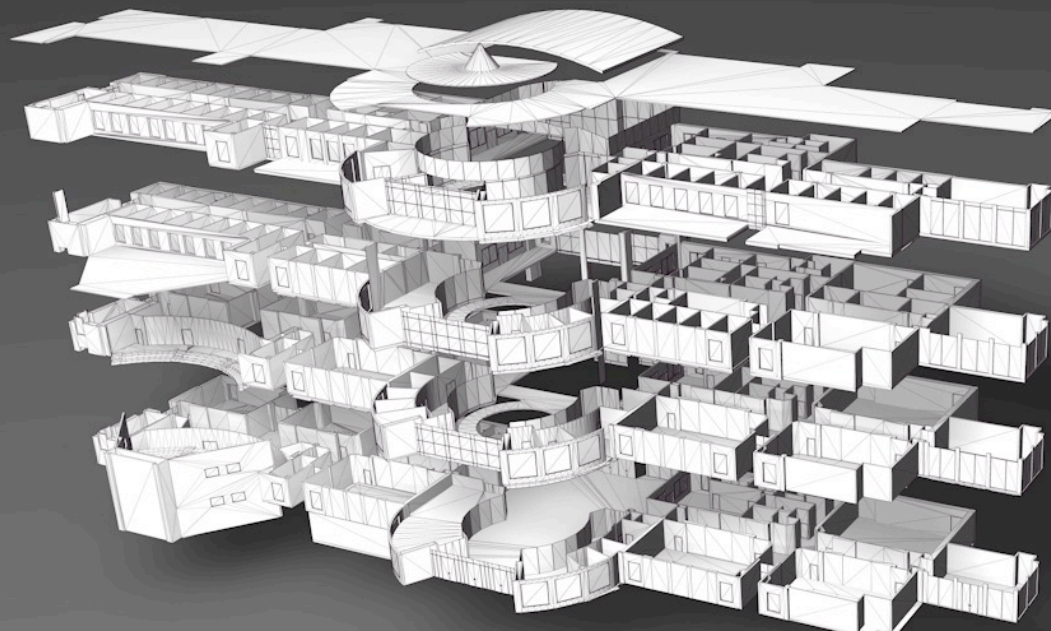







BiomeView

 Import	 Filter	 Analyze	AUTODESK
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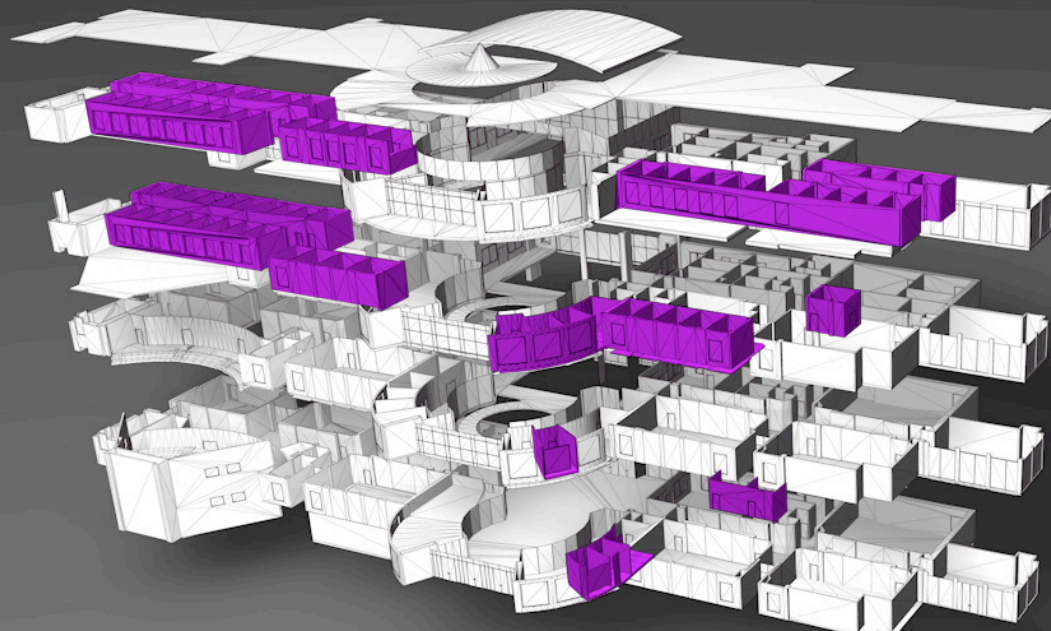


BiomeView

 Import	 Filter	 Analyze	AUTODESK
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Project Cyborg



Lillis Building



73

Offices



BiomeView

Import Filter Analyze

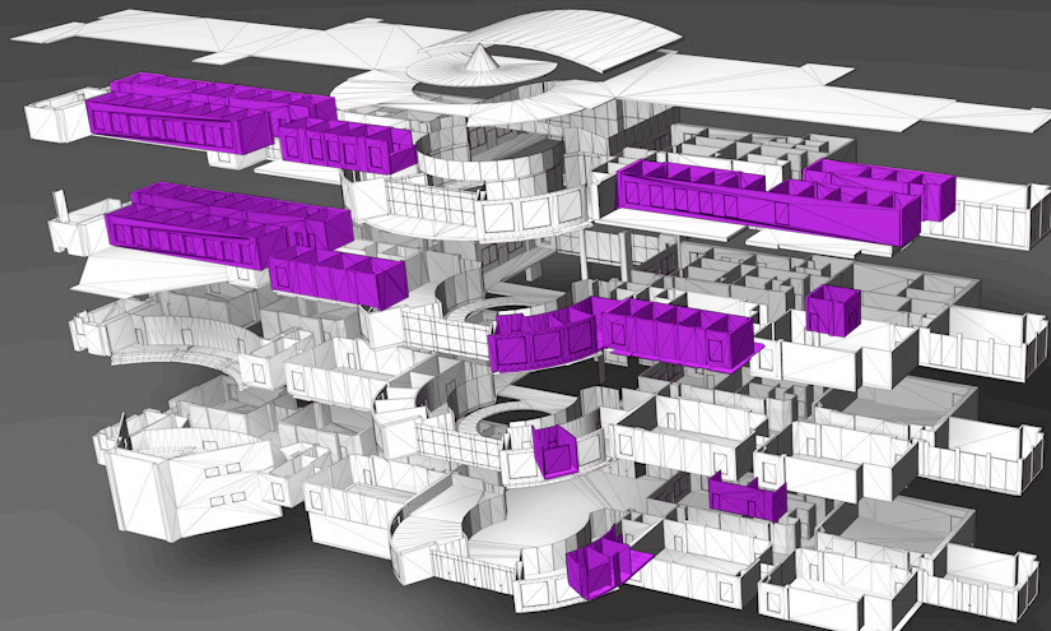
AUTODESK



73

Offices





Lillis Building



73

Offices



BiomeView

Import Filter Analyze

AUTODESK



Project Cyborg



Thursday
08:12 AM

Friday

Saturday
12:00PM

BiomeView



Import



Filter



Analyze

AUTODESK





Lilis

Air Ventilation



Thursday
08:12 AM

Friday

Saturday
12:00PM

BiomeView

Import Filter Analyze

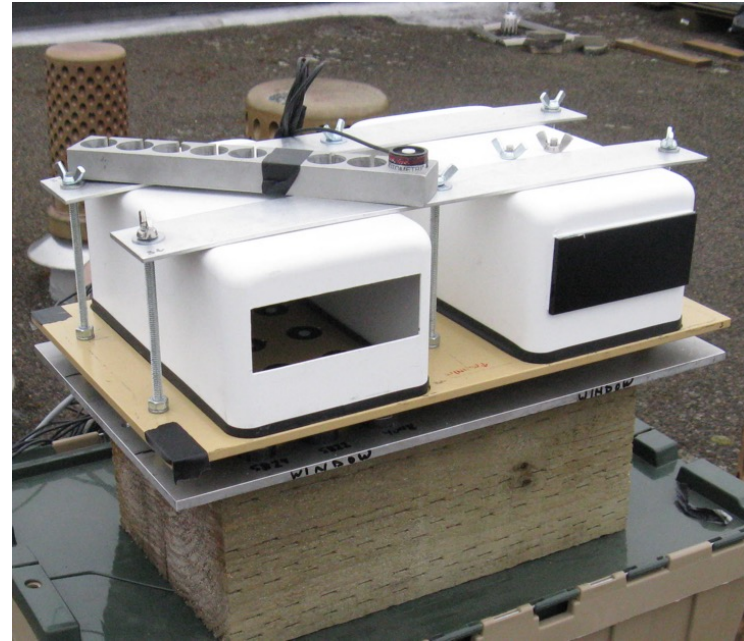


Daylight Action on Bacteria

- Downes and Blunt –1877
- The Action of Light on Bacteria - Ward, 1894
- Bacterial Destruction through Glass - Broadhurst and Hausmann, 1930
- “Further Observations on the Survival Rates of Streptococci and Pneumococci in Daylight and Darkness” – Buchbinder, et al., 1941
- “The Effect of Light on the Survival of Bacteria in Dust” – Lidwell and Lowbury, 1950

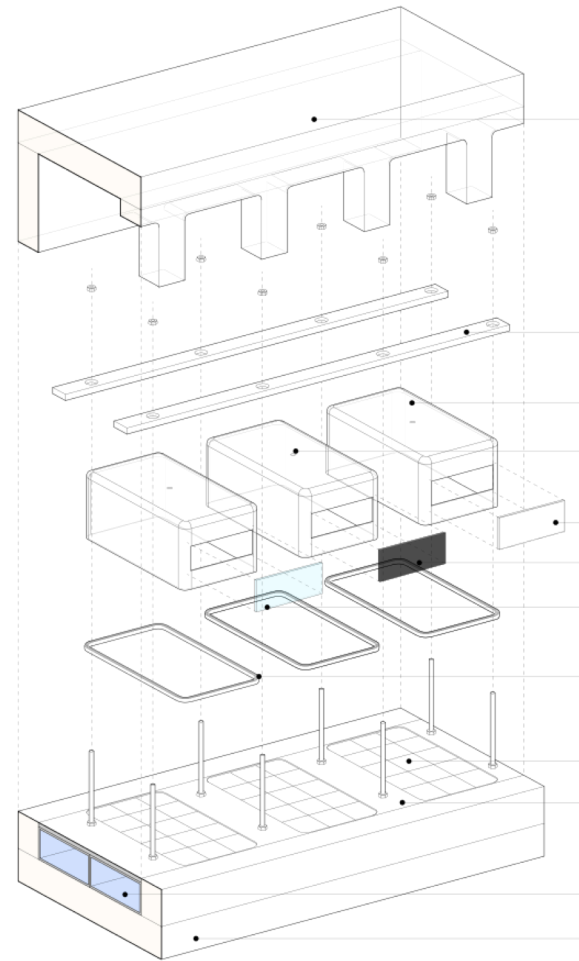


Replicate culture based methods of early 1900s?



Spectral Action?
Dose Response?

Daylight Microbiome Microcosms



Daylight Microbiome Microcosms

UV Light

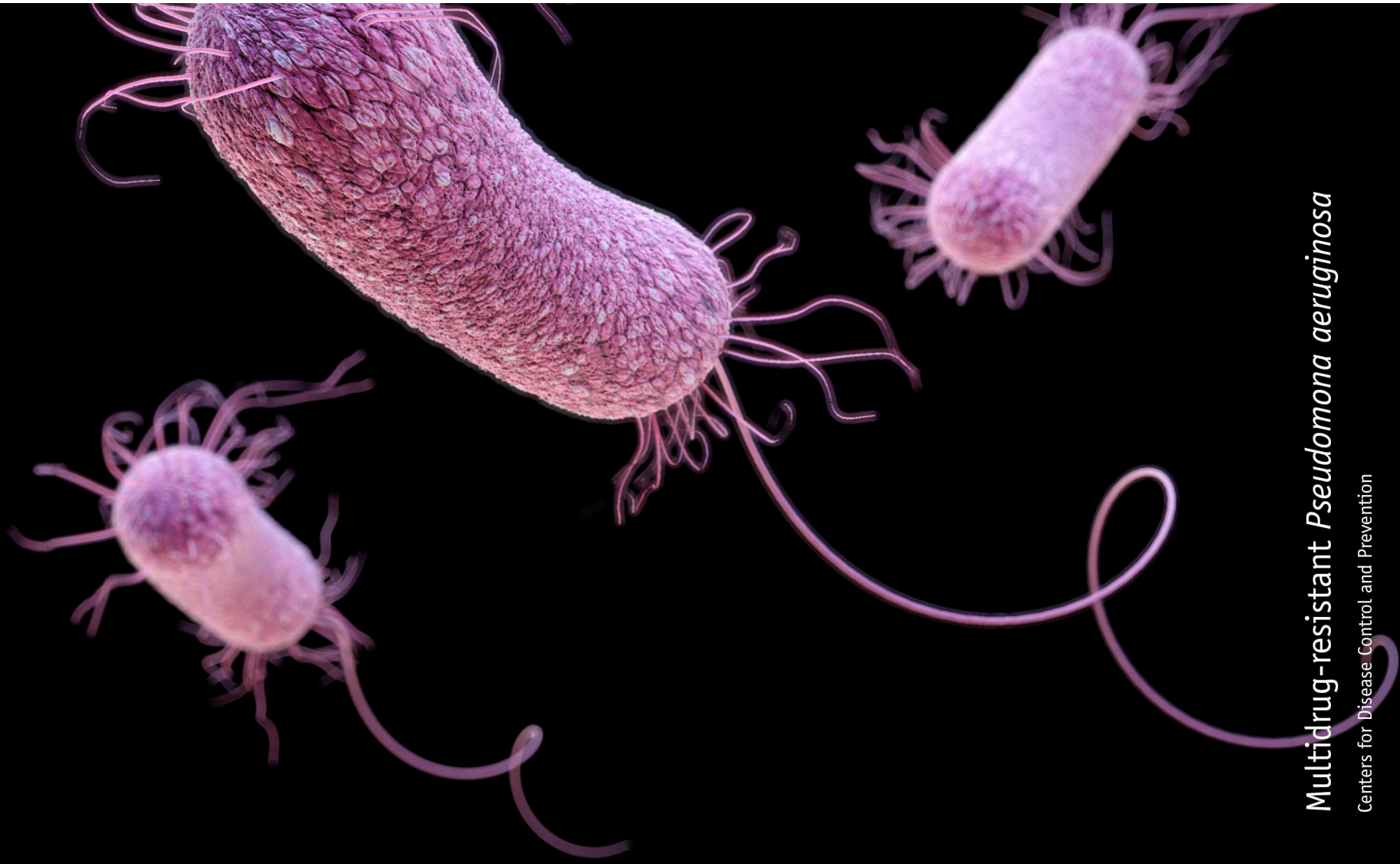


Apogee SU 100 – UV-A/B Sensor
250-400 nm
w/m²

Visible Light

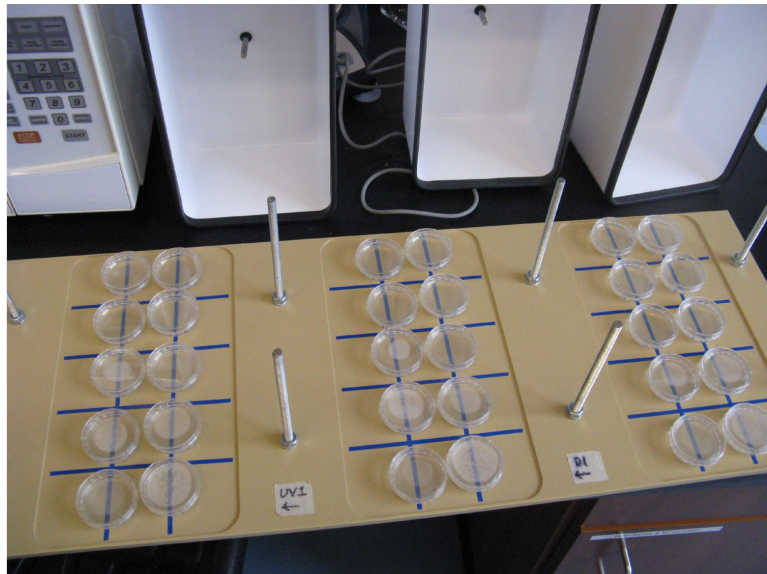


Li-Cor 210 SA – visible light
400-700 nm
lux



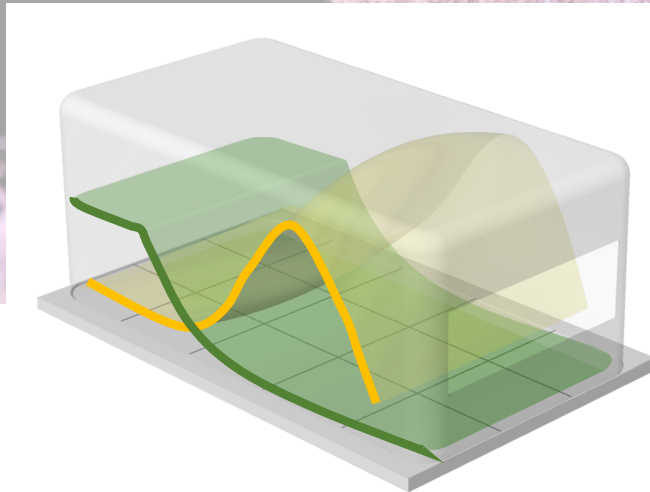
Multidrug-resistant *Pseudomonas aeruginosa*

Centers for Disease Control and Prevention



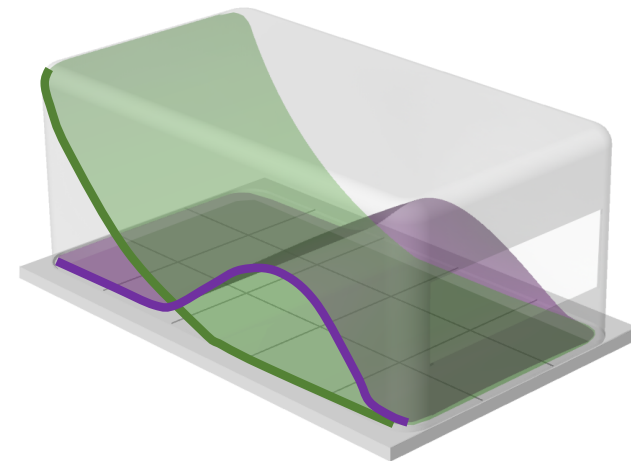
Bacterial Culture Study

Pseudomonas aeruginosa
Prevention



- Survival Factor (*Pseudomonas aeruginosa*)
- Daylight Factor (visible spectrum)

VISIBLE SPECTRUM



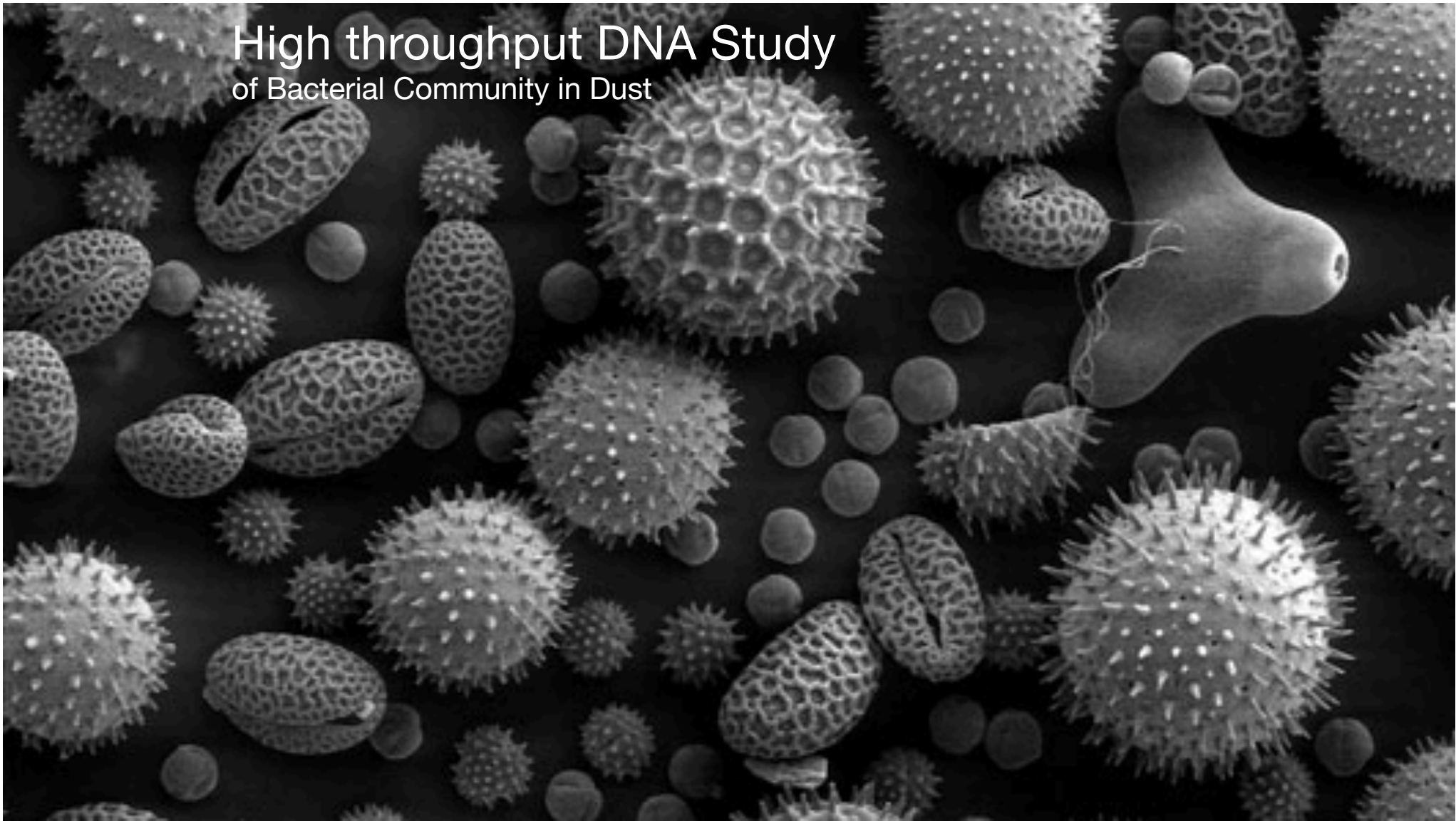
- Survival Factor (*Pseudomonas aeruginosa*)
- Daylight Factor (ultraviolet spectrum)

ULTRAVIOLET SPECTRUM



Less than ~1%
of microbial life
can be cultured
in a petri dish

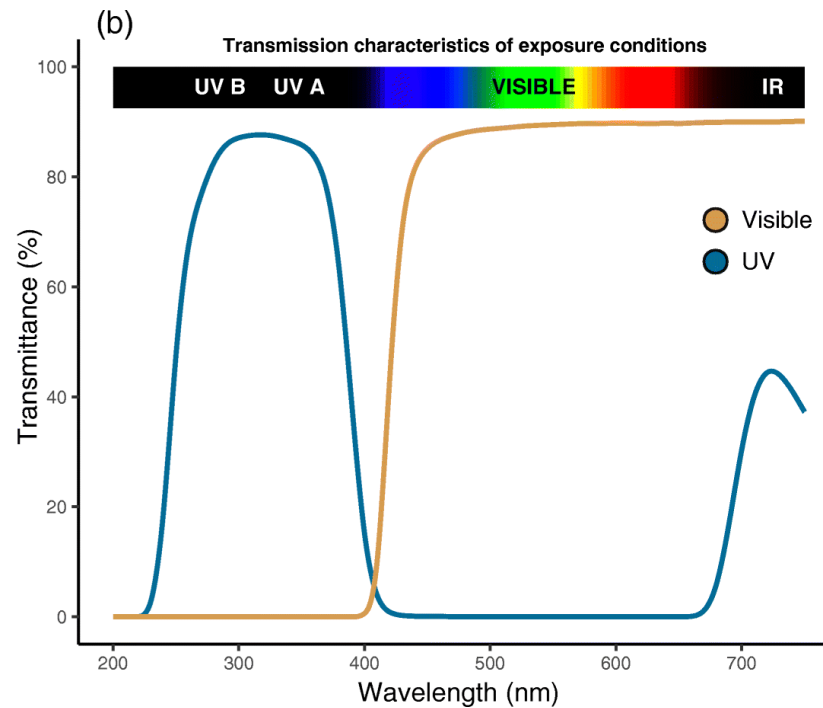
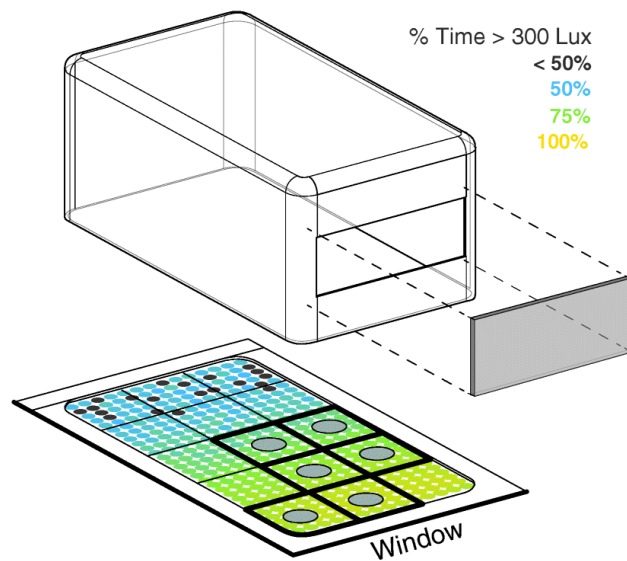
High throughput DNA Study of Bacterial Community in Dust



High throughput DNA Study of Bacterial Community in Dust

3 light treatments, Vis, UV, Dark

(a) Built environment microcosm for light exposure assessment

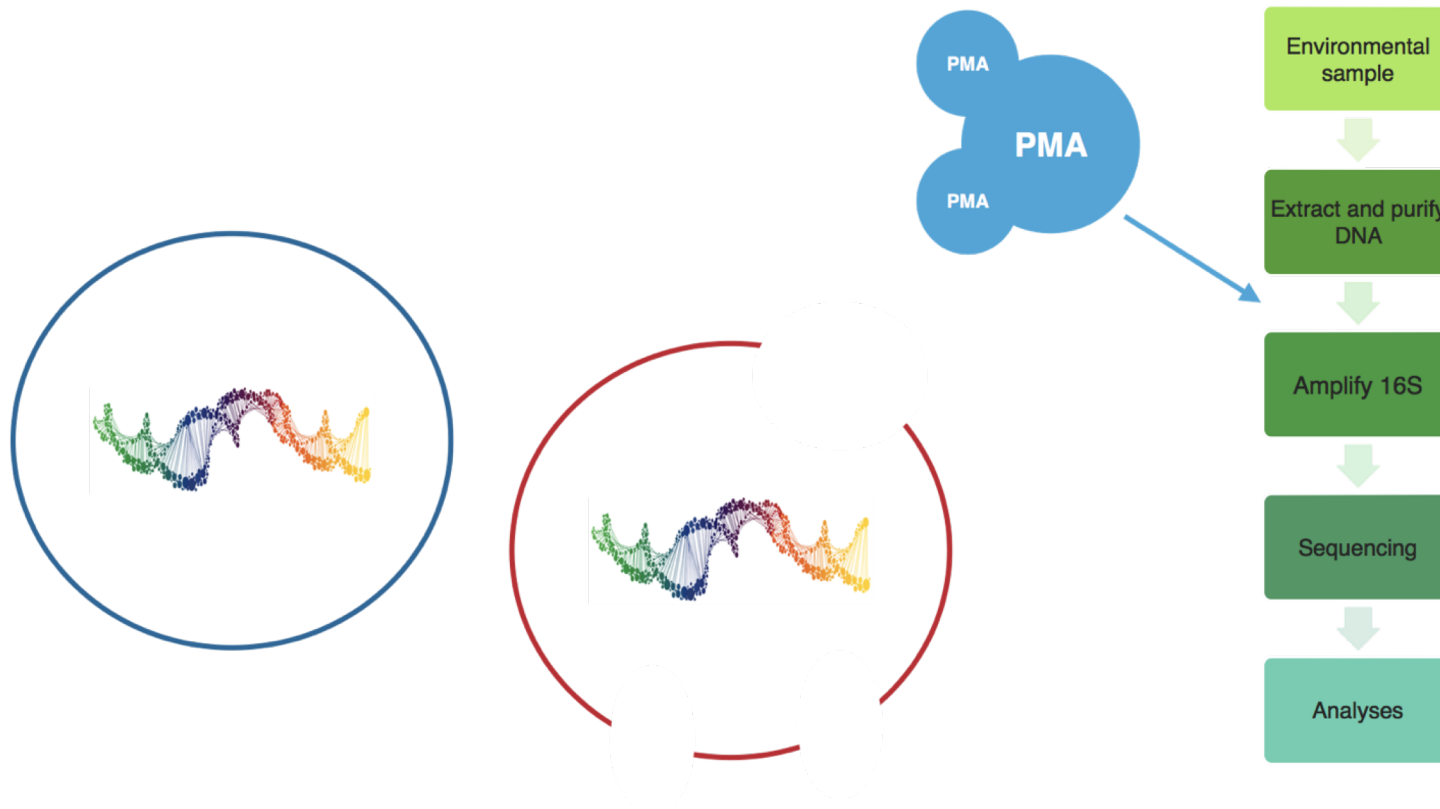


High-throughput DNA Sequencing Process

Illumina MiSeq v3v4 region of 16s rRNA gene

PMA to understand viability

qPCR to understand absolute abundance

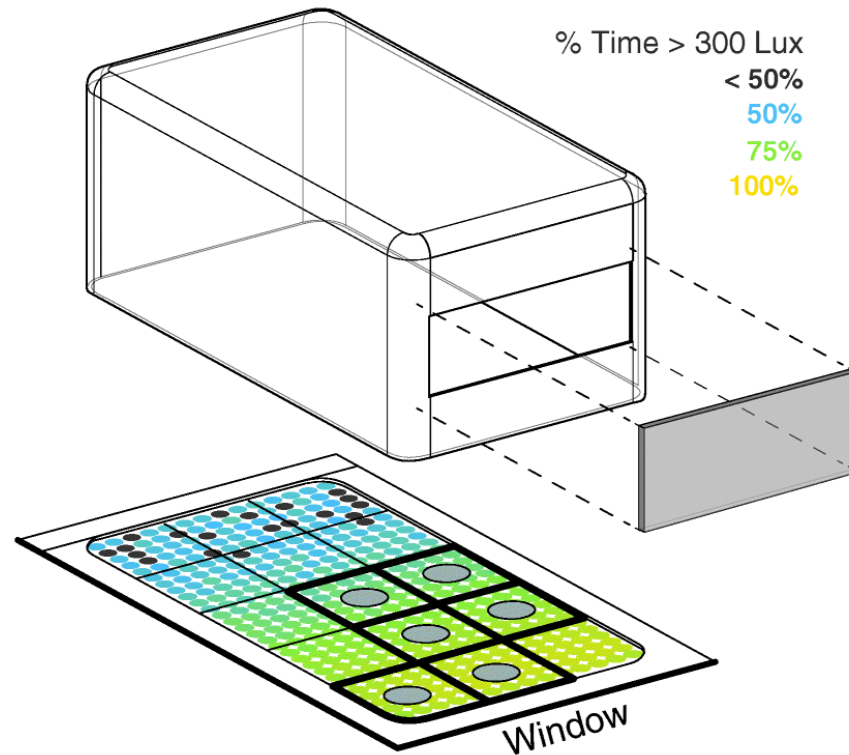


Results

abundances

- bacterial abundances determined in part by exposure to light and spectrum
- mean daily light dosage did not impact bacterial community composition among two groups that received light
- largest community composition difference observed between dark and light per se

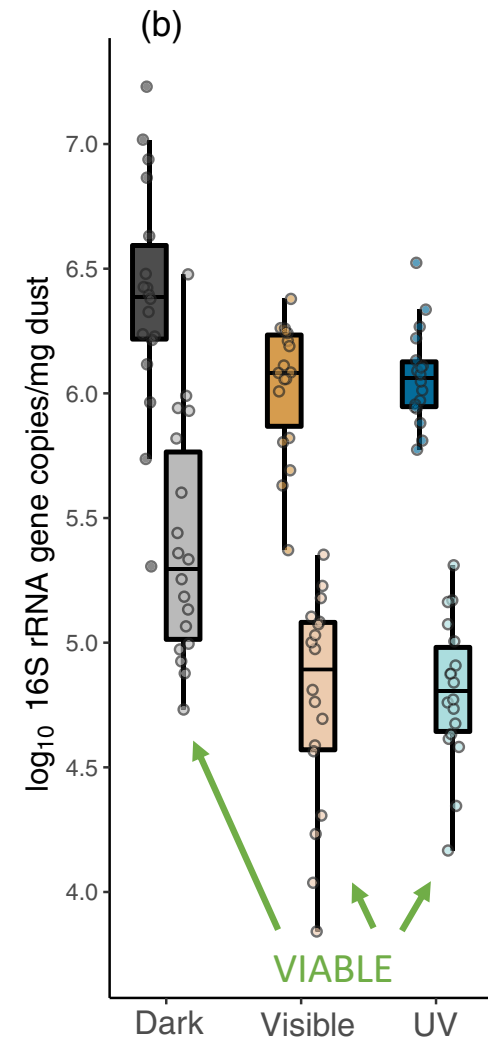
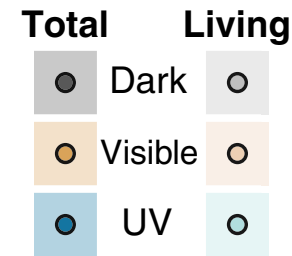
(a) Daylight Autonomy over 90 Day Study
Built environment microcosm for light exposure assessment



Results

abundances

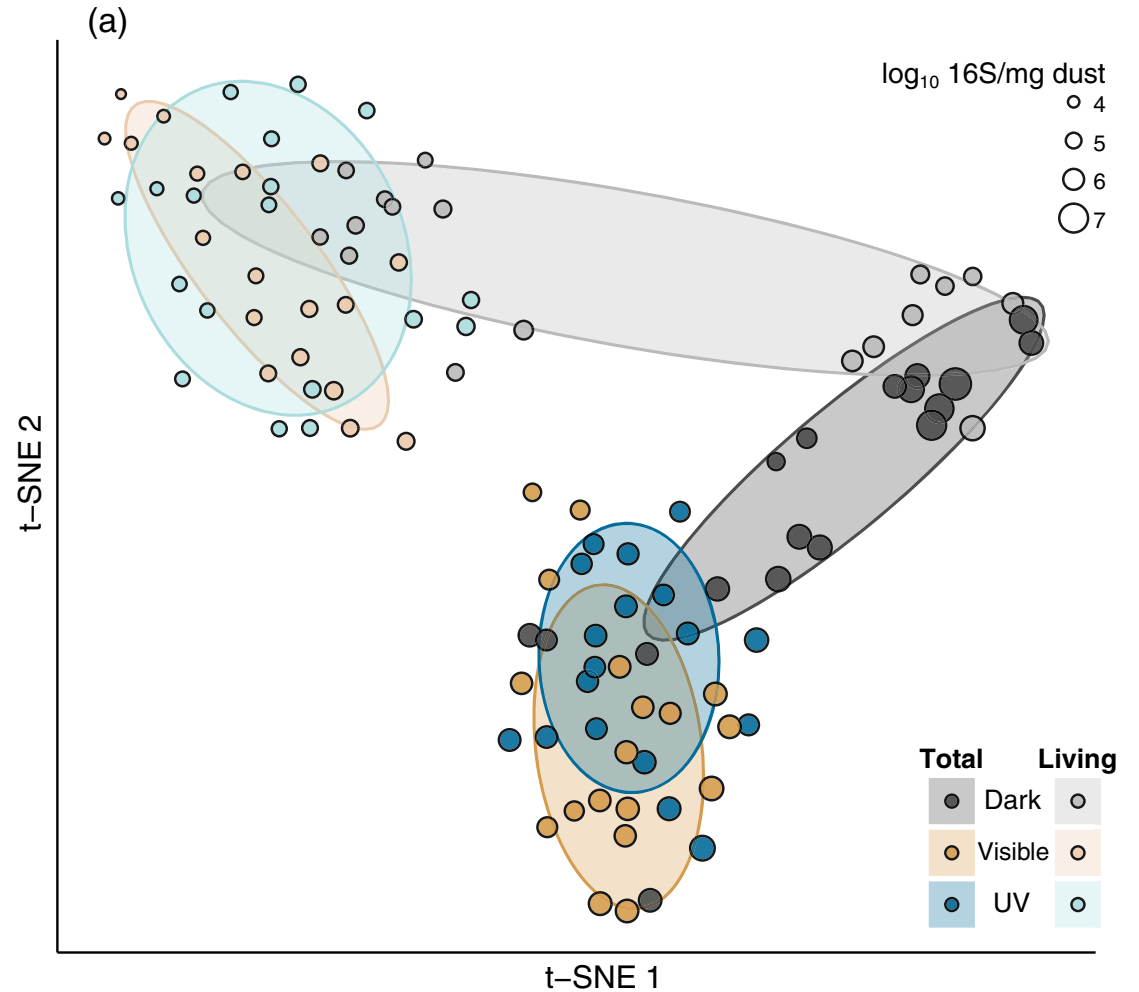
- quantitative community compositions in dark were more variable than either of light
- living bacterial abundances were lower for light than dark
- estimated fraction of viable bacteria was highest in dark (12% for dark, 6.8% visible, 6.1% UV)
- light decreases number of living bacteria in dust
- living bacterial abundance not significantly different between visible/UV light treatments



Results

community structures

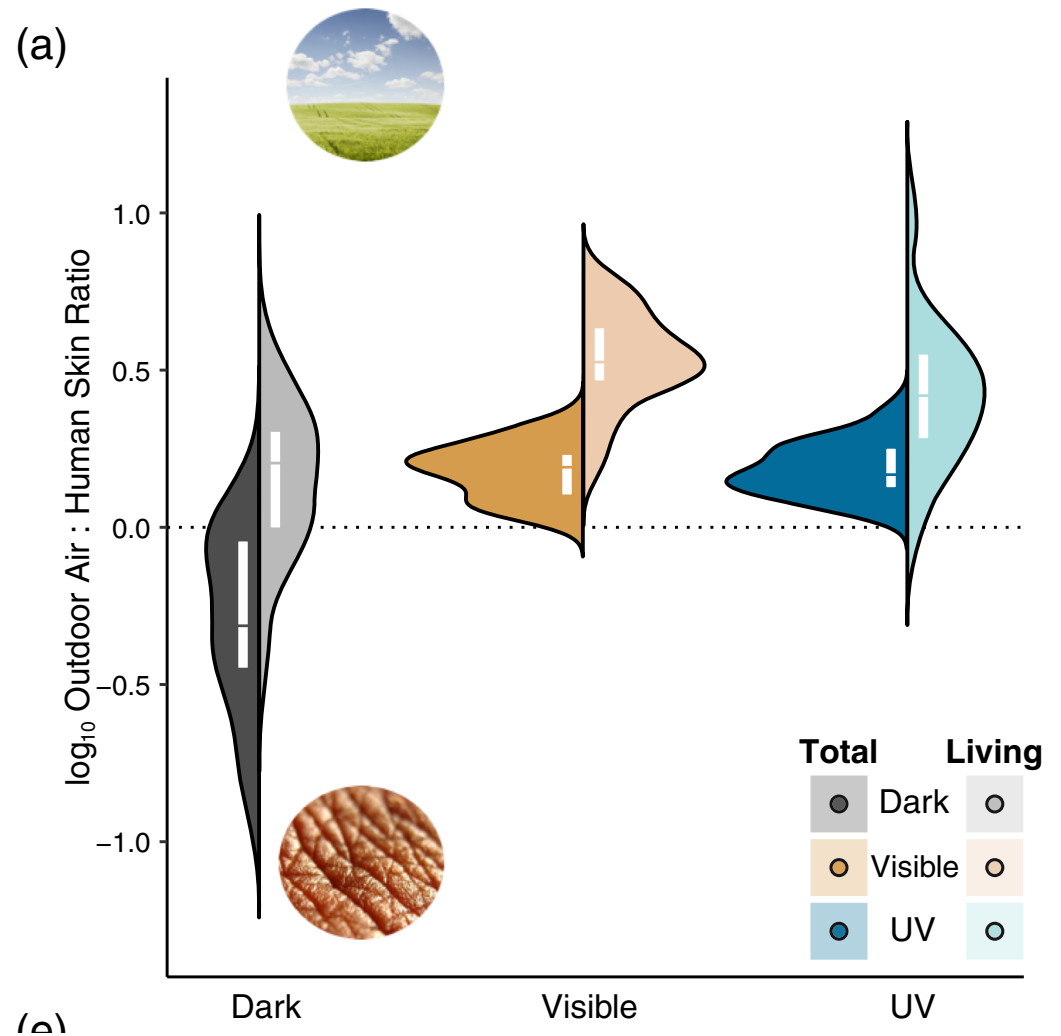
- Living dust communities were distinct from their combined living and dead counterparts on average, regardless of light treatment
- Total community structure of viable bacteria was not significantly different in visible and UV light treatments



Results

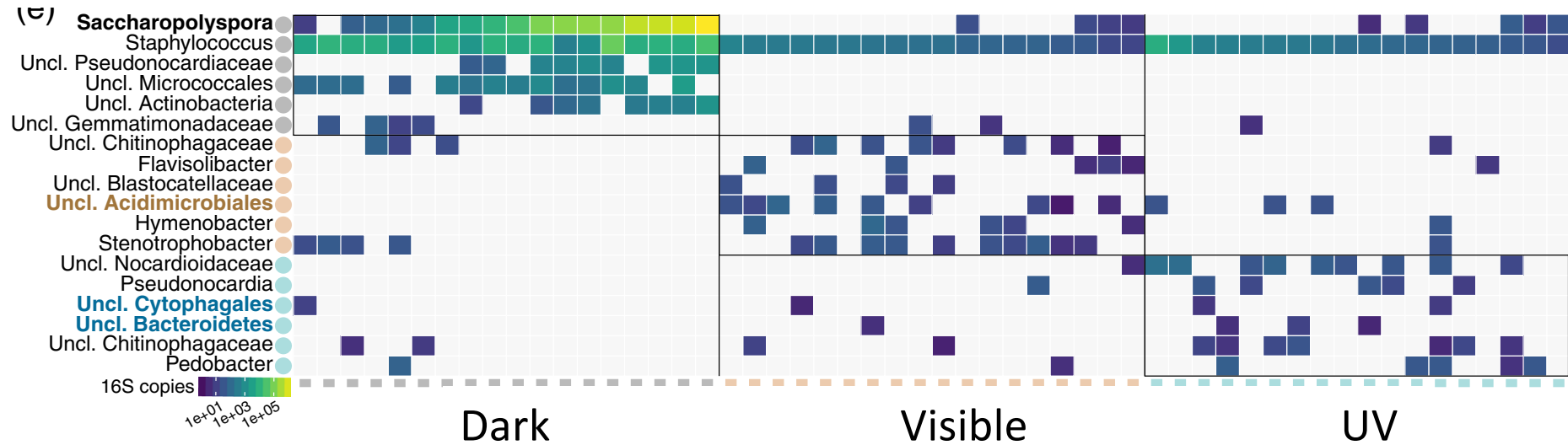
community structures

- Light exposure reduces relative abundance of skin-associated bacteria in dust
 - Dust w light comprised a significantly smaller proportion of predicted human skin-derived bacterial genera compared to dark communities
 - instead contained a plurality of outdoor air-derived genera
- Living portion within treatments harbors environmentally sourced bacteria



Results

community taxonomic composition



- Minor but significant differences between total communities experiencing visible and UV light
- Saccharopolyspora accounted for 30-90% of dark communities, previously associated with soils and buildings in rural areas and built environment-mediated respiratory diseases



Portland Community College - SRG Architects



INSTITUTE FOR HEALTH
IN THE BUILT ENVIRONMENT

Thank you!



@microbenet
@SloanFoundation

 @wymelenberg
#LightUnSeen
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