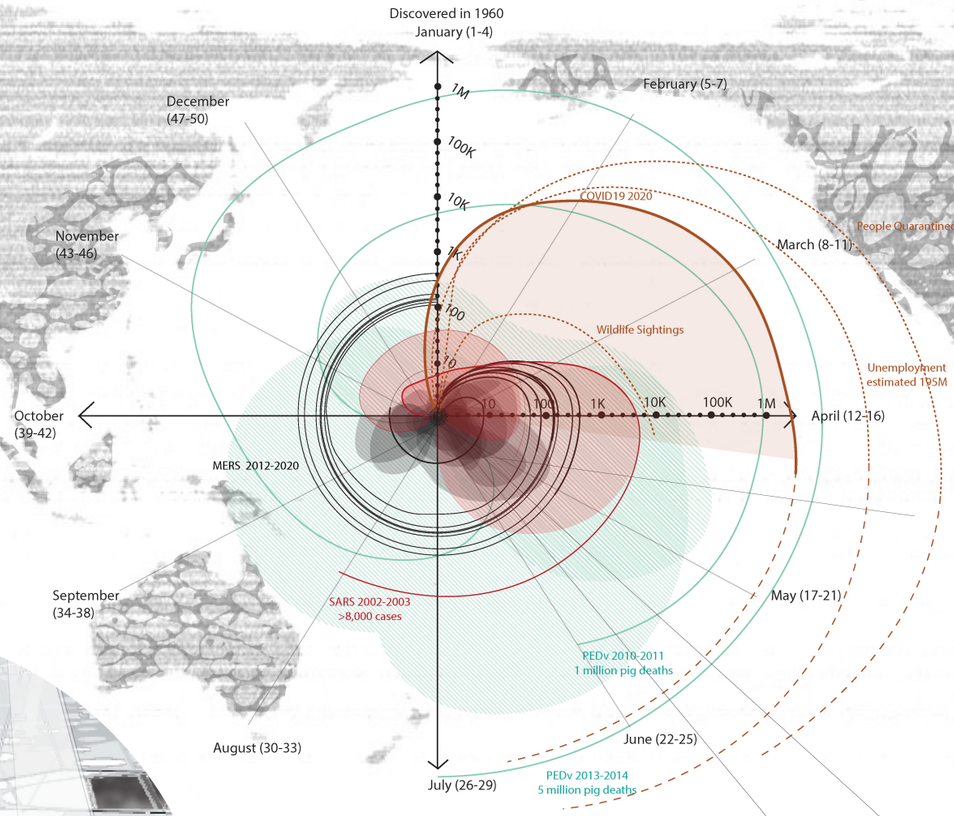
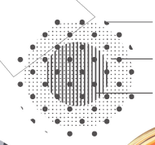
# COVID19 &
# Select Coronavirus Disturbances




# QUORUM CANOPY

**How can we understand urban design differently through COVID-19? What does it reveal? How can microbes inform a resilient design response?**

With changing rules and behavioral mandates, there is no sense of concrete or lasting safety measures. This canopy reflects that. It is not a perfectly secure solution, and it is not meant to be. We are in a state of flux and need our spaces to respond with us. We still need interaction and connection with others, along with safety, to maintain quality of life.





**We map ourselves into the city with microbes. The bacteria that grew from my apartment in Red Hook also appeared in Union Square, Times Square, City Hall Park, and Columbus Circle.**

Coronaviruses Key

SARS-CoV-2 (COVID19)
Dec. 2019- Present.
Cases: 1,847,095,
Deaths: 113,902

SARS-CoV (SARS) in humans
Nov. 2002 - May 2004. Thought to be contained August 2003, but reimerged Sept. 2003. Believed to be zoonotic transfer from bats.
Cases: >8000, Deaths: >800

MERS-CoV (MERS) in humans
April 2012-Present. Originated in Saudi Arabia. Believed to be zoonotic transfer from bats.
Season spikes March-May, September.
Cases: 2516, Deaths: 866

PEDv in swine
Discovered in 1963. First major virulent outbreak occured in China in october 2010 killing over 1M piglets. Another virulent outbreak occured in 2013 and this time made it to the US killing over 5M pigs. There are PEDv cases every year. Outbreaks are caused by new strains emerging. Seasonal spikes occur in winter.

Line is cummulative number of cases per outbreak

hatch/fill is case number by month showing pattern of infection

| | |
|---|---|
| Country / City | USA / New York City |
| University / School | Bernard and Anne Spitzer School of Architecture, City College of New York |
| Academic year | 2019-2020 |
| Title of the project | Quorum Canopy |
| Authors | Abby Stein |

## TECHNICAL DOSSIER

| | |
|---|---|
| Title of the project | Quorum Canopy |
| Authors | Abby Stein |
| Title of the course | Studio II |
| Academic year | 2019-2020 |
| Teaching Staff | Denise Hoffman Brandt |
| Department/Section/Program of belonging | Graduate Landscape Architecture Program |
| University/School | City College of New York |

Written statement, short description of the project in English, no more than 250 words

Ed Yong, in We Contain Multitudes declared: “Through microbes, we find unity with our fellow creatures, despite our incredibly different lives.” It is important that we design with many natures, even the ones we cannot see. With the outbreak of the novel coronavirus, microbes have revealed themselves to be resilient, adaptable, and an indivisible part of ourselves and our global system. Through COVID-19, we can understand our scalar systems and our deep ties to each other. Now is the time to examine and appreciate these invisible influences. We are connected and impacted by single-celled organisms in more ways than we can ever know. The following project is a design response to COVID-19 informed by an in-depth exploration of microbial presence in the city through mapping and technical drawings of microbial processes. As urbanization continues to accelerate viral mutation and transmission, public spaces will need to adapt along side changing social conditions. This "Quorum Canopy" brings us together safely in times of contagion, but at all times its shadows and shafts of light animate the city.

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# CLIMATE CHANGE AGAIN

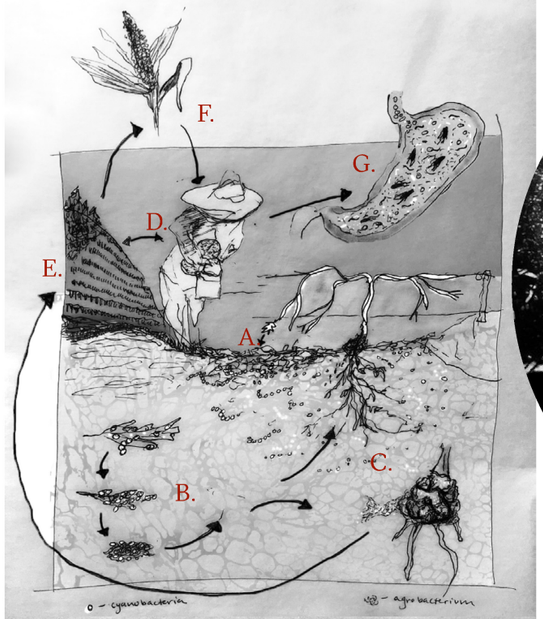
**11th International Biennial Landscape Barcelona**

**Barcelona** September 2020

SCHOOL PRIZE

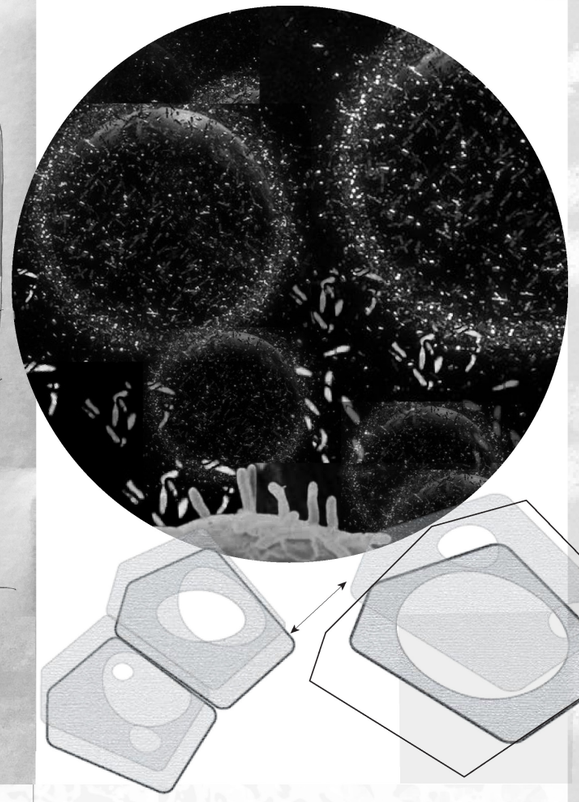
# METAGENOMICS

# QUORUM CANOPY




## Cyclical

This chart shows the interconnection of one bacteria, Agrobacterium tumefaciens, with its greater biotic and abiotic systems in Argentina. It is an example of the constant adaptation and interaction between ourselves and microbes/other biota.



## QUORUM CANOPY

I propose a quorum canopy in response to COVID-19. The design structure and function is informed by microbial qualities of adaptability, permeability, cyclical change, interconnection, and expansion.

In light of COVID-19 and social distancing, we are forced to consider our gathering sizes. Whether mandated by the CDC or by personal preference, people have various comfort thresholds when it comes to interacting. As public space designers, addressing new safety and comfort thresholds challenge the goal of inclusion and openness associated with public space. How can we remain inclusive while providing opportunity to signal to one another that we have reached our threshold? In the microbial world, bacteria use a process called quorum sensing to communicate with each other to regulate behavior in response to fluctuations in population density. I took my cue from them.

This proposal looks forward to create a public shelter that adapts to external conditions while connecting us to each other and our surroundings. The canopy promotes interaction and safe gatherings of various sizes while providing ephemeral boundaries that can signal comfort thresholds between parties or individuals.

## Qualities

**Cyclical Change**
The structure embraces cycles. It is flexible system that anticipates change, both in terms of weather and social limitations caused by cyclical viral outbreaks.

**Adaptability**
We are living in a state of uncertainty and rapid change. Instead of determining how we interact, this structure prompts users to adjust its form depending on what feels good to them; or is allowed. It has the capacity to limit group sizes but does not have to.

**Permeability**
The canopy amplifies changing sun conditions by casting shadows through its permeable layered top. This allows for plant growth, a feeling openness, and a generally enjoyable condition. The enclosures that signal comfort thresholds are also permeable, conveying the idea that we are not really separate.

**Expansion**
This canopy system requires a physical push and pull from its users that magnifies their efforts across the structure by changing light patterns and physical forms.

**Interconnection**
This canopy offers opportunity to connect to one another in a time of restricted interaction. COVID-19 has shown us our systemic connections to each other, biota, microbes, and socio-political systems.

## Structure

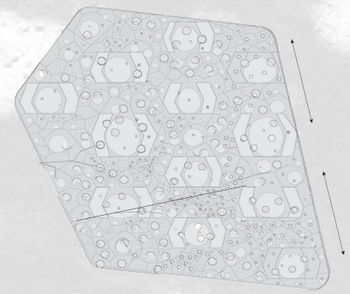
This canopy has a two layered covering. The bottom layer is in a fixed position and has larger holes, including 11 oculus openings where fabric enclosures drop from. This layer would be made from a a modular translucent ETFE film membrane that allows light to pass through. The top layer has smaller holes and is made from a woven polyester that also allows light to pass through. The canopy layers are supported by a truss structure. The bottom layer attaches beneath the truss, while the top layer rests on tracks above the truss. Because the materials are all very light weight, the poles and truss sizes are minimized.

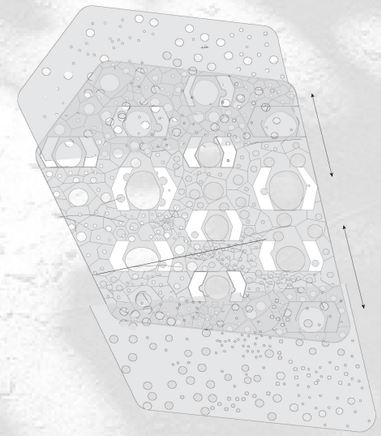
## Sun

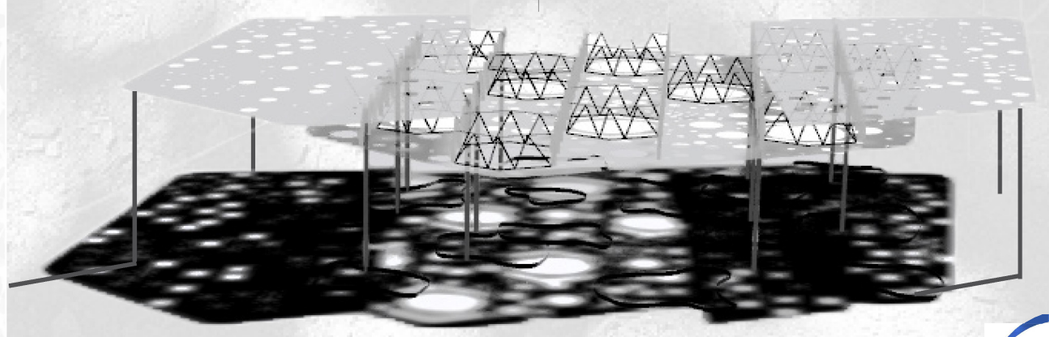
The top of the canopy can open and close to allow more or less light to pass through the structure. Then opened, the structure provides a larger surface area of shade.

## Rain

The structure is purposefully permeable. It is not meant to completely keep rain out, but because the holes in both layers are not aligned, when the structure is closed they provide a sheltered area much like a large tree provides during rain.



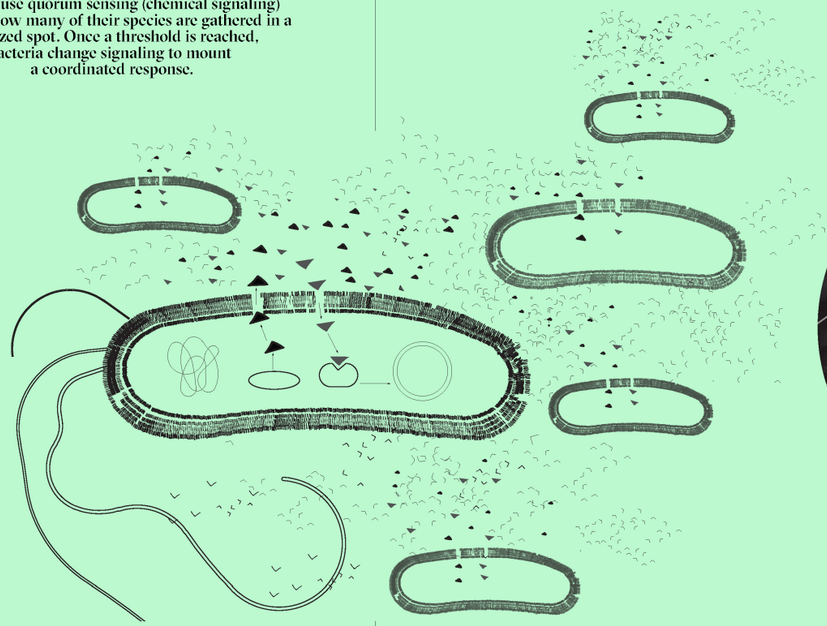




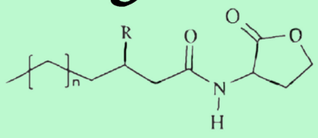
# QUORUM SENSING

## Communication

Bacteria use quorum sensing (chemical signaling) to detect how many of their species are gathered in a localized spot. Once a threshold is reached, bacteria change signaling to mount a coordinated response.



## Chemical Signal



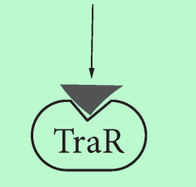

N-acyl-homoserine lactone

## OUTGOING

The protein **TraI** synthesizes N-acyl-homoserine lactone molecules which act as diffusible QS-signals. These signals are sent out of A. tumefaciens to be recieved by other bacteria of the same species.


## INCOMING

Beyond a threshold concentration, N-acyl-homoserine lactone molecules bind and activate the transcriptional regulator **TraR**, thereby initiating the QS-regulatory pathway which regulates genes.

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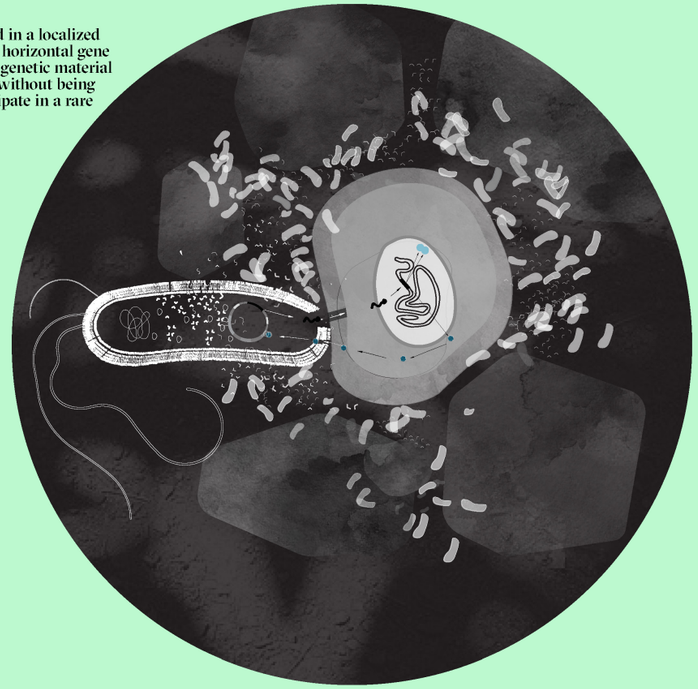
N-acyl-homoserine lactone

## Mitosis

The plant cells replicate through mitosis. The cell grows, replicates its DNA and splits into two identical cells.

## Horizontal Gene Transfer

Once enough bacteria have gathered in a localized spot, they start their group behavior- horizontal gene transfer (HGT). HGT is the transfer of genetic material from another organism to another without being its offspring. A. tumefaciens participate in a rare transkingdom HGT.



## Inducers

**Acetosyringone**
Plant stress hormone

**TraI and TraR**
Quorum sensing chemical signals

## Actors

**TI (tumor-inducing) Plasmid**
The essential genetic structure that replicates DNA and allows horizontal gene transer

**Virculence Proteins**
These proteins guide the horizontal gene transfer by leading the TDNA to the host cell

**T(transfer)-DNA**
The T-DNA from the Ti Plasmid connects to the host cell's DNA completing HGT

## PRODUCTS

**Cytokinin and Auxin**
Cytokinin and Auxin tell the cell to keep reproducing

**Opines**
Opine feeds the bacteria AND induces the Ti Plasmind to keep producing T-DNA to continue HGT. Agrobacterium is the only known organism that can feed off of opine.

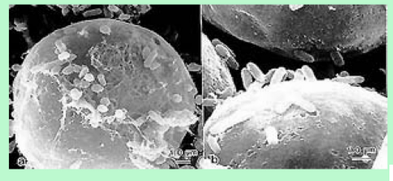
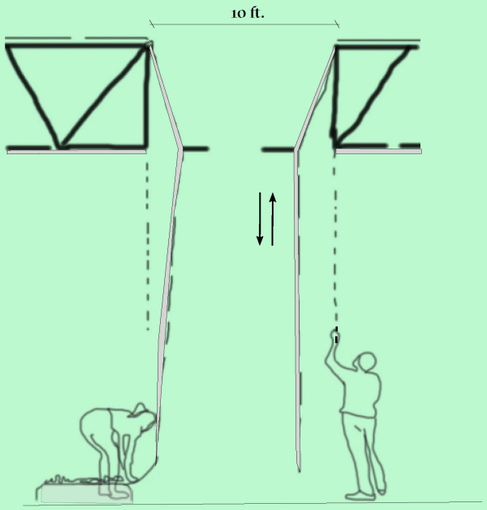


Image of A. tumefacien attached to plant cell to begin horizontal gene transfer

# INTERCONNECTIONS

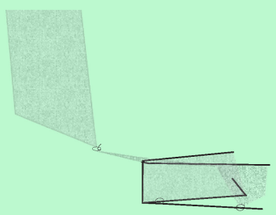



## Operation

While under the canopy, an individual or group of people can access and operate the enclosures using the pulley string hanging down. The ends of the enclosure fabric can be connected to the planters to create spaces of varying size. Once connected, users can sit inside these permeable barriers. They will not be completely closed off, but will be signaling that their group has reached their comfort threshold.

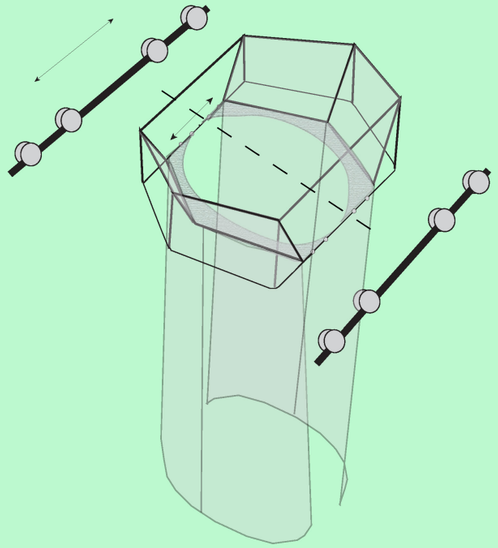
## PLANTERS

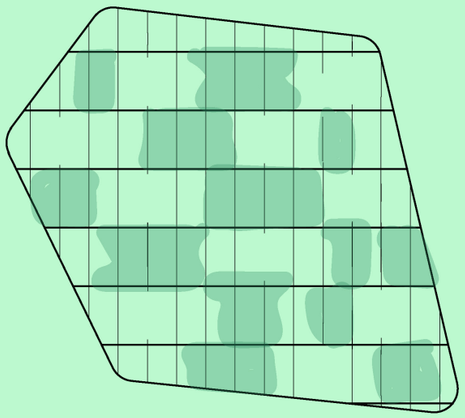
Planters beneath the canopy fragment the space to provide structure for gathering sizes. They can be clipped to the enclosure drop downs so users can create spaces of differing size and shape. Planters will rise to 1ft maximum so spaces will feel less confined and more open.



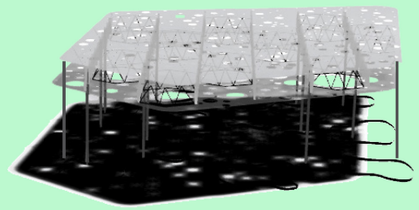
## Ephemeral Enclosures

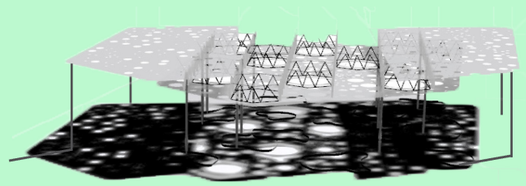
The bottom layer of the canopy has 11 oculus openings that are 10ft x 12ft and placed at least 6ft apart. These openings are on tracks and can expand or contract. Fabric connects to the top of the truss and is channeled through the edges of the oculus. Users can access and operate these 11 features much like one would operate curtain blinds- through a venetian blind pulley that hangs from the canopy. I imagine the enclosure fabric is thin, slightly stretchy, and translucent.





# EXPANSION





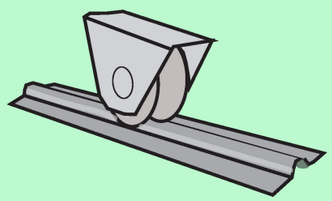
## Movement

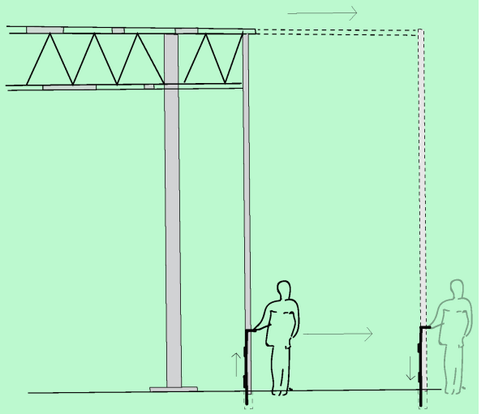
Poles attached at the top layer connect to the ground like gate posts. Two people are required to expand the structure. Each would stand at a pole, lift the drop rod shown, and move the canopy out to place it in a pre-drilled hole. Retracting it would be the same procedure. The materiality of the top is lightweight enough to make this possible.



## Tracks

The top can move because it rests on a set of tracks that extend along the top of the truss. Each side rests on four wheels. The top of the canopy splits in the middle and each side can extend.





## AGENCY

The canopy's shape and shade range is defined by it's users. This allows a dialog between users and structure and encourages interaction.