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Agent-Based Modeling to Assess Optimal Conditions for Reducing Pathogenic Air Transmission

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AGENT-BASED MODELING TO ASSESS OPTIMAL CONDITIONS TO MINIMIZE AIRBORNE TRANSMISSION

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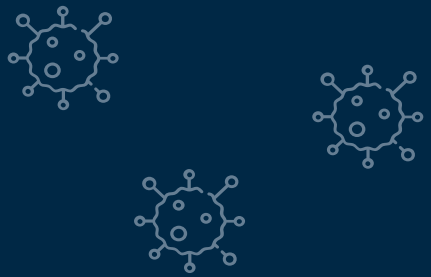
COVID-19 PANDEMIC

2020

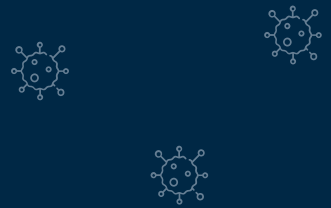
SARS-COV-2

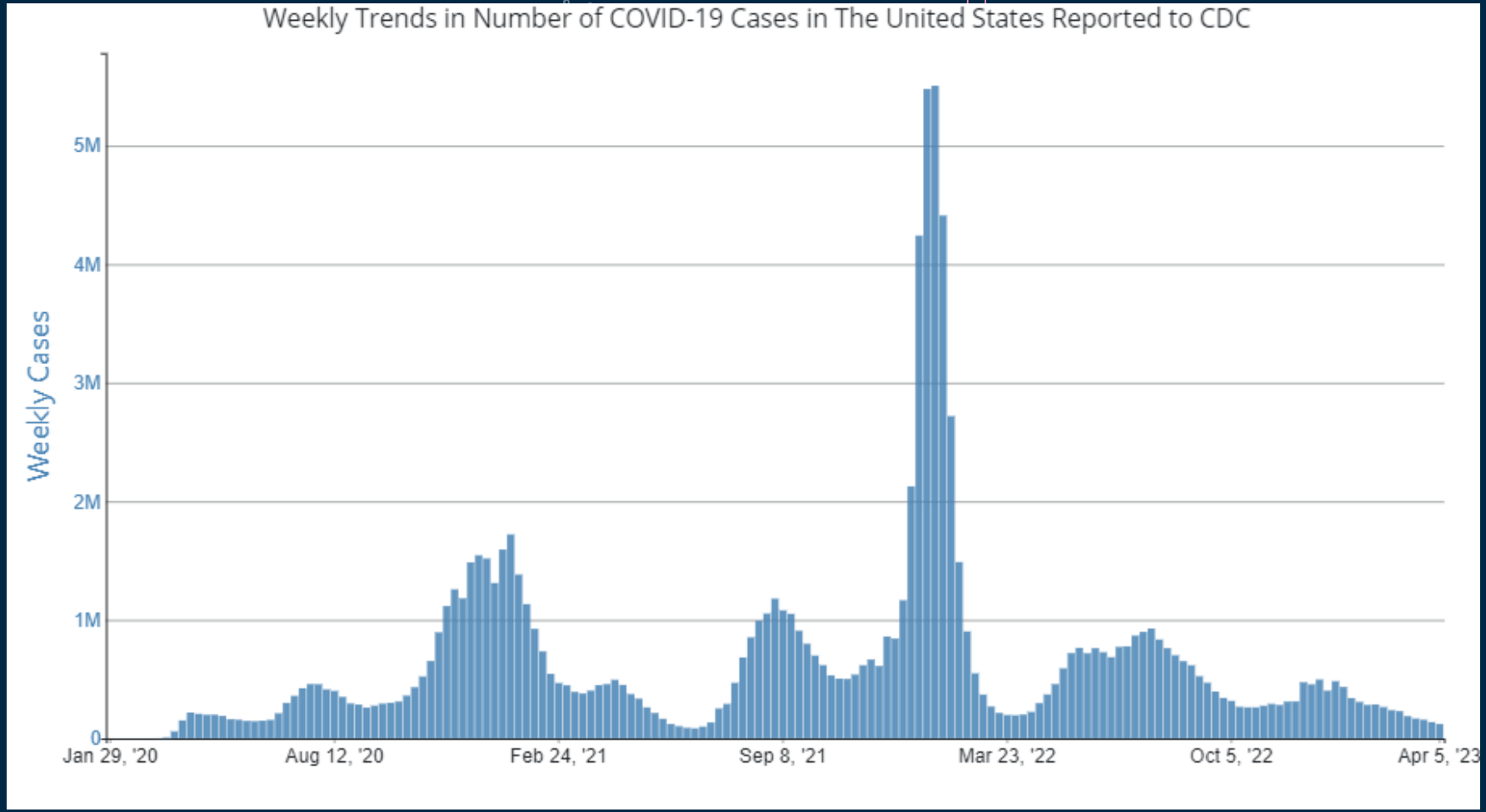
- ENVELOPED, POSITIVE-SENSE, SINGLE STRANDED RNA VIRUS (Zhu et al., 2020)
- AIR TRANSMISSION VS. AEROSOL TRANSMISSION (Lee, 2020)
- SOCIAL DISTANCING GUIDELINES- 6 FEET

DROPLETS

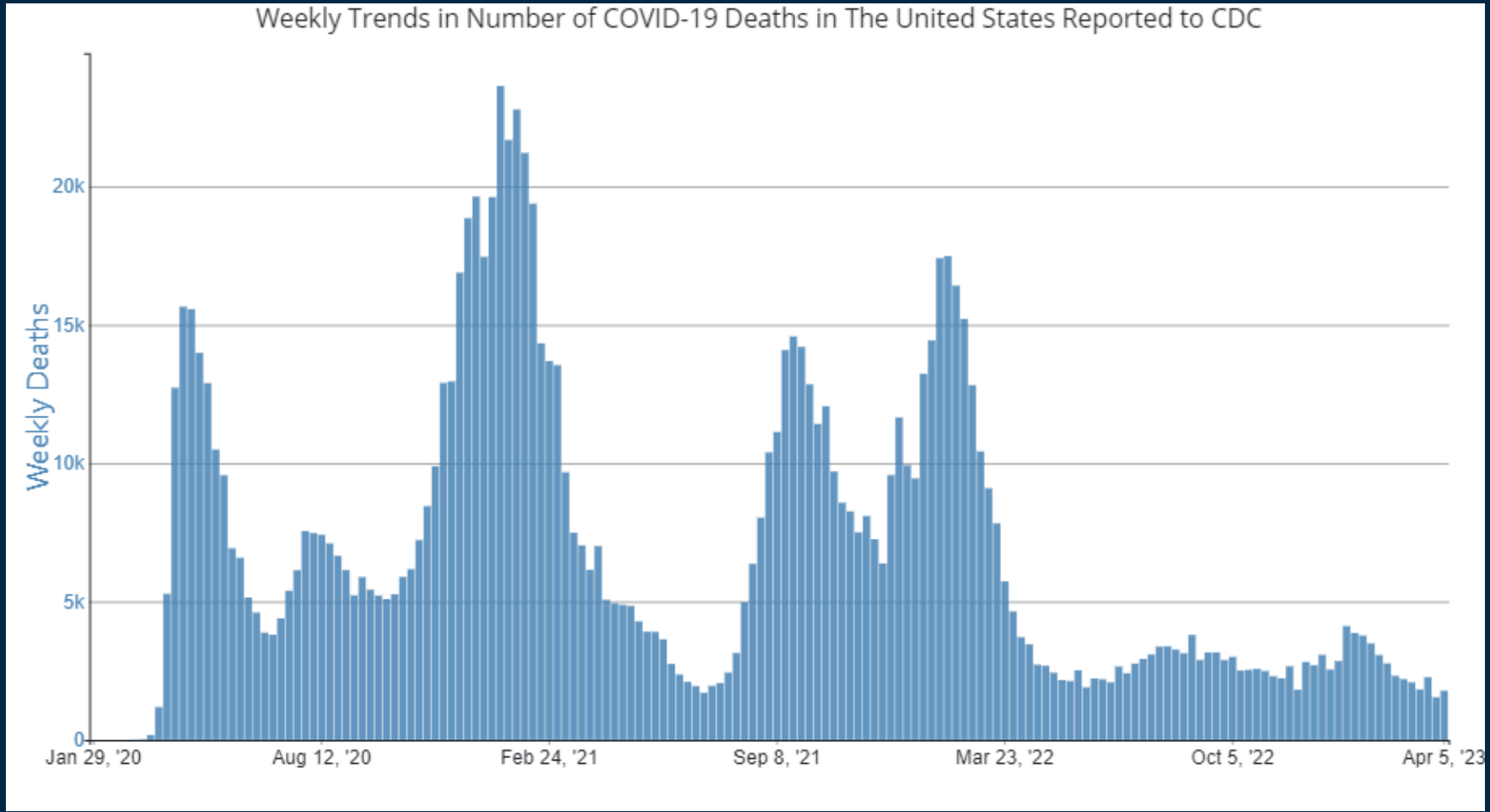


AEROSOLS





https://covid.cdc.gov/covid-data-tracker/#trends_weeklycases_select



https://covid.cdc.gov/covid-data-tracker/#trends_weeklydeaths_select_00

IT IS NOT OVER!

Hierarchy of Controls

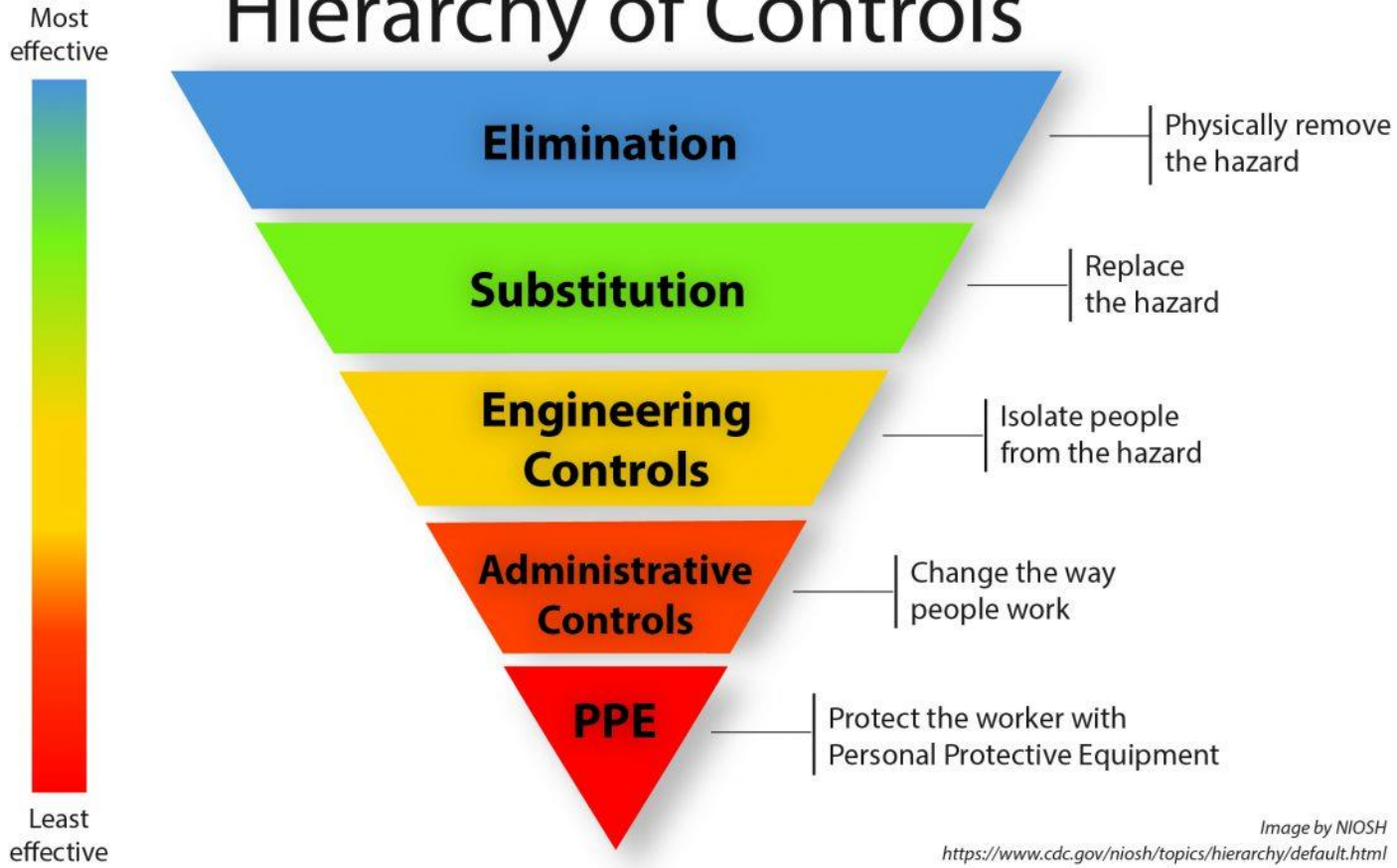


Image by NIOSH
https://www.cdc.gov/niosh/topics/hierarchy/default.html

GOAL:

TO CREATE A TOOL TO ENHANCE OUR UNDERSTANDING OF HOW TO MANIPULATE THE BUILT ENVIRONMENT TO REDUCE THE HAZARD Of AIRBORNE TRANSMISSION

VIRAL SURROGATE

SARS-COV-2

VERY DANGEROUS VIRUS

CANNOT EMIT INTO THE AIR

HARD TO STUDY IN SCHOOL

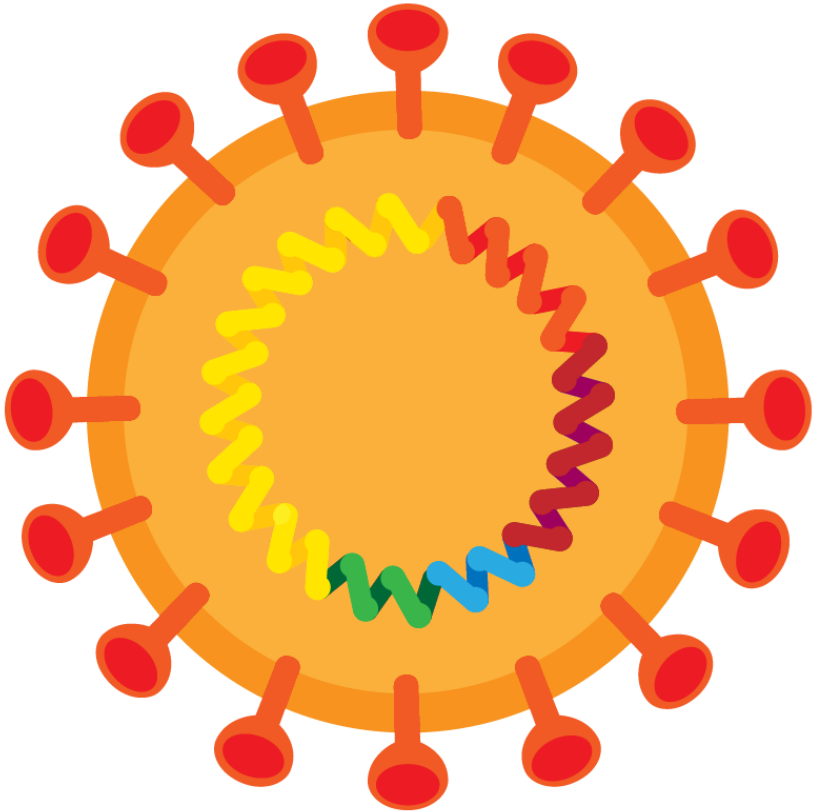
BACTERIOPHAGE PHI6

PHAGE IS NOT DANGEROUS

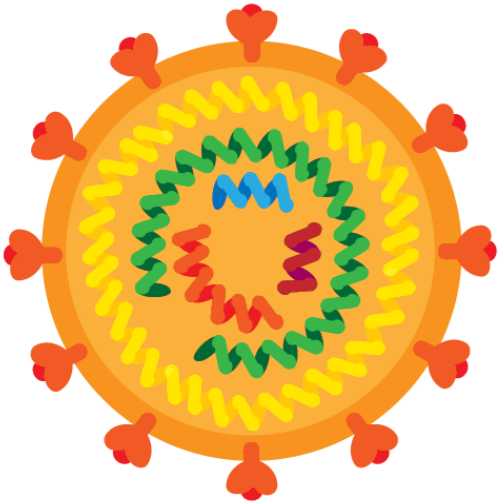
CAN EMIT INTO THE AIR

CONFIRMED SURROGATE

(Serrano-Aroca, 2022)



Coronavirus

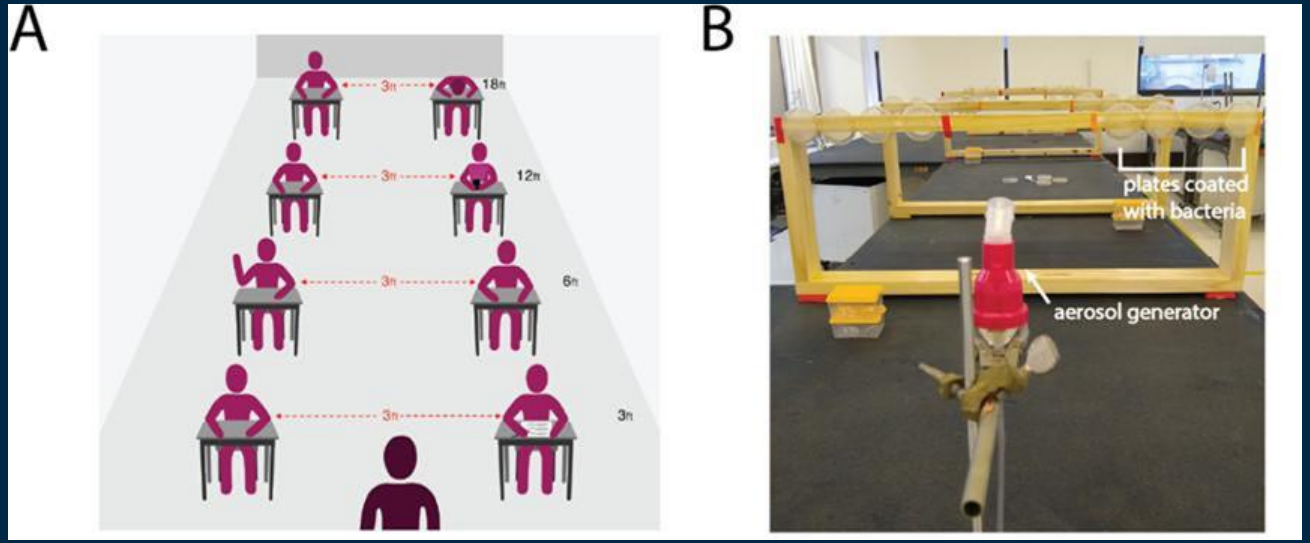


Bacteriophage Phi 6

Molly Metz 11/22

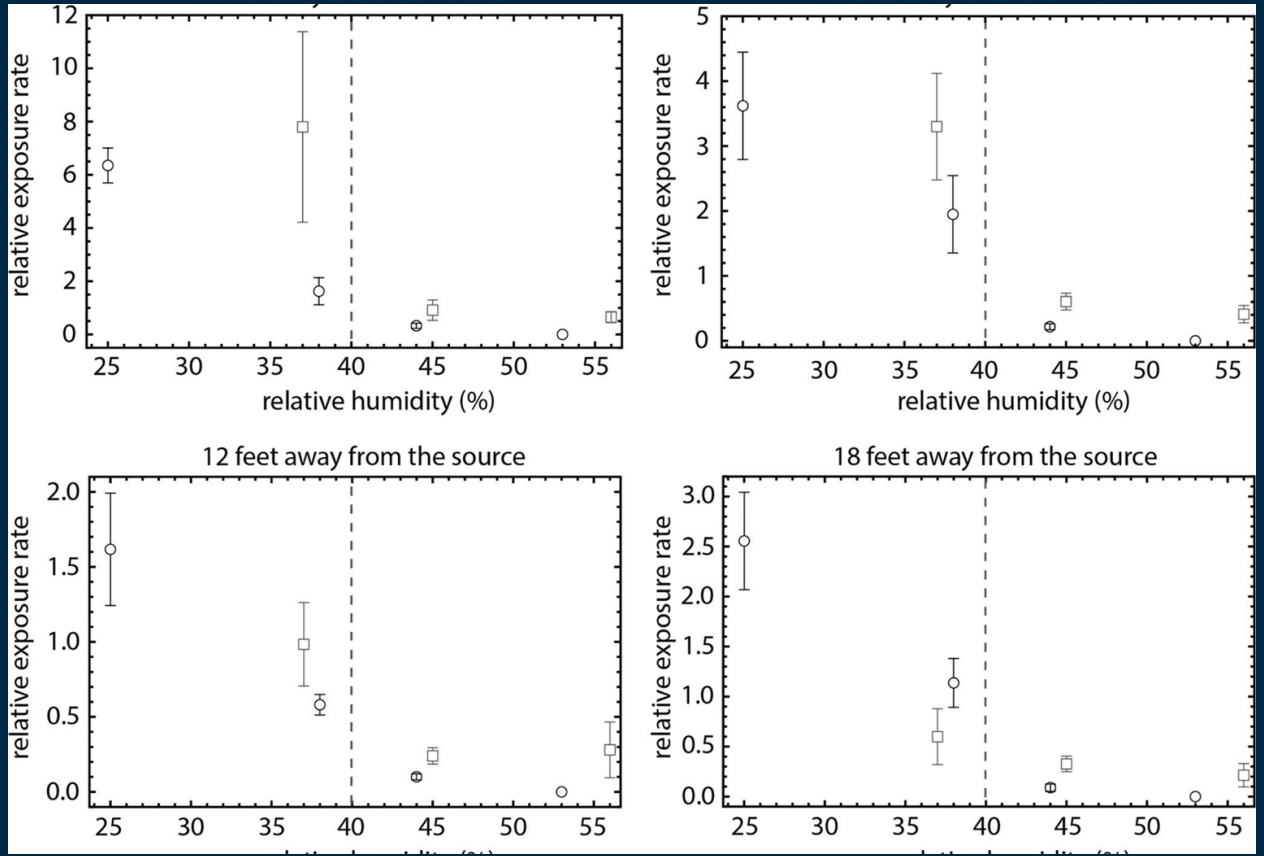
PHAGE EXPERIMENTS

EXPERIMENTAL DESIGN



SKANATA ET AL. (2022)

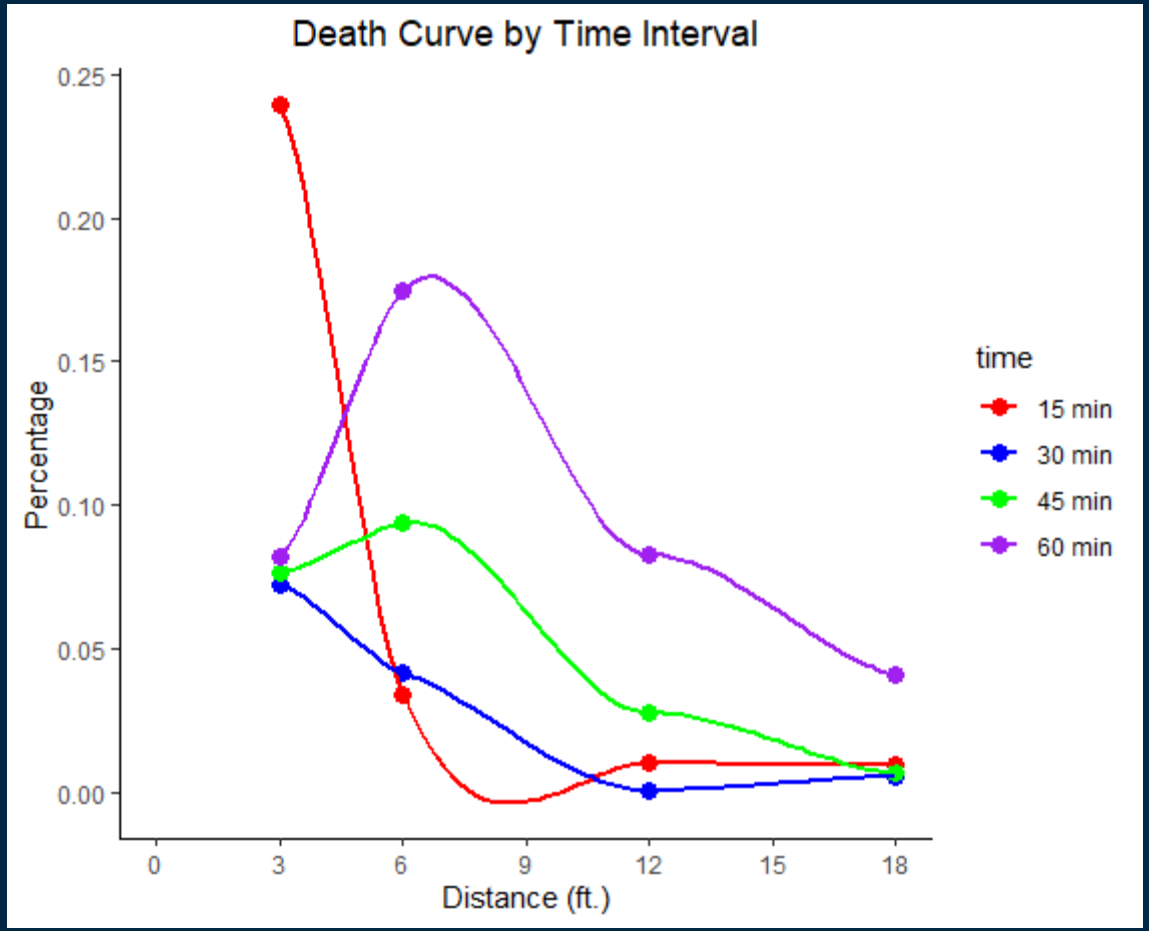
PUBLISHED FINDINGS



SKANATA ET AL. (2022)

6 FEET IS NOT ENOUGH!

DEATH = NOT DETECTABLE/ NO LONGER IN AIR

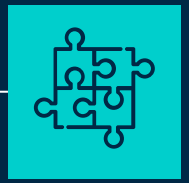


IS THIS PLATE COUNTING METHOD ENCOMPASSING ALL THE PHAGE PRESENT IN THE AIR?

NO!

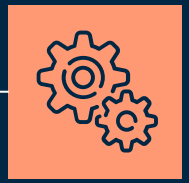
MODELING

COMPUTATIONAL RESEARCH



01

COMPLIMENTS REAL WORLD EXPERIMENTS



02

IMPOSSIBLE OR UNETHICAL EXPERIMENTS

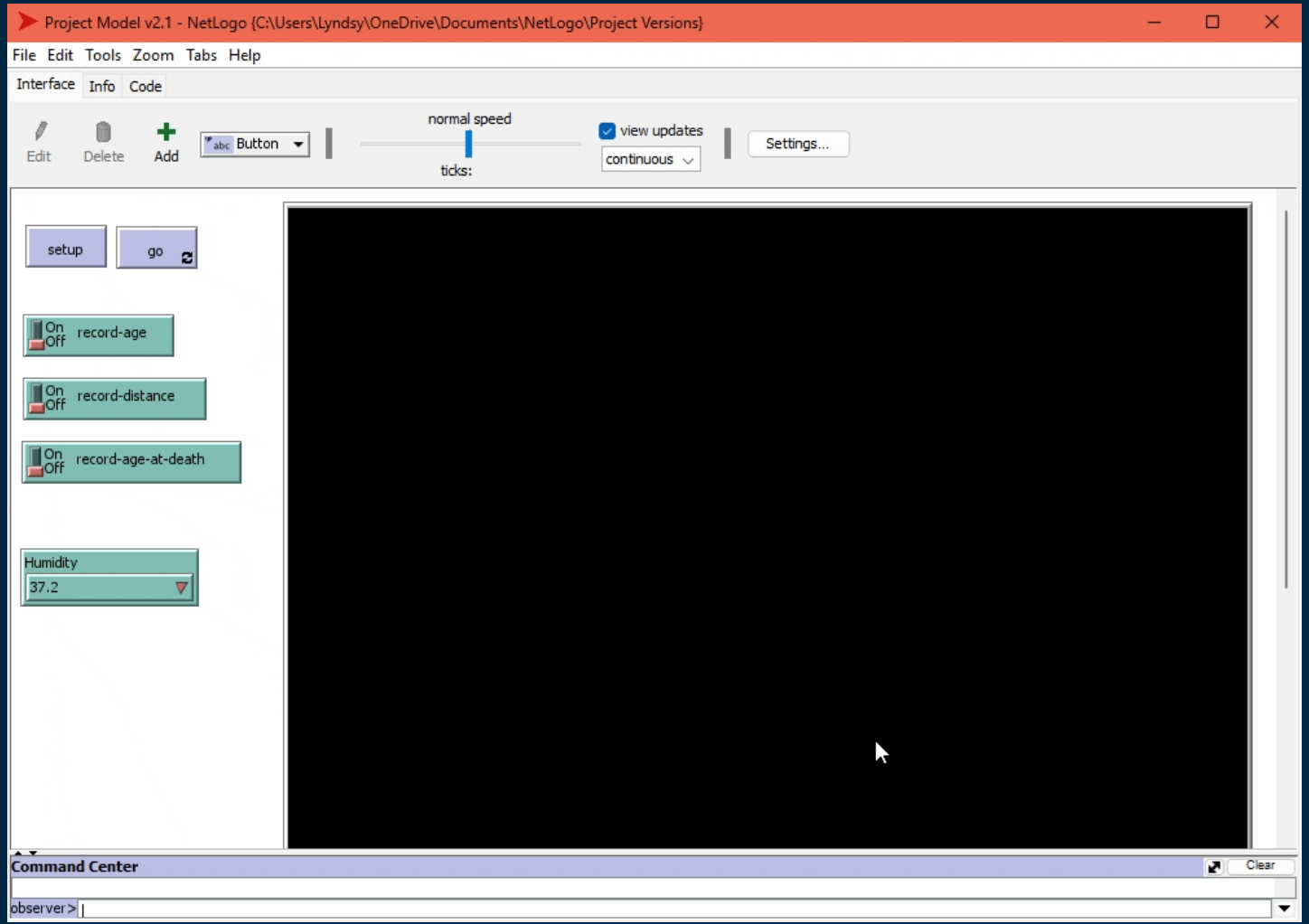
03

UNIQUE PATTERNS

NETLOGO

- ★ PROGRAMMING LANGUAGE
- ★ AGENT-BASED MODELING ENVIRONMENT
- ★ FREE!
- ★ WEB VERSION AVAILABLE

https://ccl.northwestern.edu/netlogo/


Project Model v2.1 - NetLogo {C:\Users\Lyndsy\OneDrive\Documents\NetLogo\Project Versions}
File Edit Tools Zoom Tabs Help
Interface Info Code
Edit
Delete
Add
Button
normal speed
ticks:
view updates
continuous
Settings...
setup
go
On Off record-age
On Off record-distance
On Off record-age-at-death
Humidity
37.2
Command Center
Clear
observer>

THE CODE: PIECEWISE FUNCTIONS

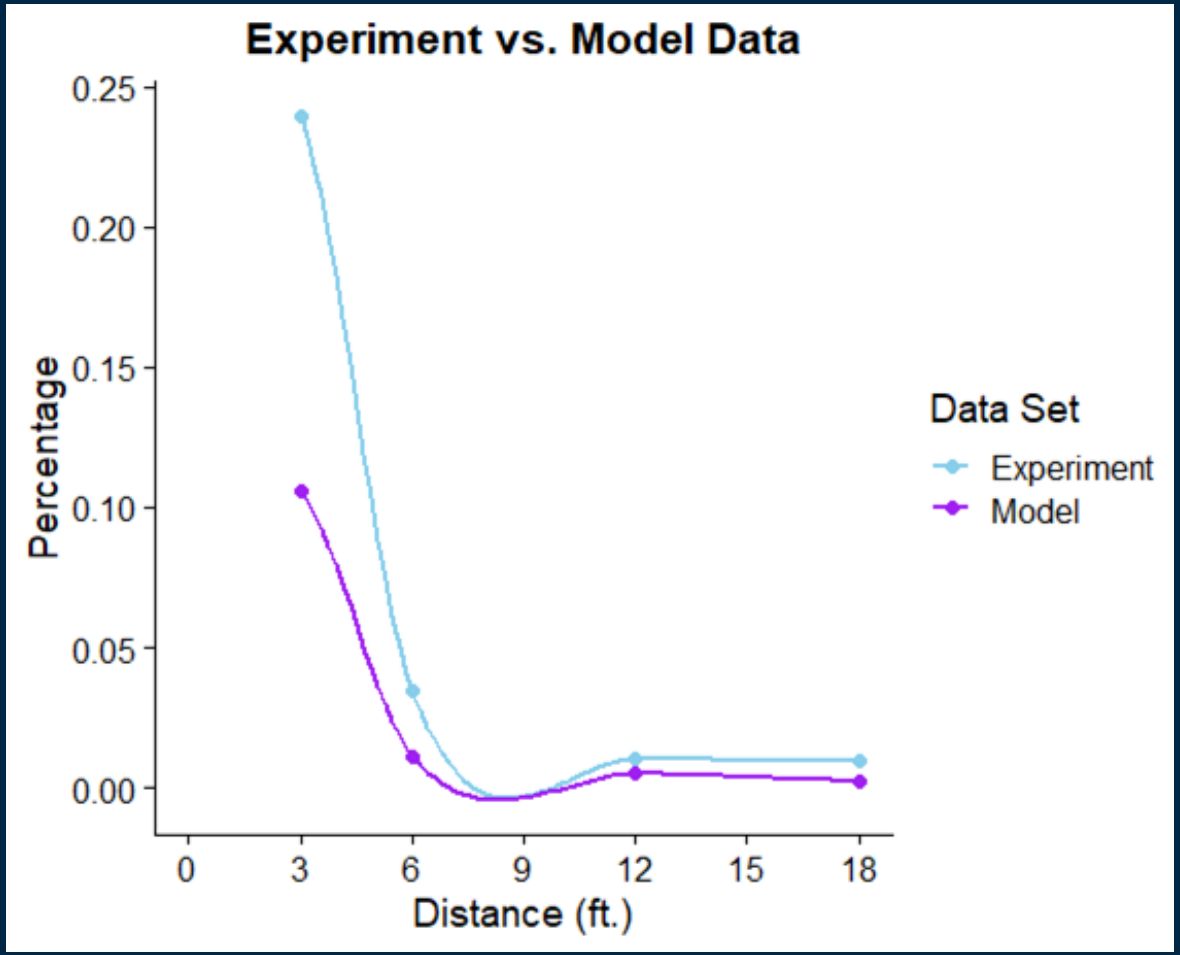
```
setup environment

go
    create 10 phages
    move phages 1 ft
    how long has each phage been in the air?
    how far has each phage traveled?
    how humid is it?
        does the phage die?- check formula
    increment age of phage by 1
    increment time passed by 1
end
```

CODE LINGO:

1 PHAGE = 1 PFU

DIE = REMOVED FROM THE ENVIRONMENT

AGE = HOW LONG PHAGE HAS EXISTED IN THE MODEL

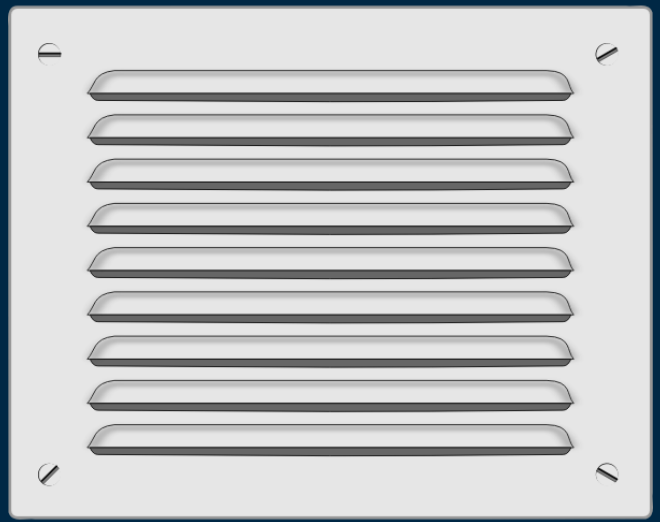

Experiment vs. Model Data
0.25
0.20
0.15
0.10
0.05
0.00
Percentage
0
3
6
9
12
15
18
Distance (ft.)
Data Set
Experiment
Model

FUTURE DIRECTIONS

QUANTIFICATION

https://www.chaibio.com/innovaprep-airprep-cub-air-sam

HVAC



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Do you have any questions?

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THANKS



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