



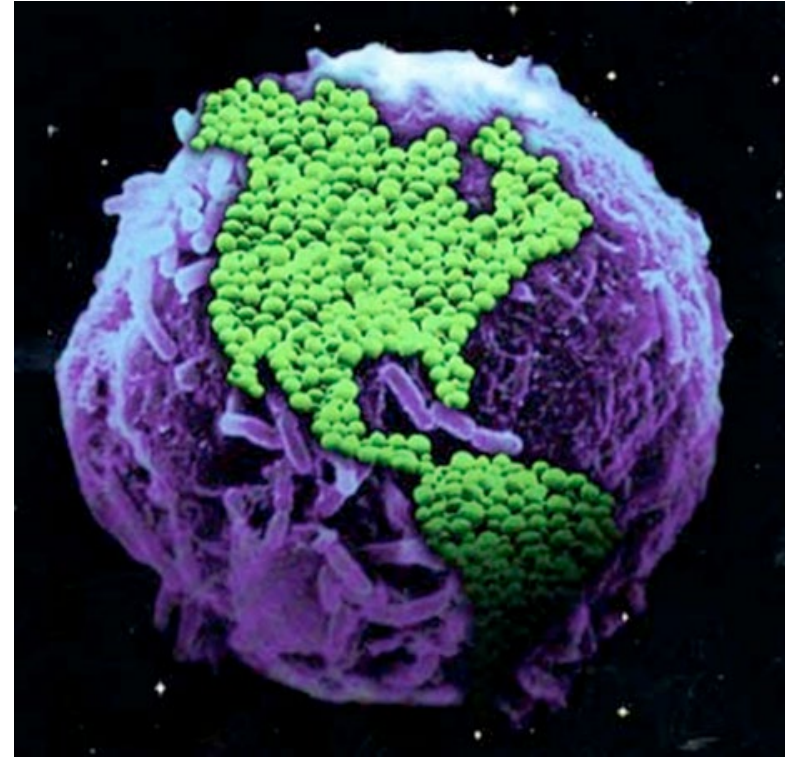
Biopelículas de *Pseudomonas aeruginosa*: múltiples estrategias para persistir en el ambiente

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XVII Jornadas Científicas, Instituto de Salud Pública de Chile 2025



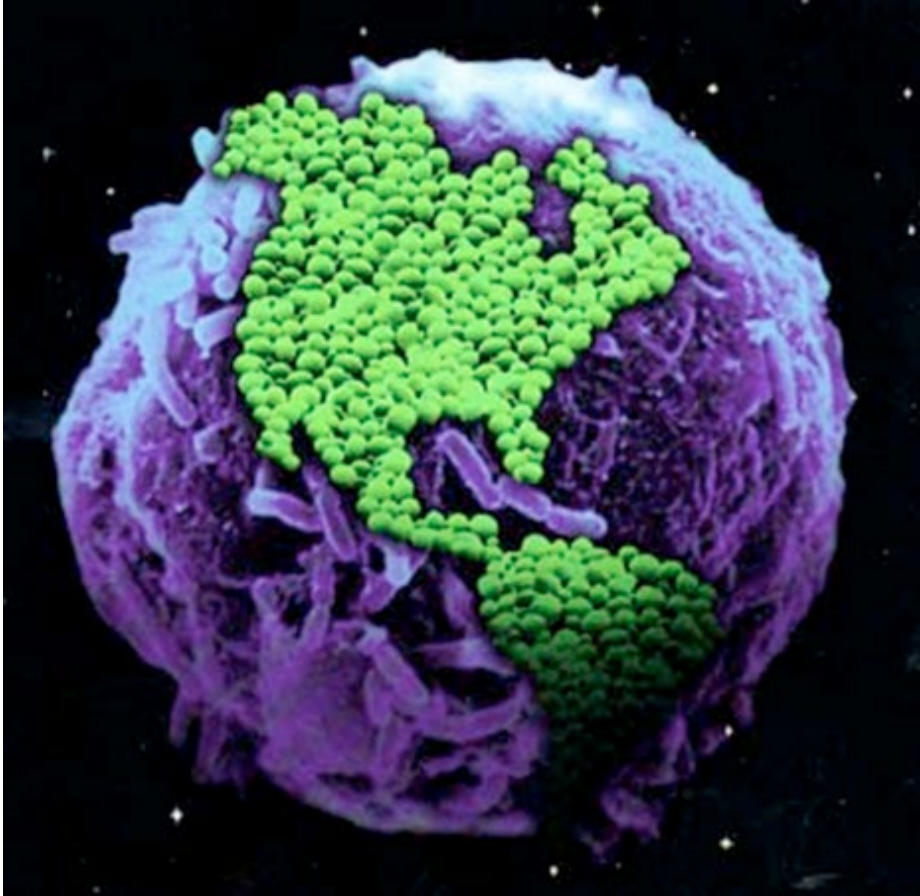
Apolo 17, 1972



Microbial earth, ASM

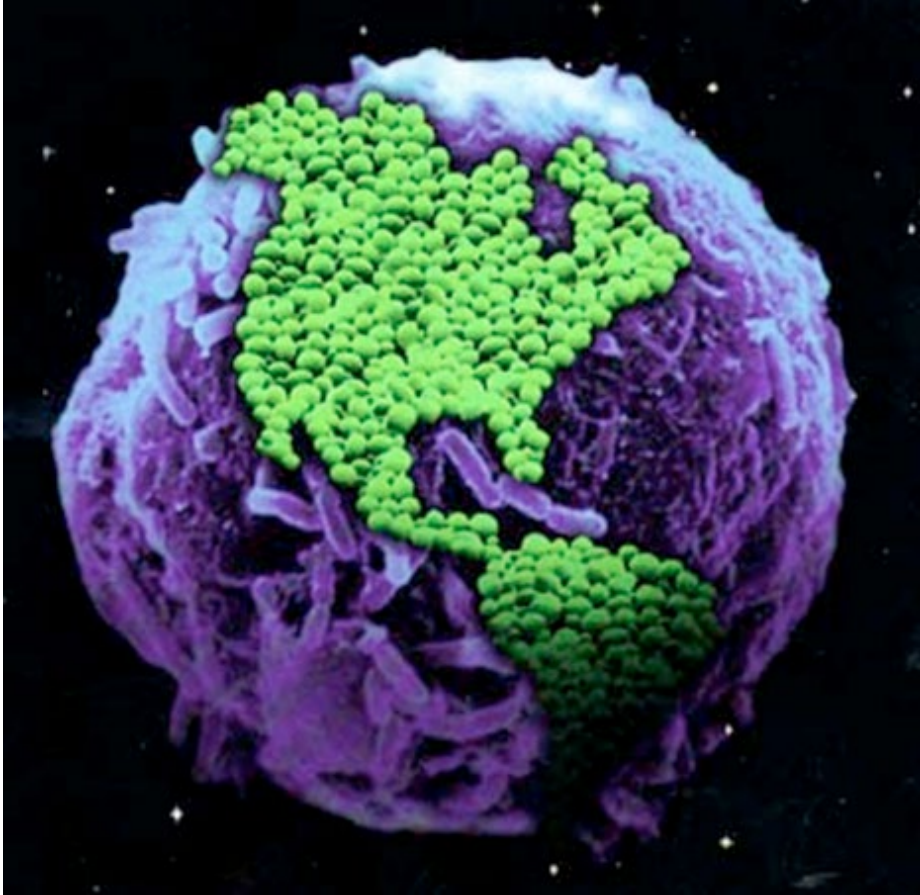
Microbes are the most abundant form of life on our planet

It is a microbial world



Understanding microbial behavior
is key to finding **solutions** to the
most relevant challenges faced by
mankind

It is a microbial world

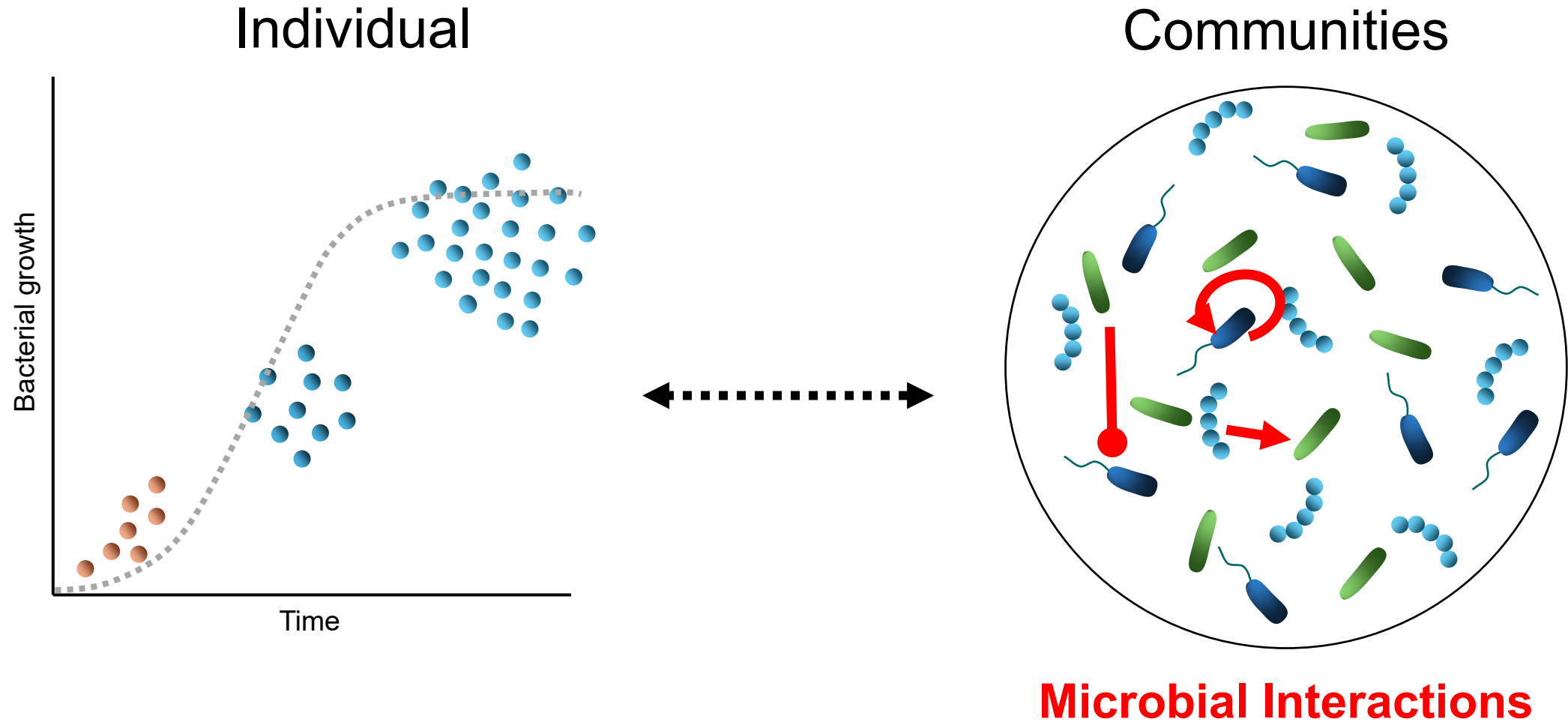


Climate change

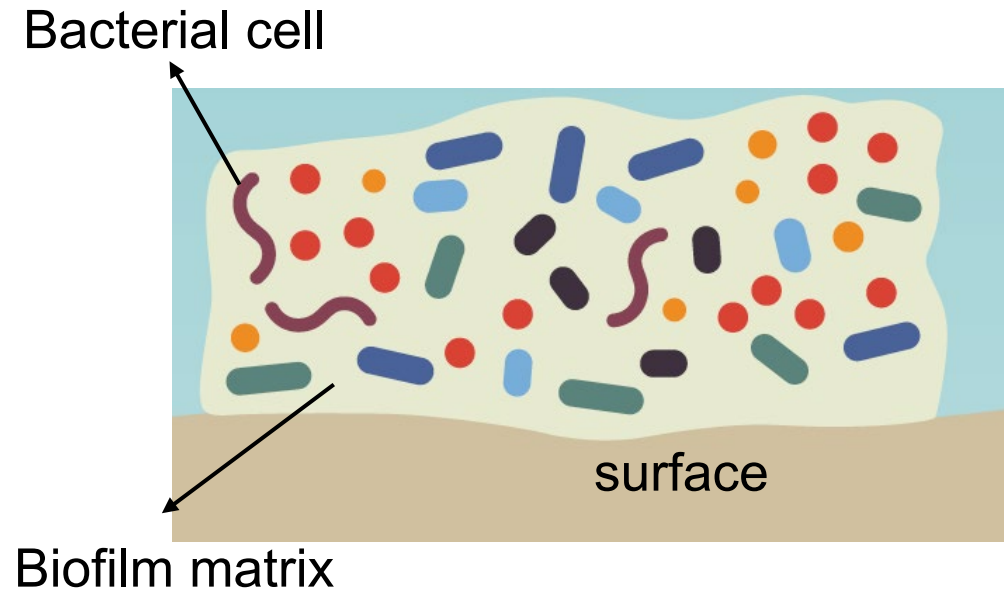
Microbes:

- biomarkers
- inspire solutions
- new challenges

Improving our understanding of the microbial world



Biofilms are one of the most widely distributed and successful modes of life on Earth

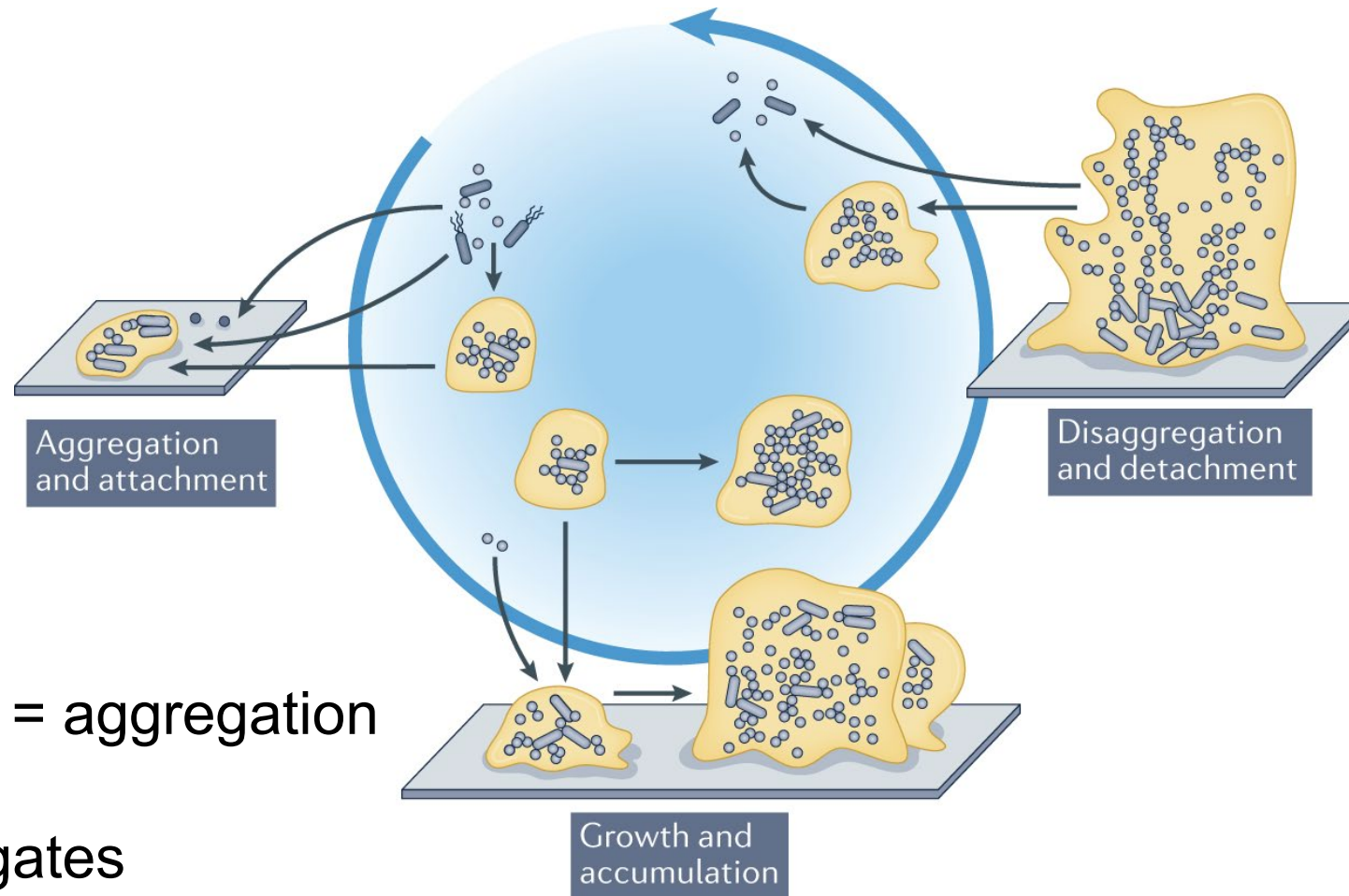


Biofilms are complex microbial communities living in close association with surfaces embedded in a self-produced matrix

Estimated total (bacterial and archaea)
cell number = 1.2×10^{30}

40-80% resides in biofilms

Expanded conceptual model of biofilm formation

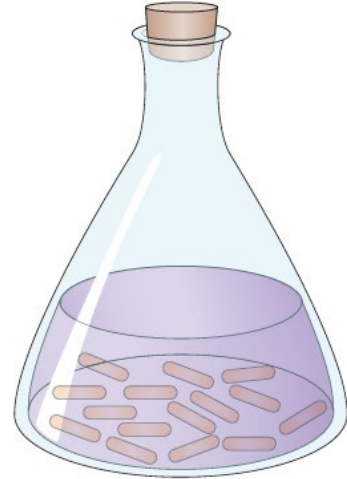


Biofilm formation = aggregation

Biofilms = aggregates

Bacteria growing in biofilms are substantially different from free-living bacterial cells

“free-living” bacteria



≠

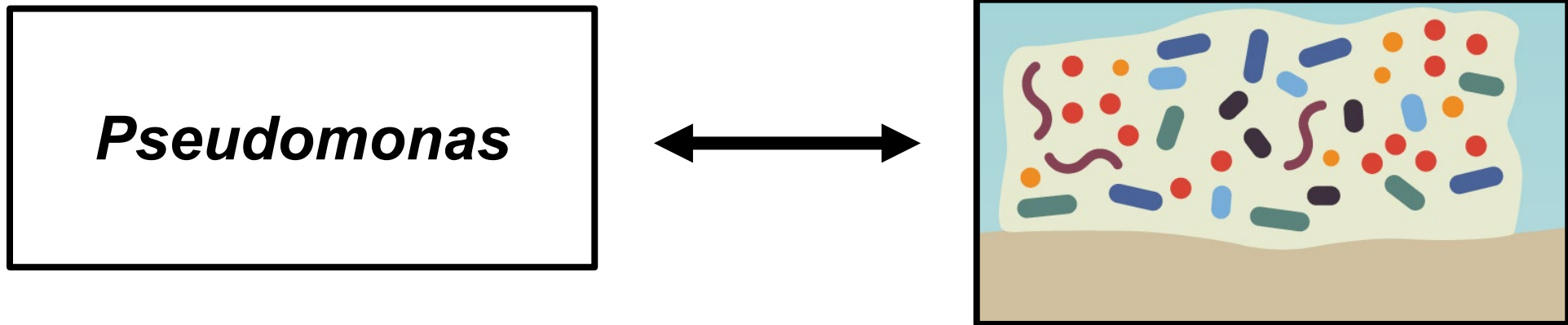
Biofilms



Pathogenic bacteria forming biofilms

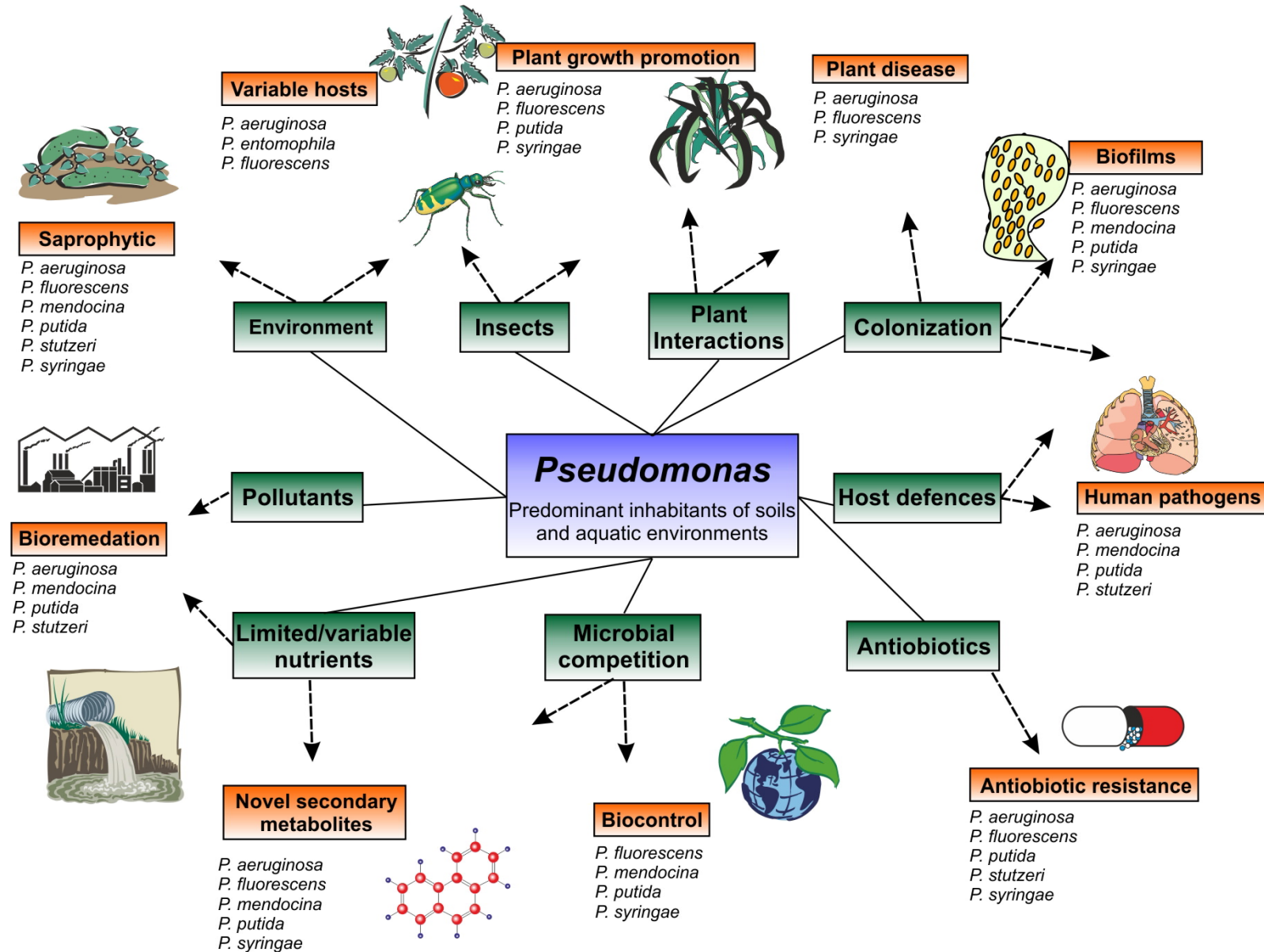
Persistent Infections → increased **tolerance to antimicrobials** and the host immune response

The functional and environmental range of *Pseudomonas* spp.



***Pseudomonas* spp ability to form biofilms across different environments.**

The functional and environmental range of *Pseudomonas* spp.



Model organism I

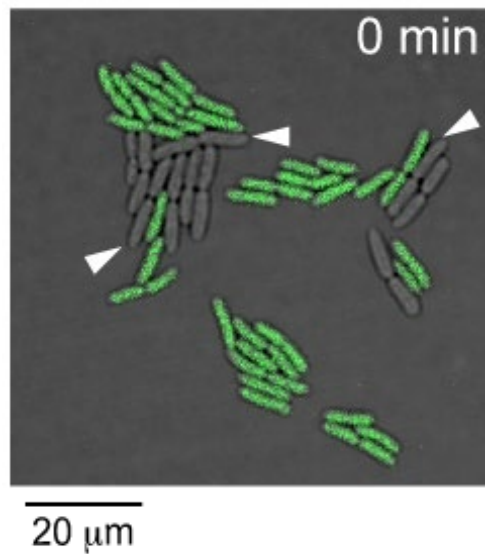
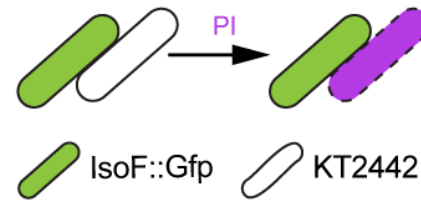
Pseudomonas putida IsoF

- Plant promoting bacteria
- Root colonizer
- Uses cell-to-cell communication (Quorum Sensing, QS) to form biofilms

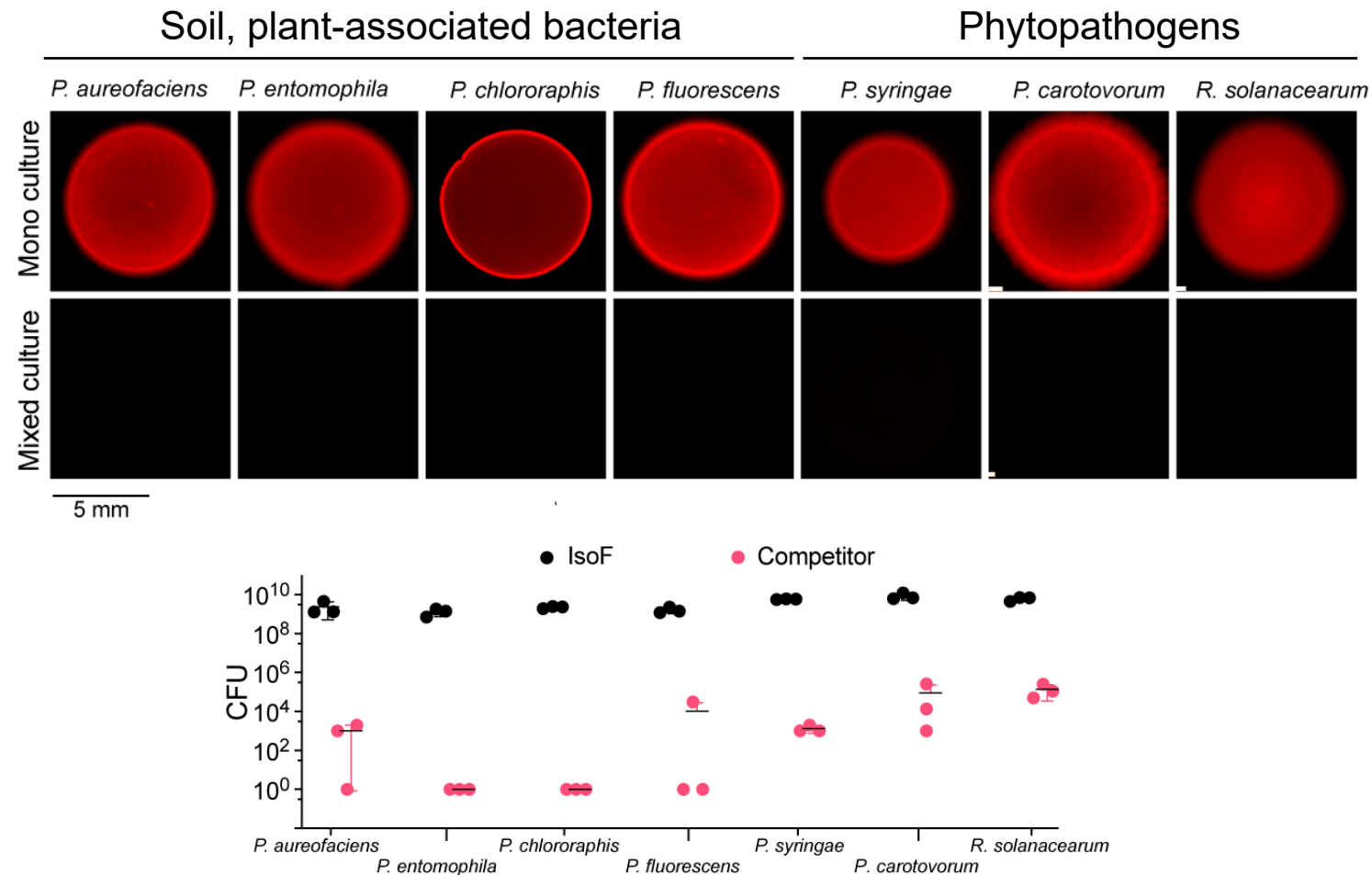
Quorum sensing triggers the stochastic escape of individual cells from *Pseudomonas putida* biofilms

Nature Communications volume 6, Article number: 5945 (2015)

***P. putida* IsoF displays contact-dependent antagonism against a wide range of Gram-negative bacteria**



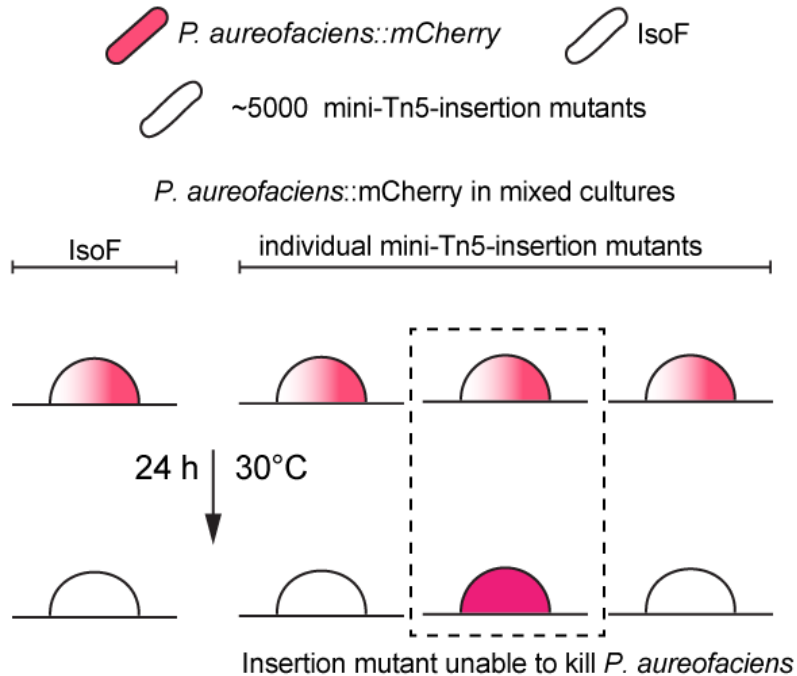
P. putida IsoF displays contact-dependent antagonism against a wide range of Gram-negative bacteria



IsoF utilizes a rare T4BSS for bacterial killing

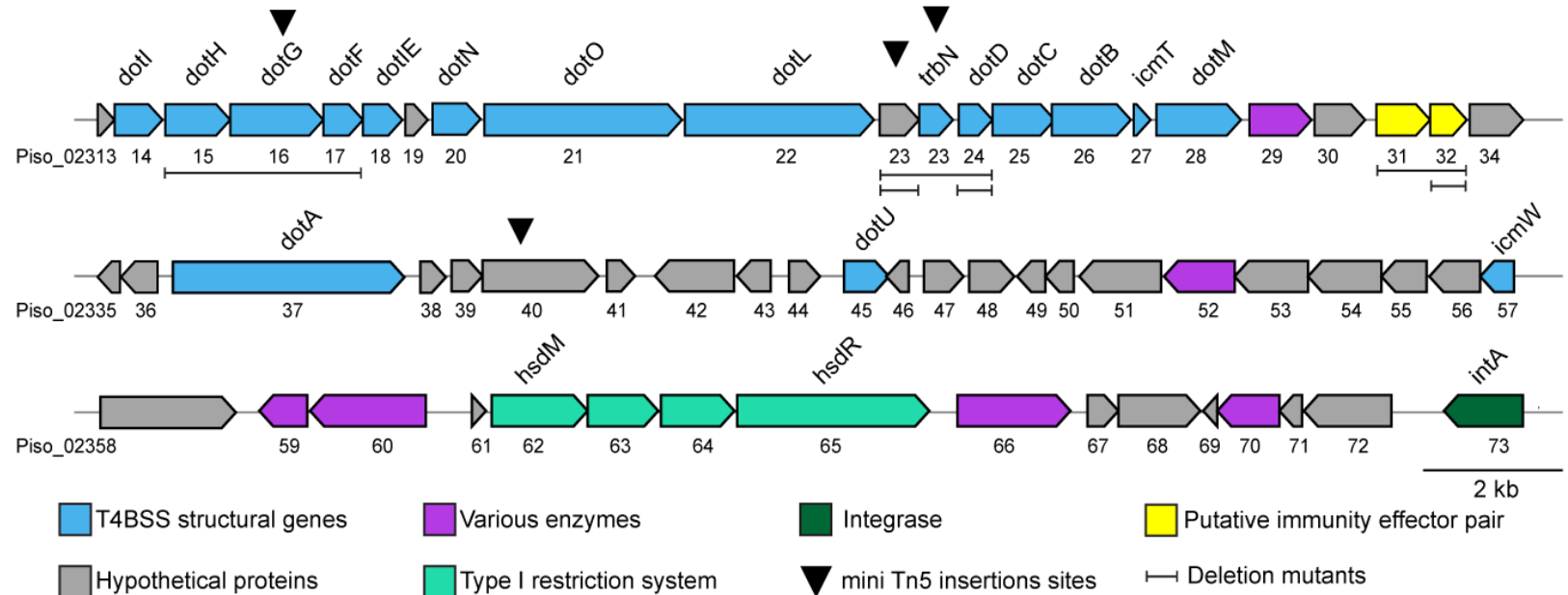
... looking for a mechanism

Screening mini-tn5 library mutants



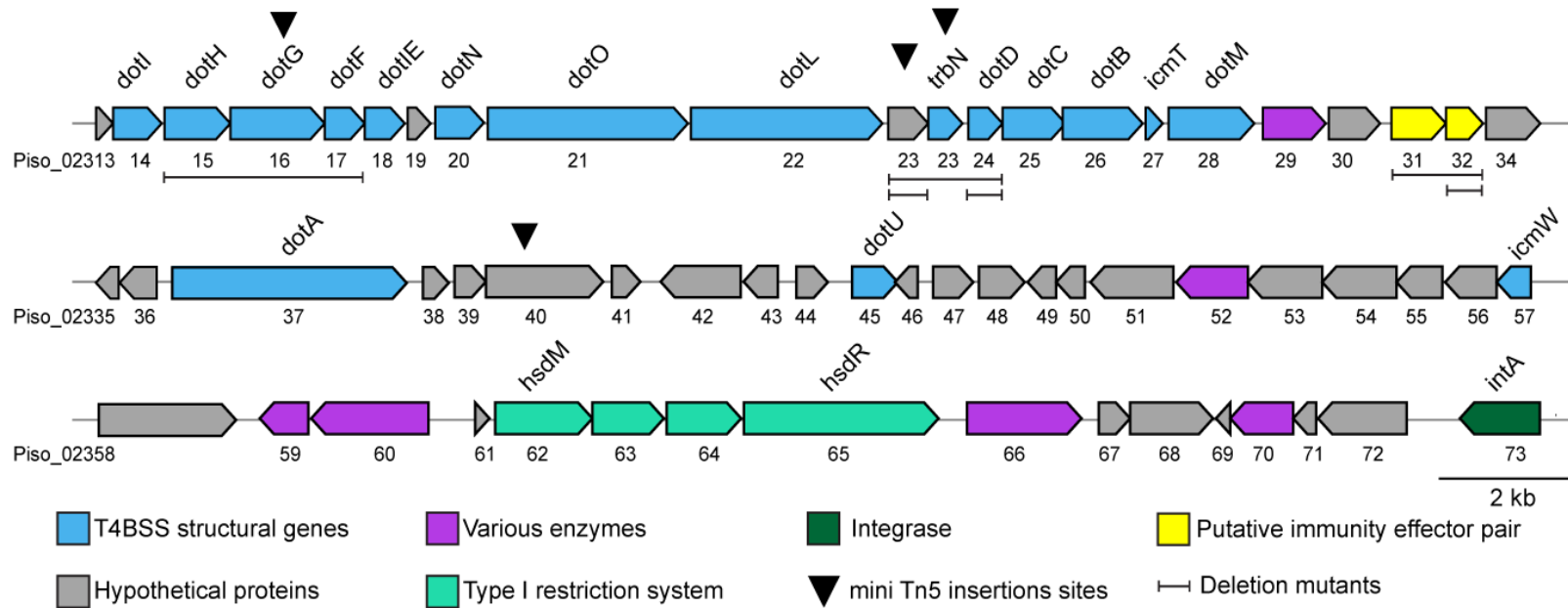
16 insertion mutant
8 identified by PCR

Genetic organization of the IsoF Genomic Island that encodes a T4BSS required for bacterial killing

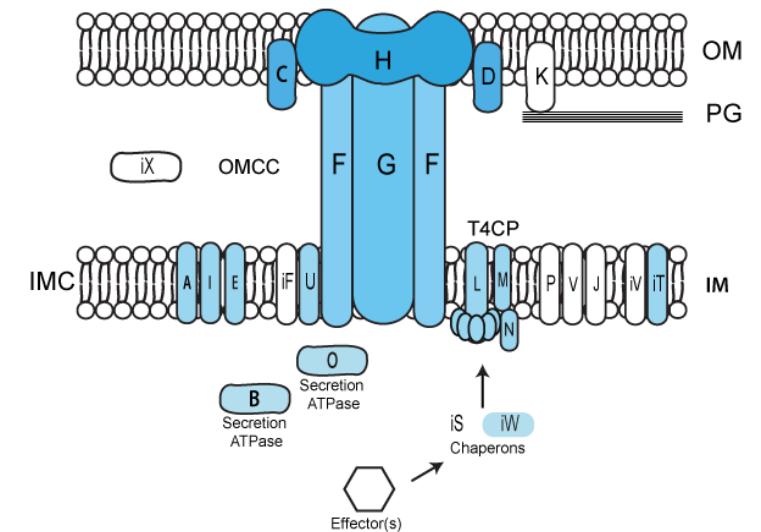


IsoF utilizes a rare T4BSS for bacterial killing

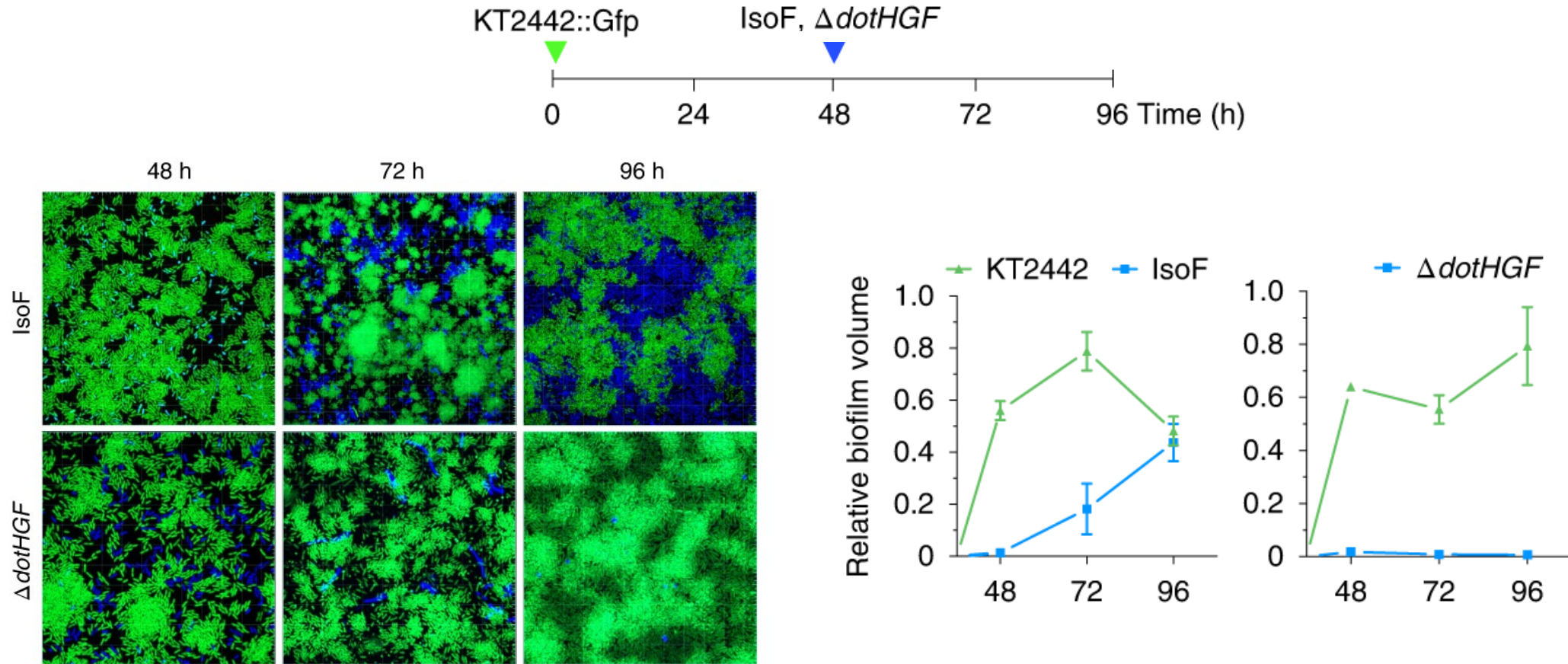
Genetic organization of the IsoF Genomic Island that encodes a T4BSS required for bacterial killing



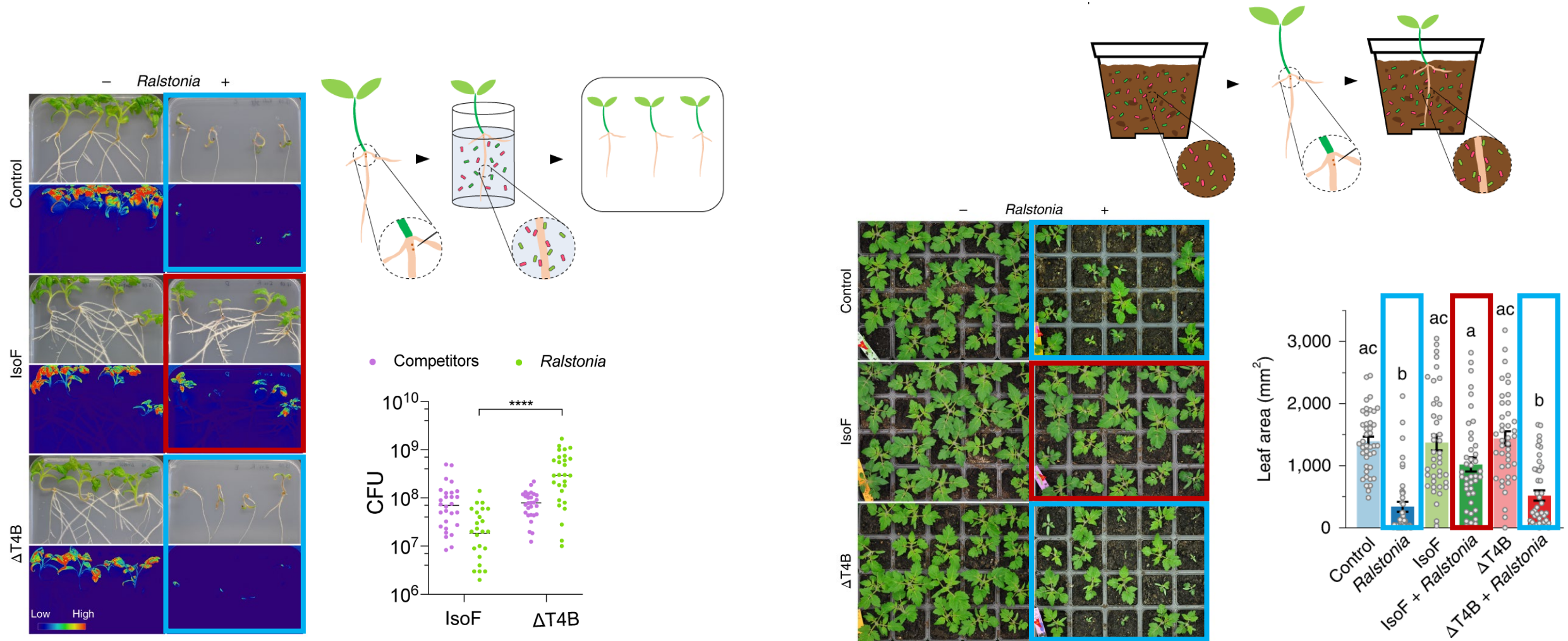
Architecture of the T4BSS gene cluster in *Legionella*



IsoF wild type invades and displaces a pre-established competitor biofilm



IsoF-T4BSS is required for biocontrol activity

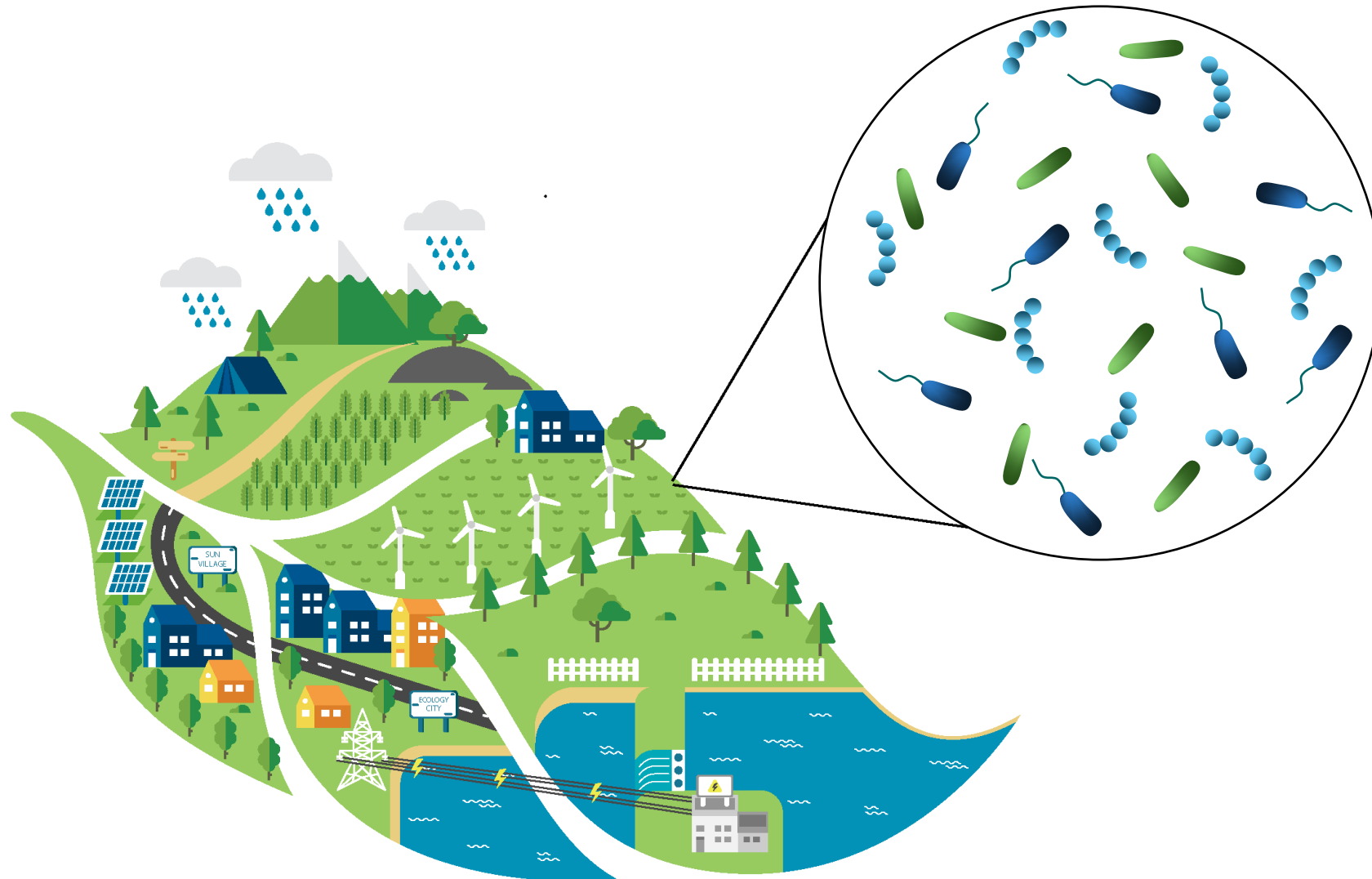


Summary I

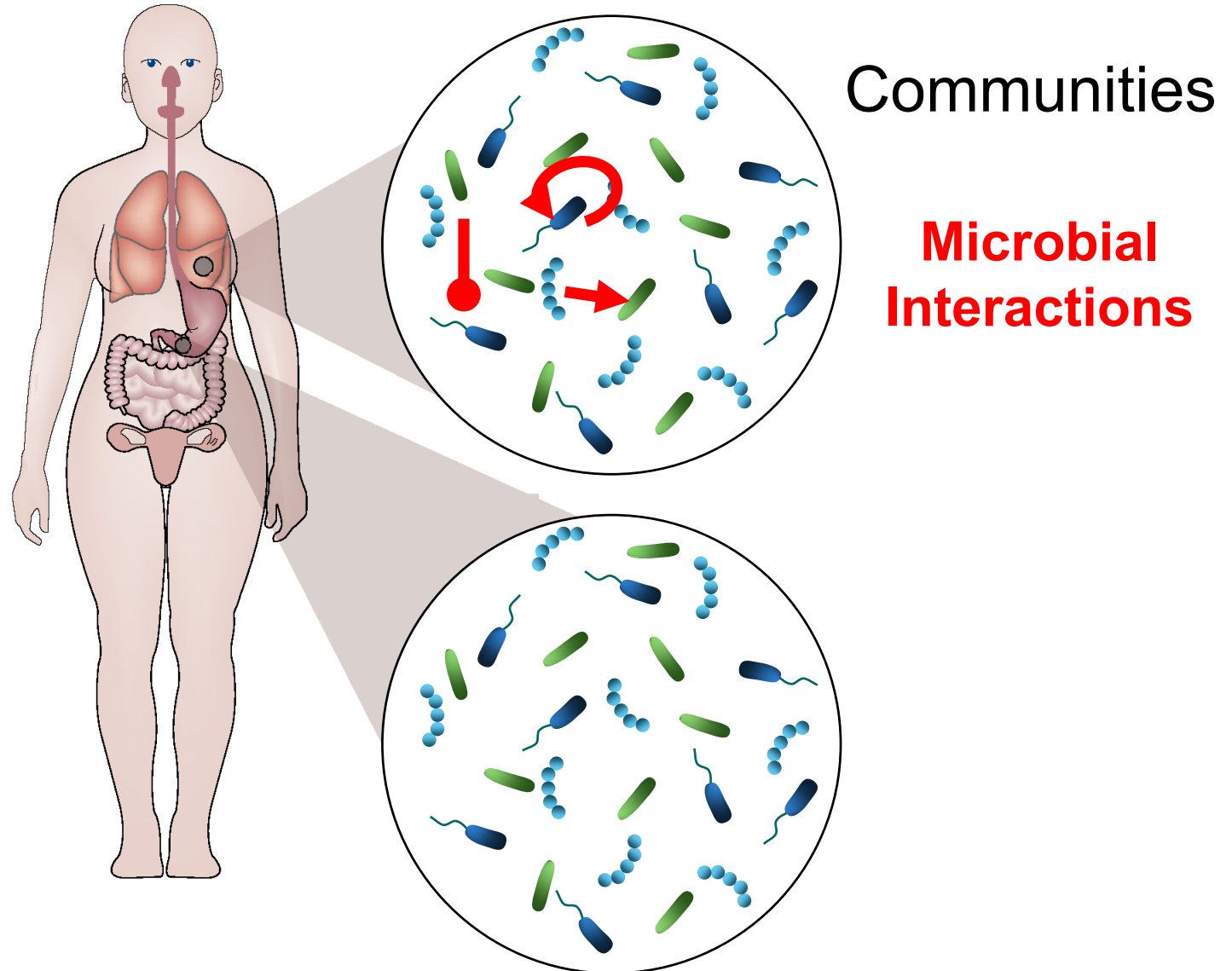
“Plant-beneficial pseudomonads use a type **IVB secretion system** to kill bacterial competitors and invade biofilms, **playing a major role in root-associated lifestyle.**”

“Understanding the mechanisms of plant–bacteria interactions and the **role of secretion systems in shaping microbial communities will impact** fundamental sciences and **translational applications related to human and plant health**, and will be key to foster a more sustainable agriculture.”

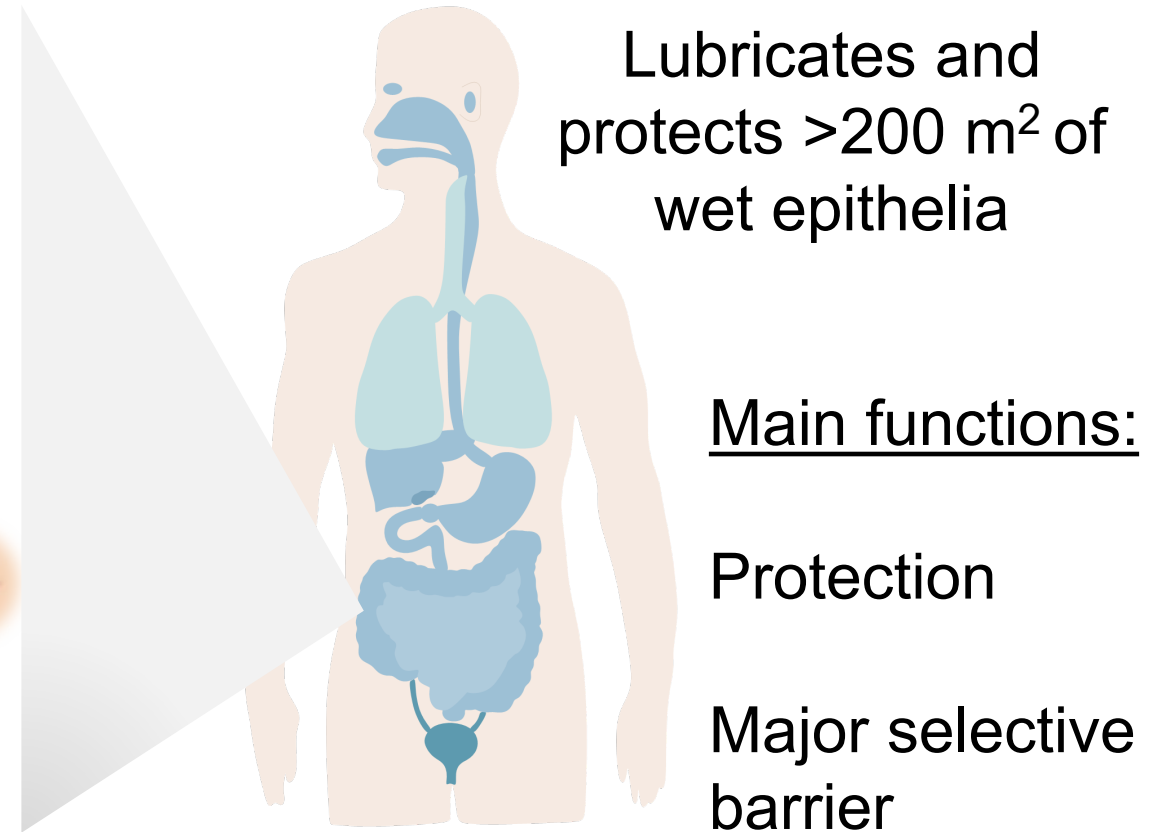
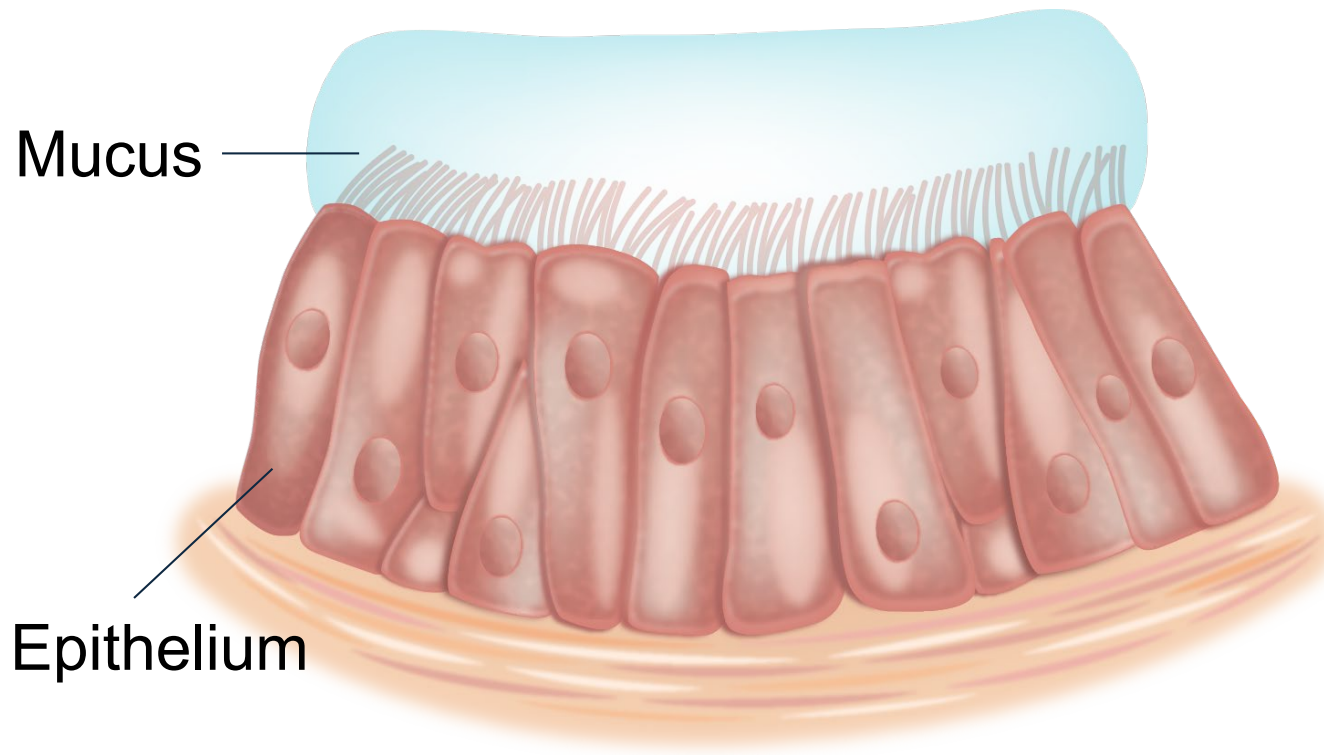
The environment influences the composition of microbial communities



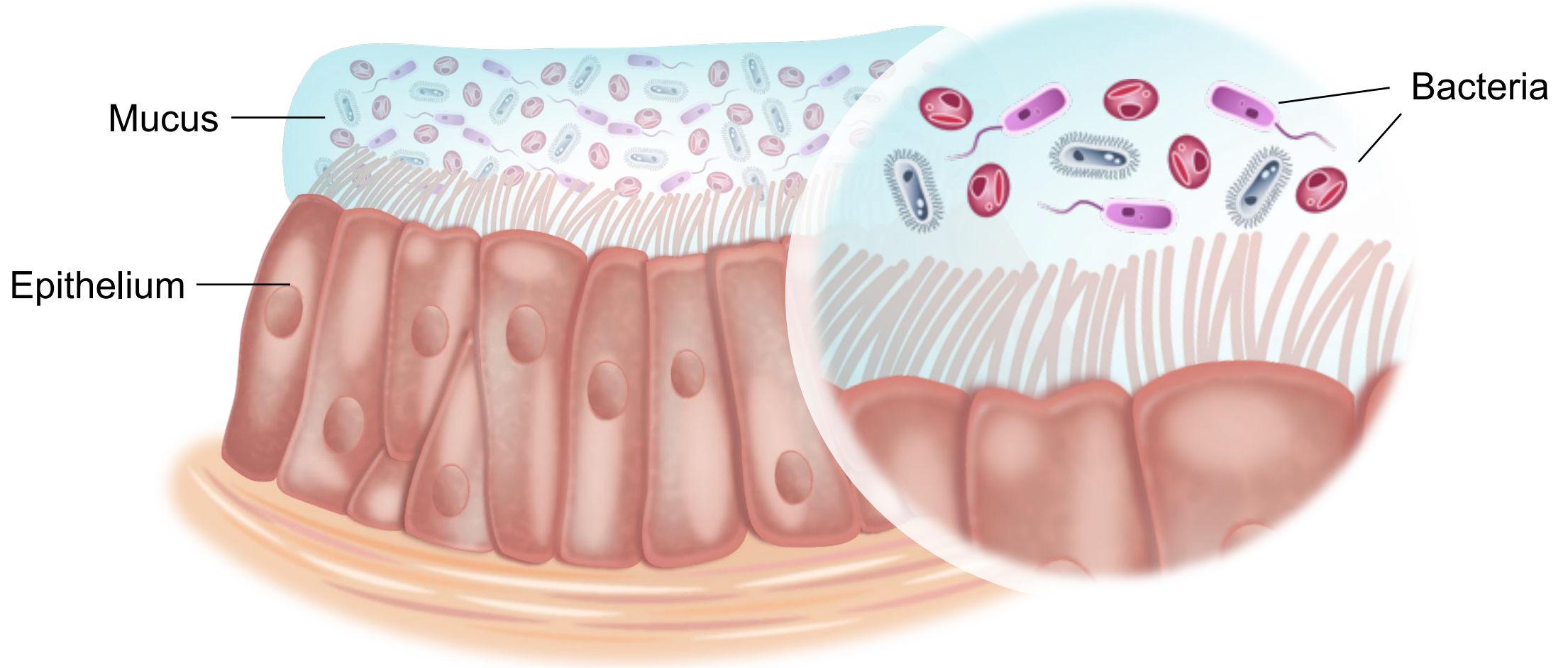
The environment influences the composition of microbial communities



Mucus lines all wet epithelia in the human body

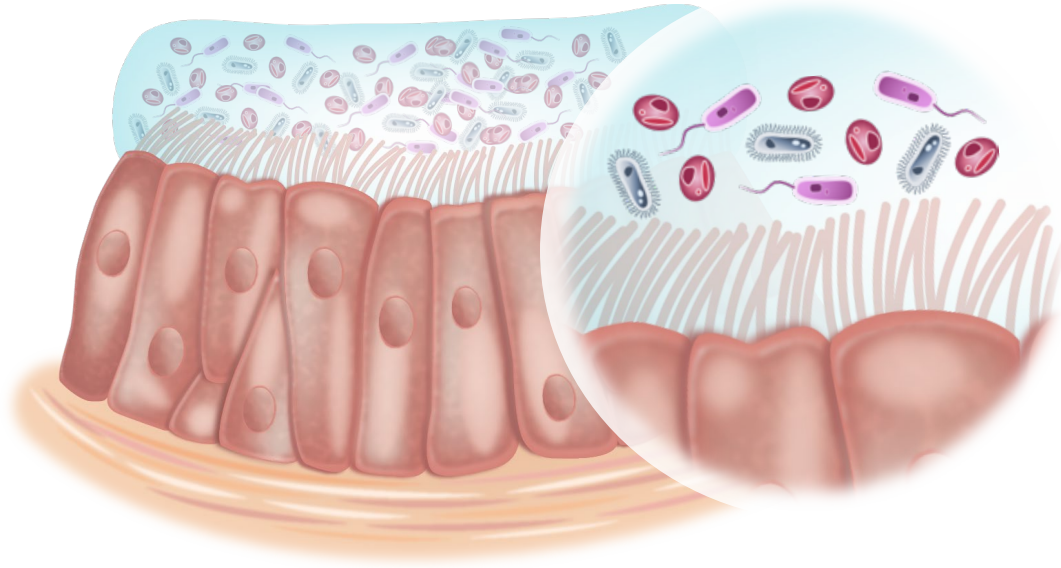


Mucus forms a major ecological niche for the human microbiota

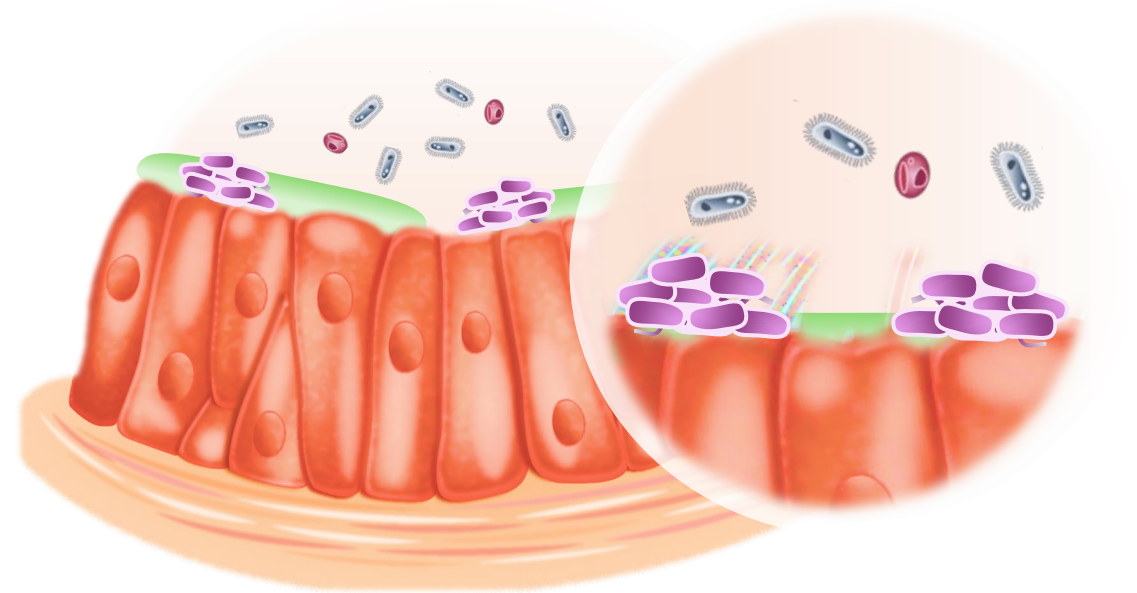


Healthy mucus protects against barrier dysfunction and disease

Healthy

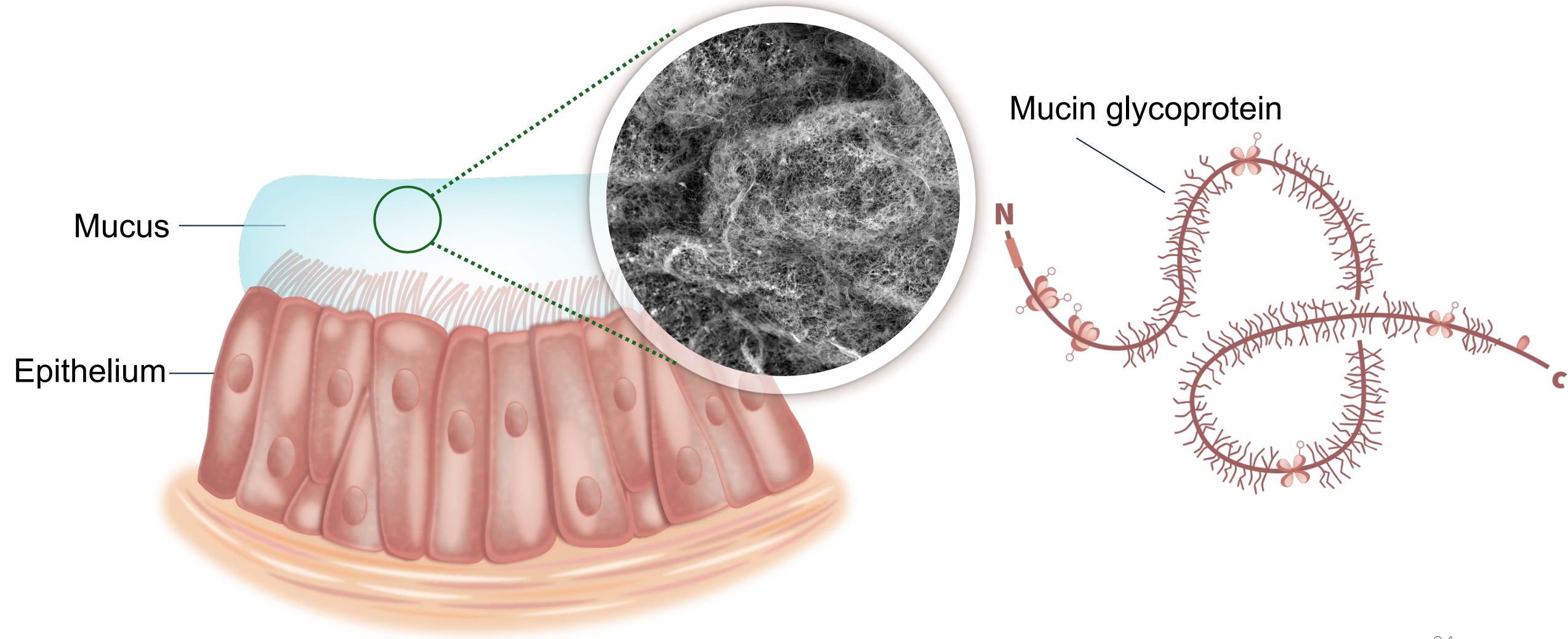


Diseased



- Cystic Fibrosis & *P. aeruginosa*
- Sjogren's Disease & Dental Caries (cariogenic streptococci)
- Inflammatory bowel disease
- Preterm birth

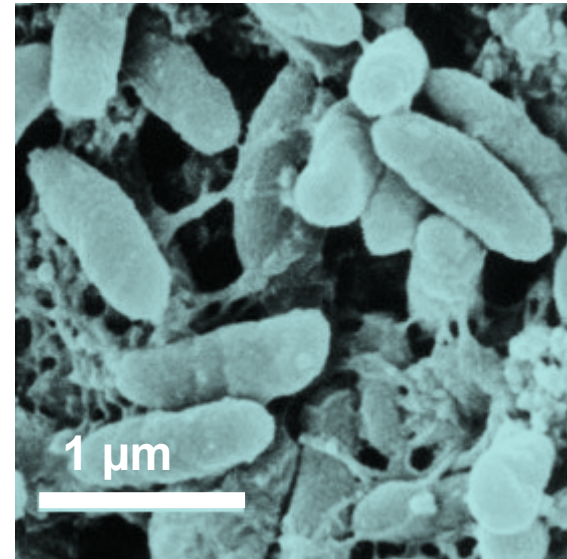
Mucus lines all wet epithelia in the human body



Model organism II

Pseudomonas aeruginosa

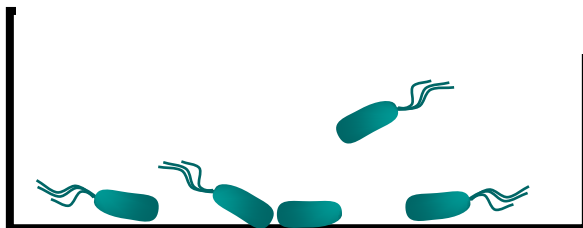
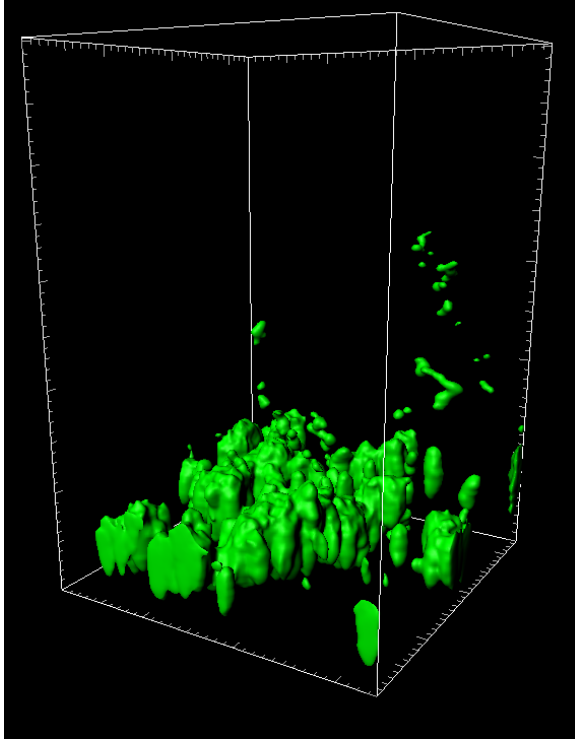
- Gram-negative, rod-shaped, motile
- Opportunistic pathogen
- Important in hospital acquired infections and immuno-compromised individuals, especially cystic fibrosis (CF)
- Forms antibiotic resistant biofilms implicated in chronic infections



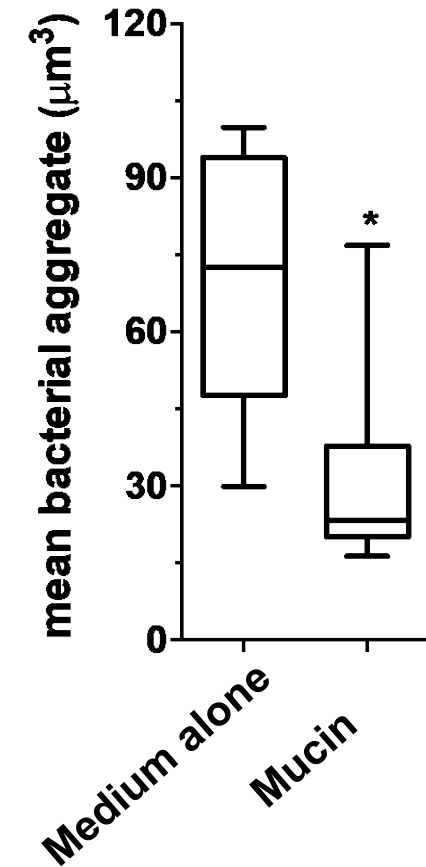
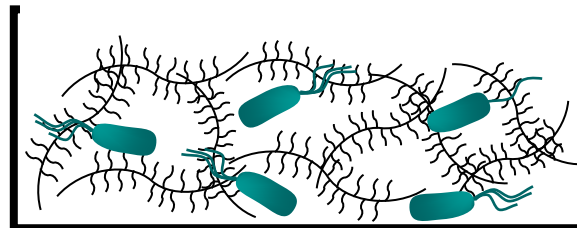
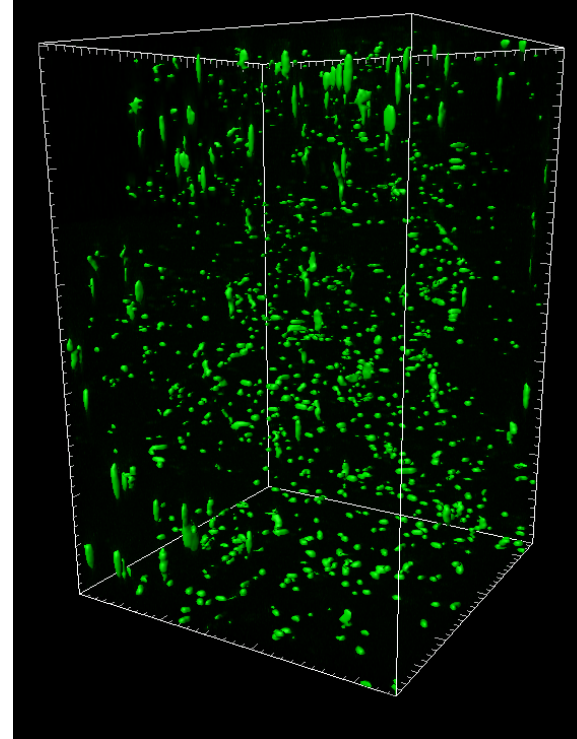
P. aeruginosa biofilm

Mucins prevent biofilm formation by *P. aeruginosa*

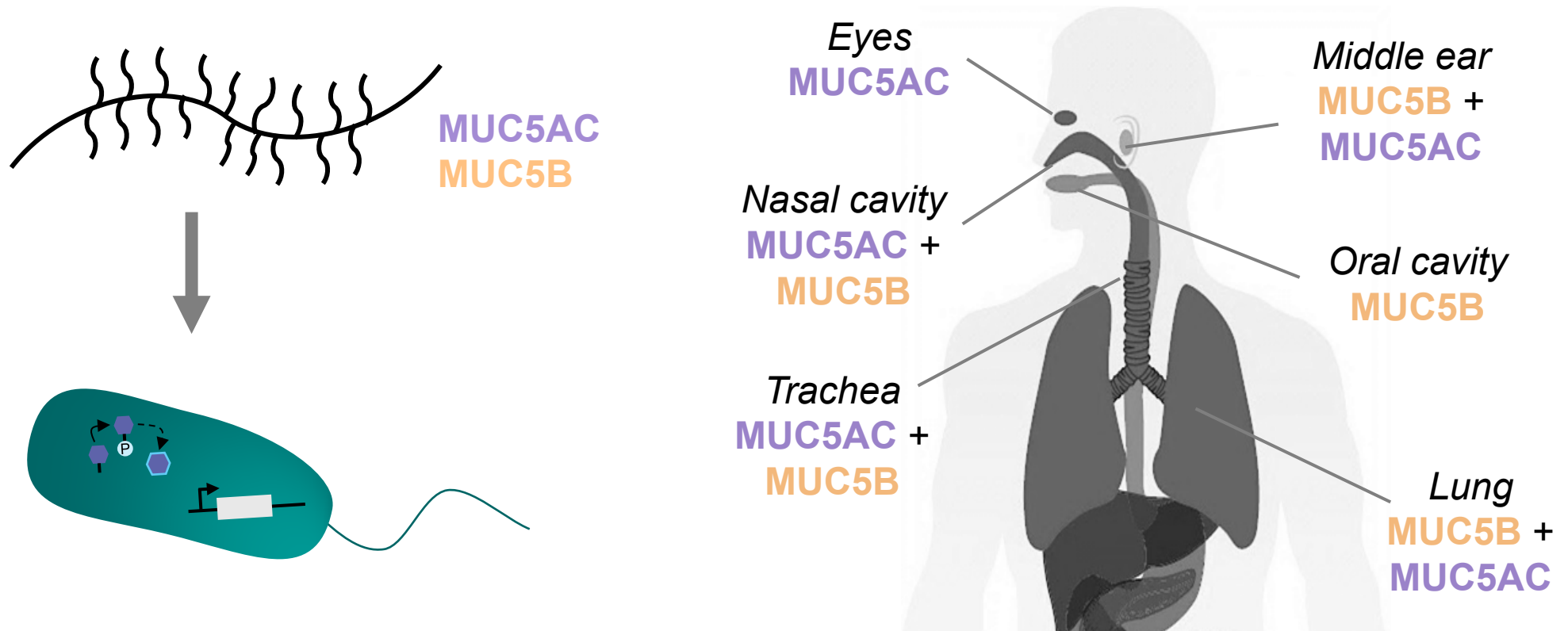
Medium alone



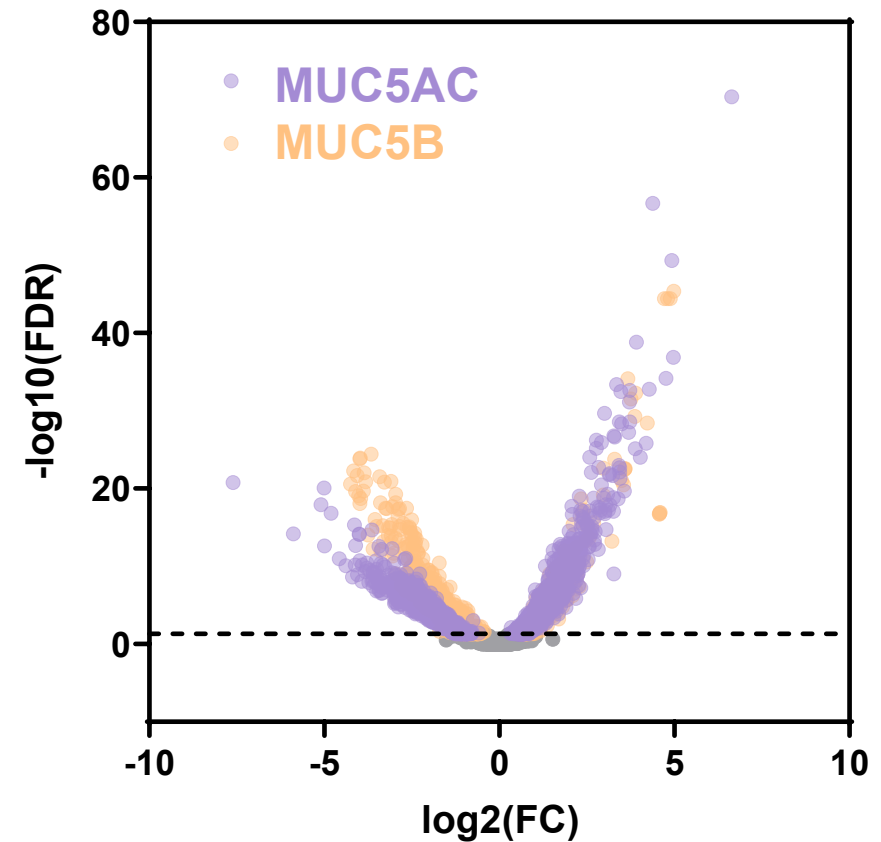
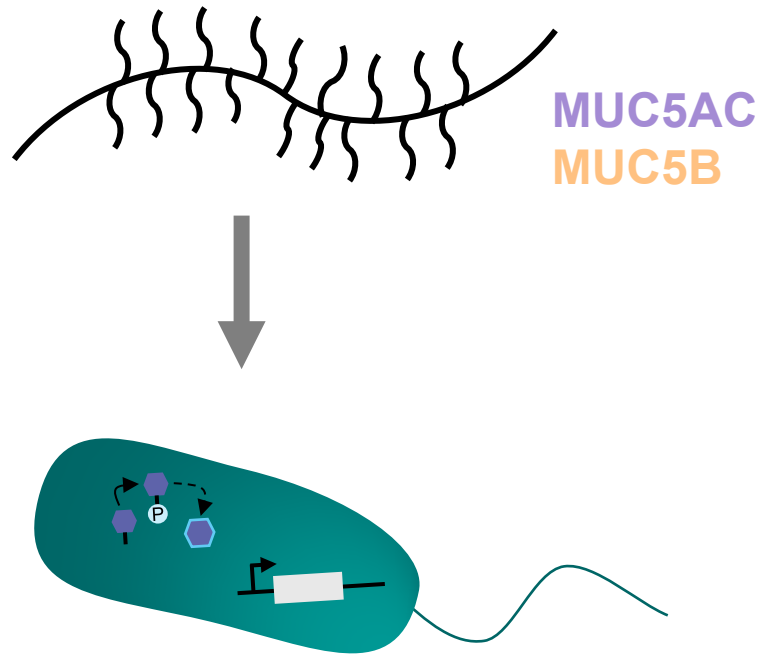
0.5% Mucin



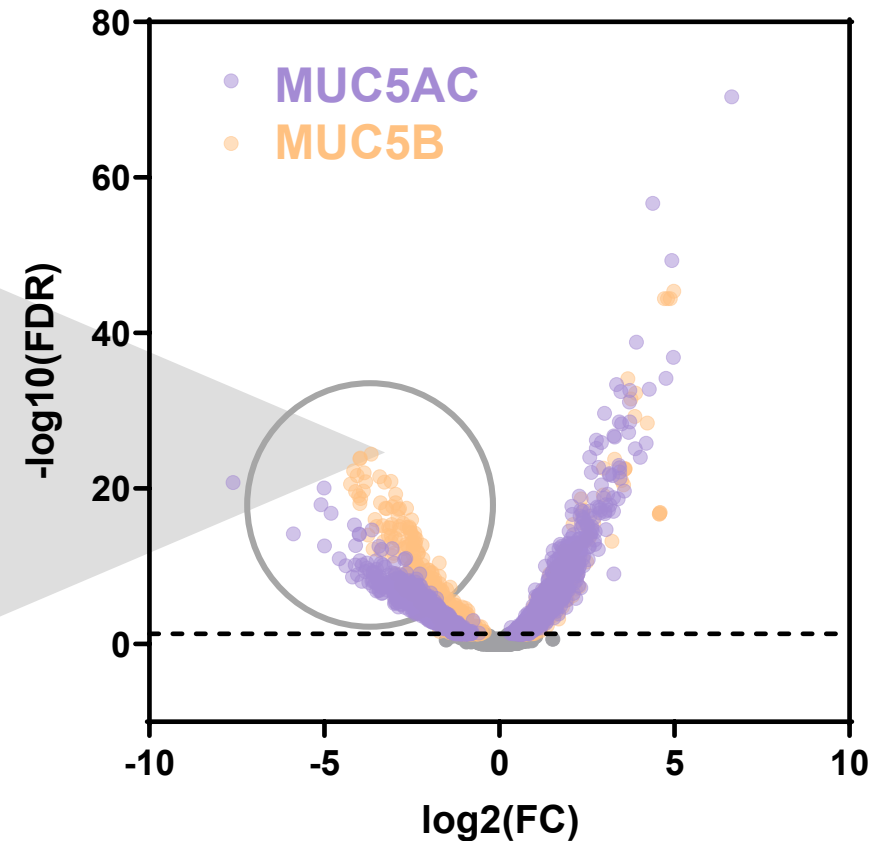
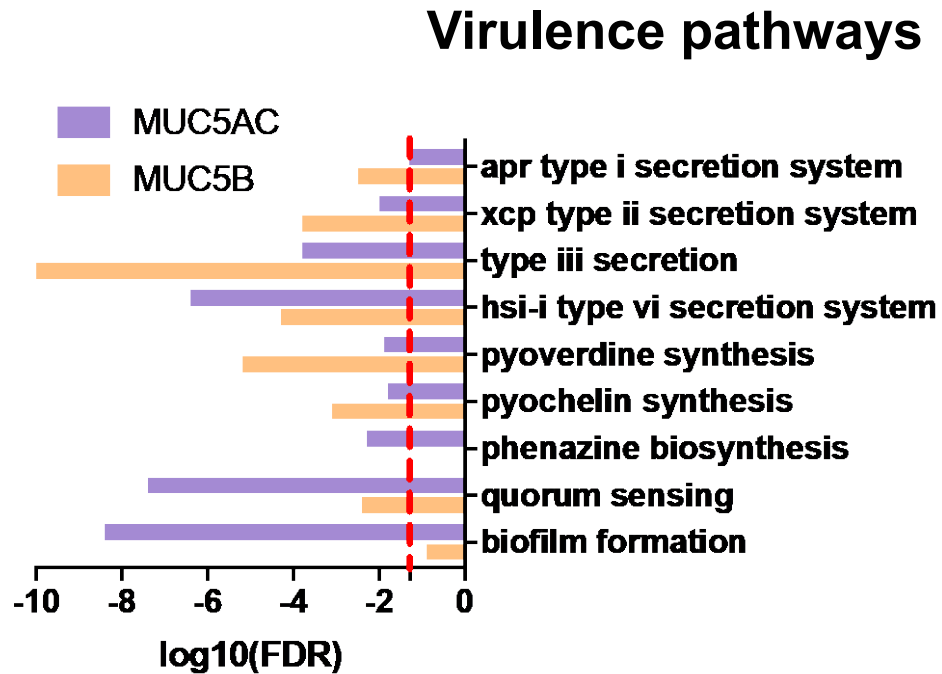
Do mucins regulate *P. aeruginosa* gene expression?



Mucins trigger a genome-wide transcriptional response

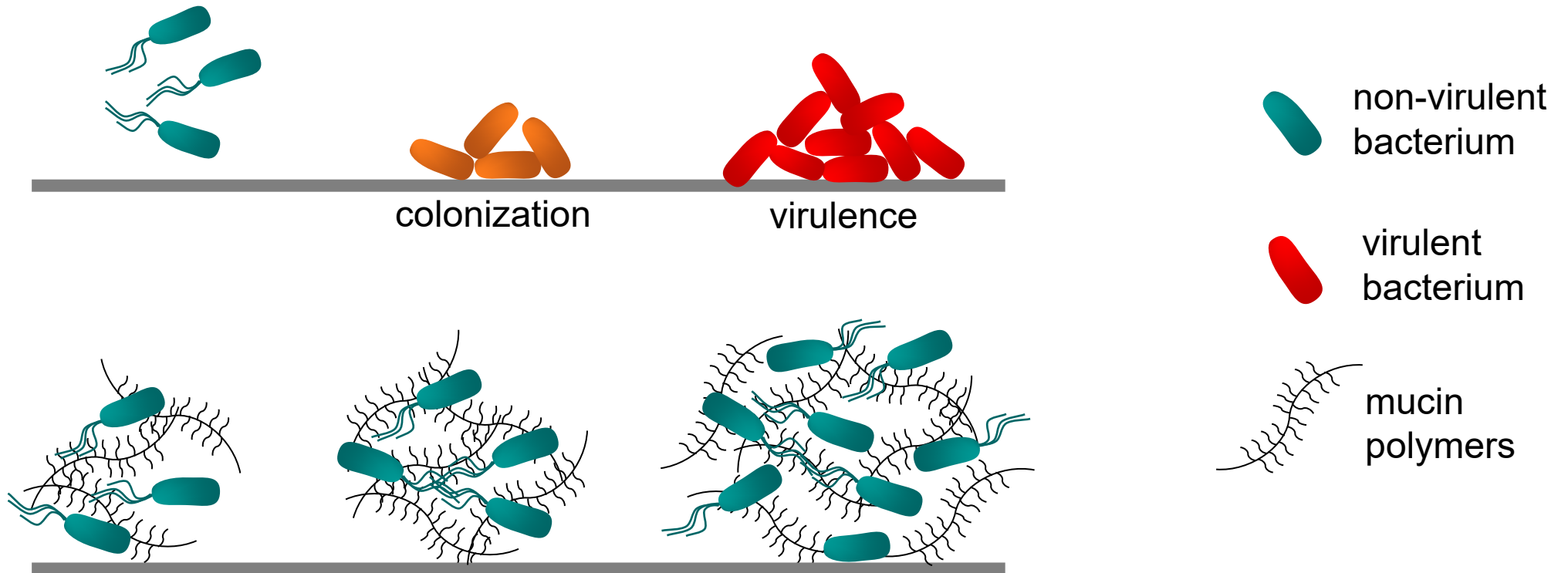


Mucins trigger a genome-wide transcriptional response



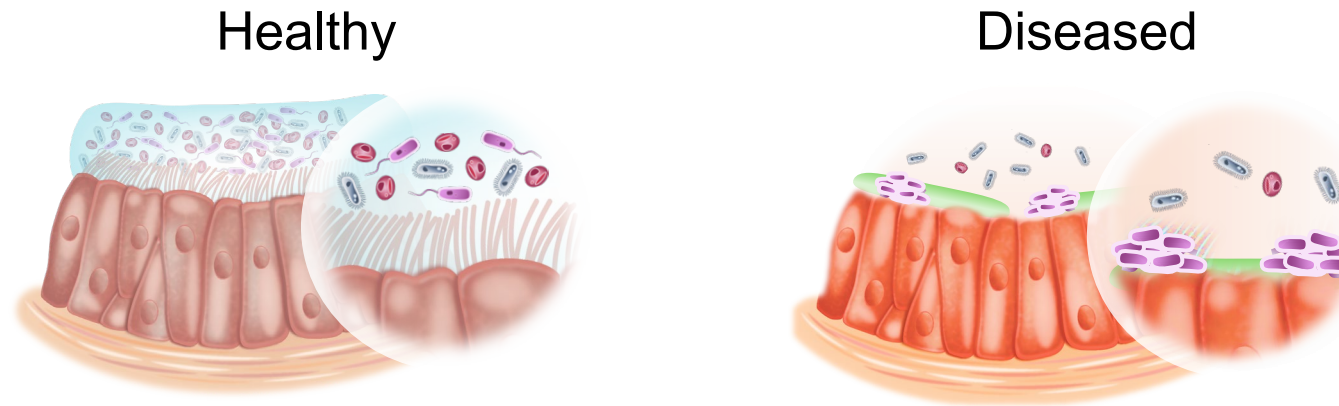
Summary II:

Mucins suppress attachment and virulence



Current Research Perspectives

Transition between healthy and disease-like bacterial communities in mucus environments



Body sites

Respiratory tract
Oral cavity
Intestinal tract

Microbial players

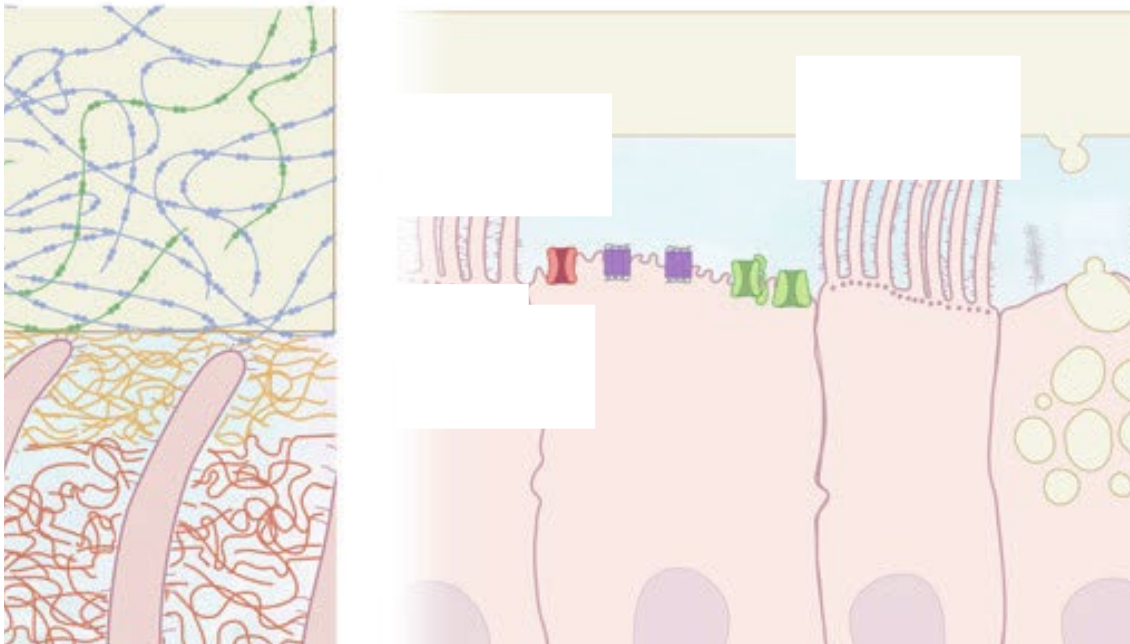
Mono infections
Polymicrobial infections
Communities' unbalances

Antimicrobial therapy

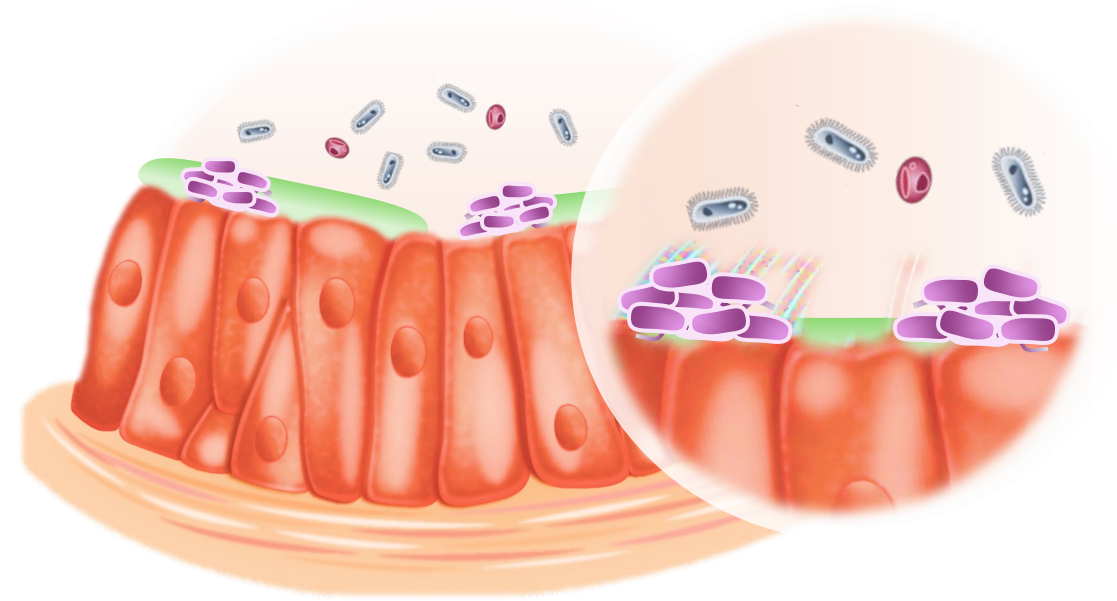
Revert antimicrobial
tolerance

Can we use components of mucus as a proxy to study mucus-associated infections?

Muco-obstructive airway diseases

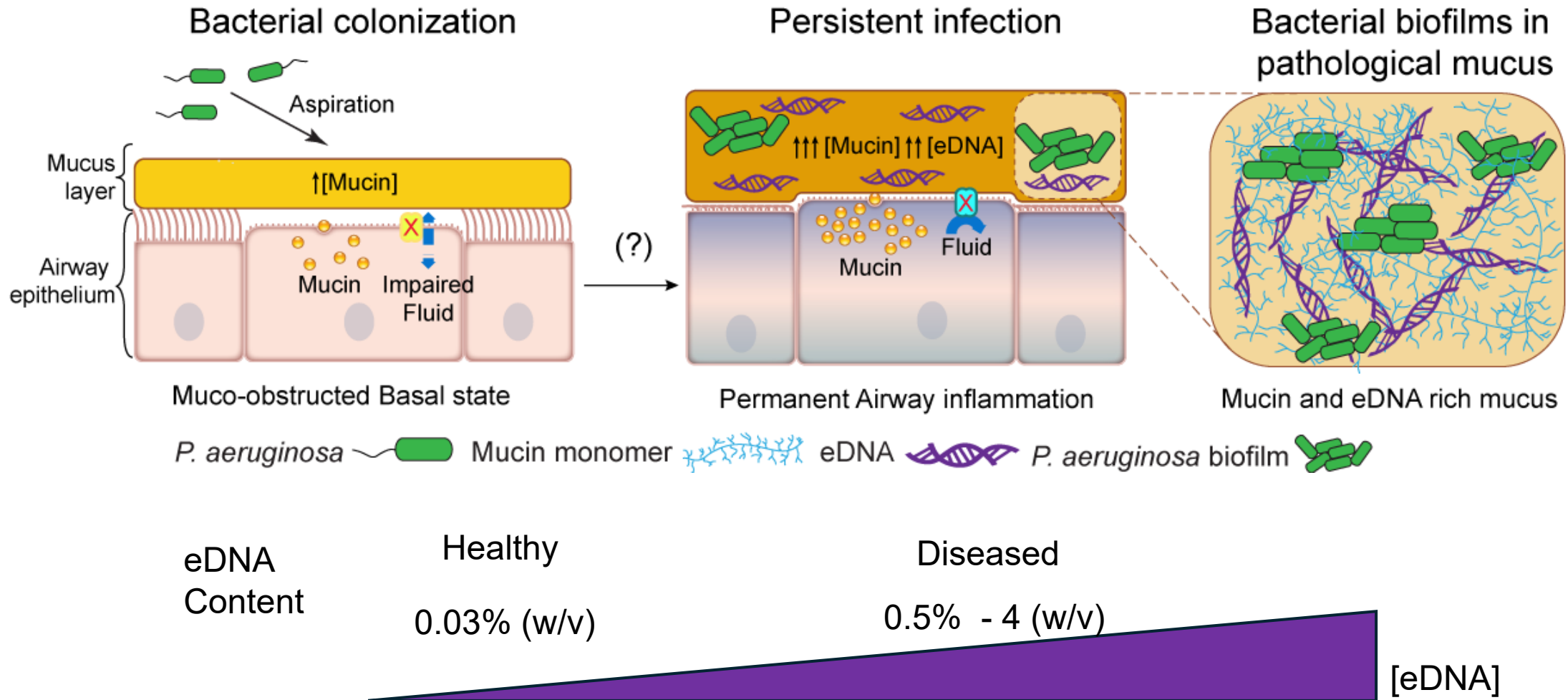


Diseased

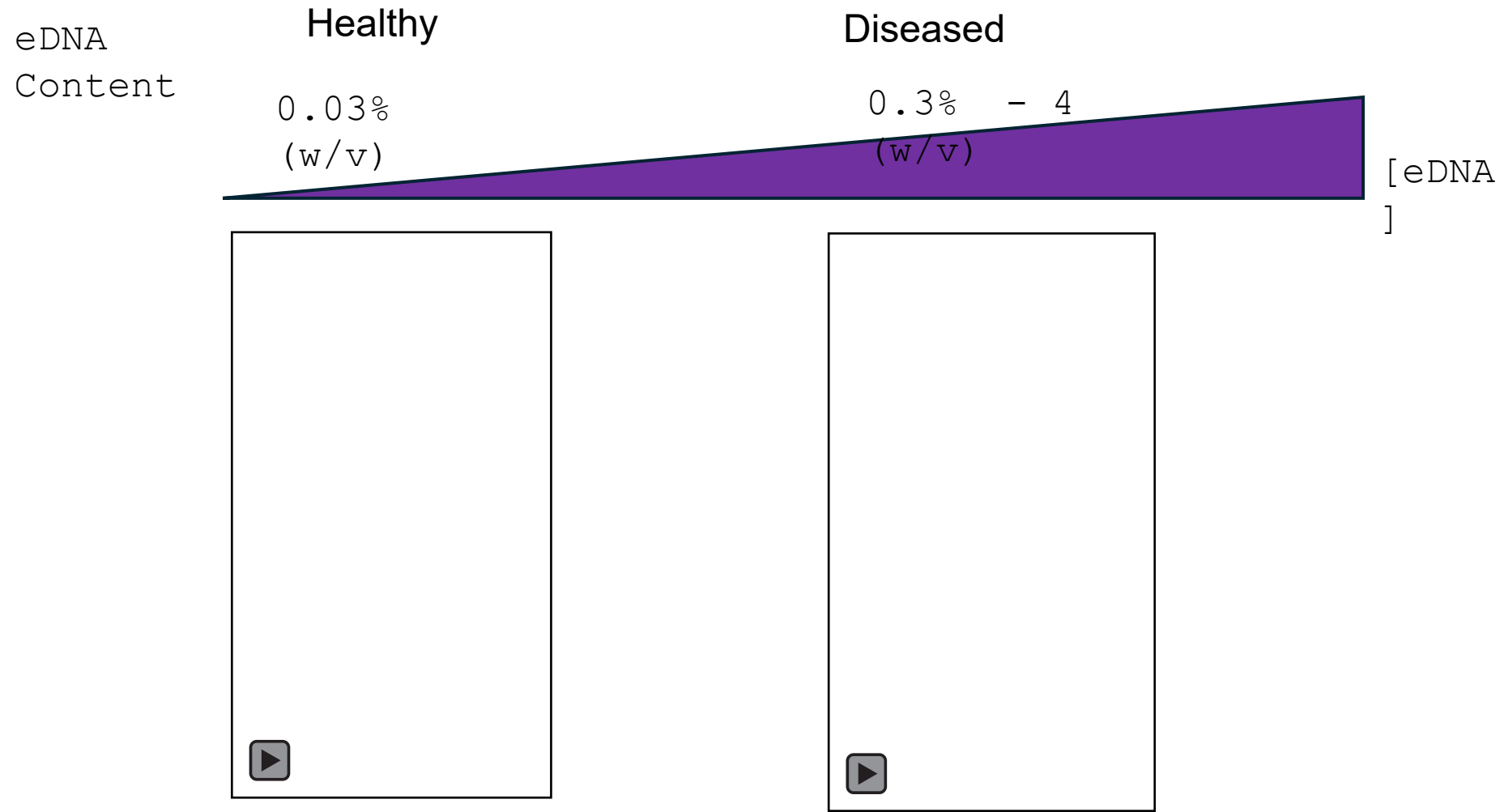


- Muco-obstructive airway diseases
 - *P. aeruginosa*

Muco-obstructive airway diseases (MADs) associated infections



Extracellular DNA (eDNA) is a major factor governing MADs associated infections

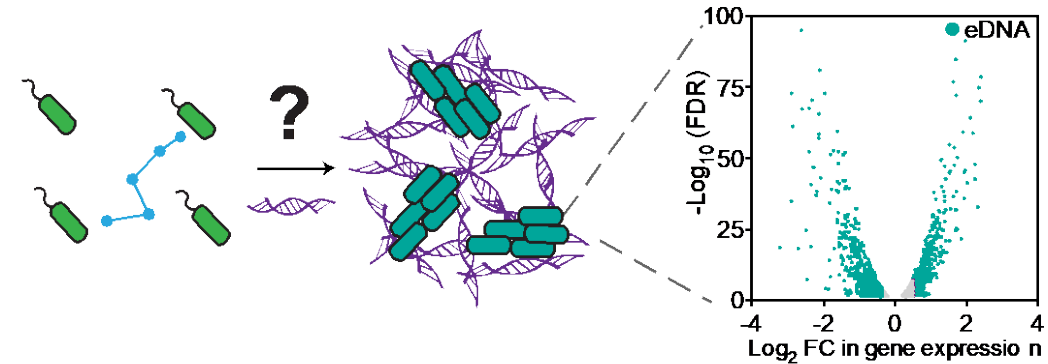


Extracellular DNA (eDNA) is a major factor governing MADs associated infections

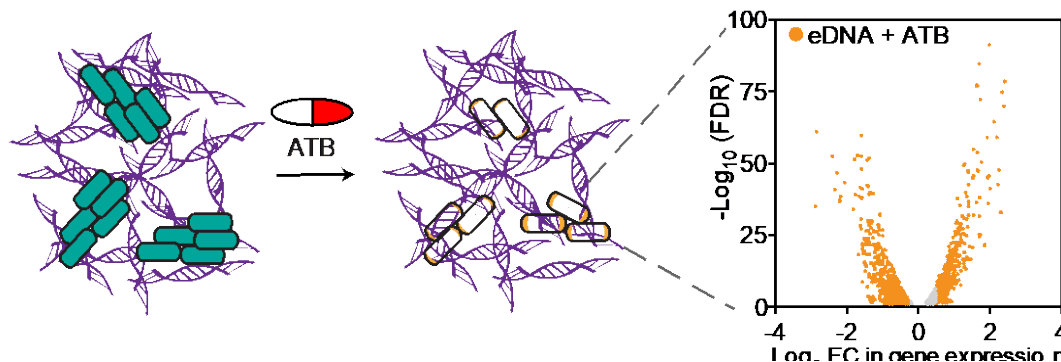
Fondecyt Regular 2025

Unraveling the role of extracellular dna on biofilm formation and antibiotic tolerance of *Pseudomonas aeruginosa*

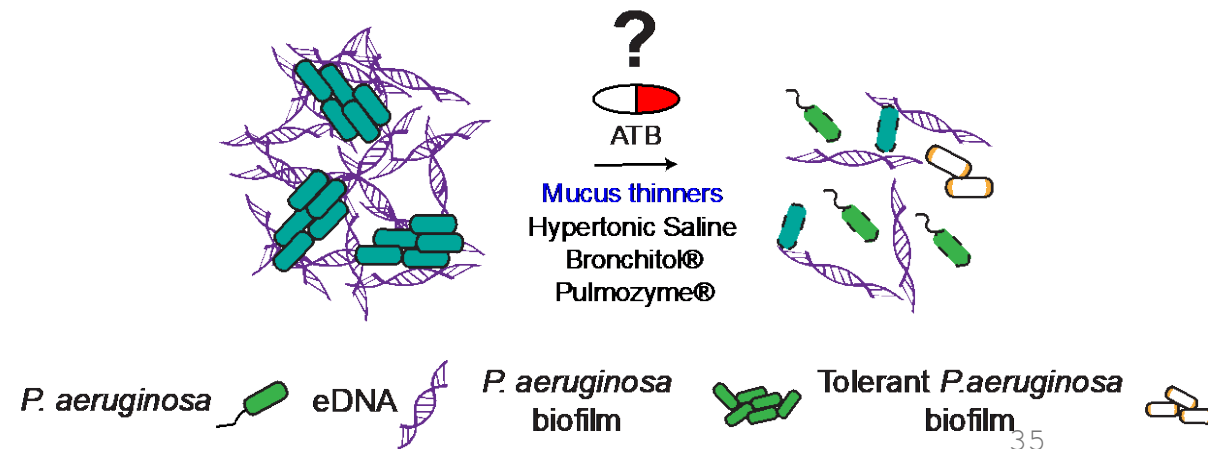
1) eDNA - Bacterial behaviour



2) eDNA - Antibiotic tolerance

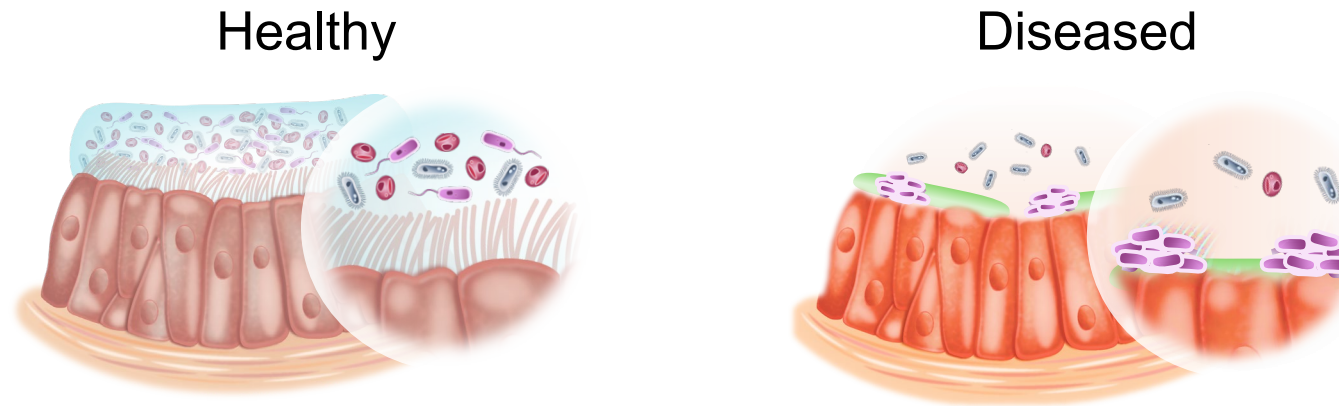


3) eDNA as therapeutic target



Future Research Perspectives

Transition between healthy and disease-like bacterial communities in mucus environments



**Environmental
(hospitals/nature)
biofilm forming
bacteria**



Microbial players

Mono infections
Polymicrobial infections
Communities' unbalances

Antimicrobial therapy

Revert antimicrobial
tolerance



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