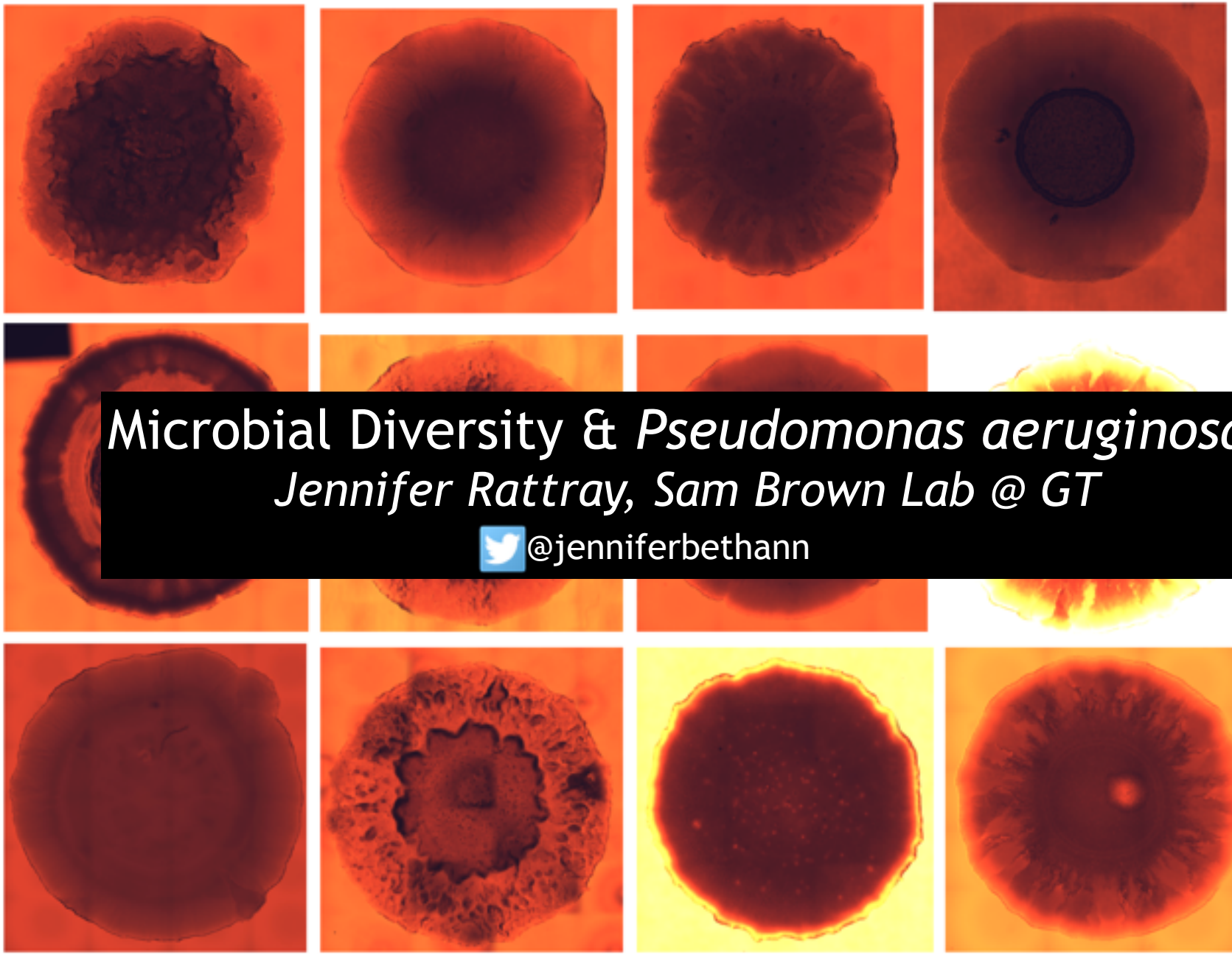
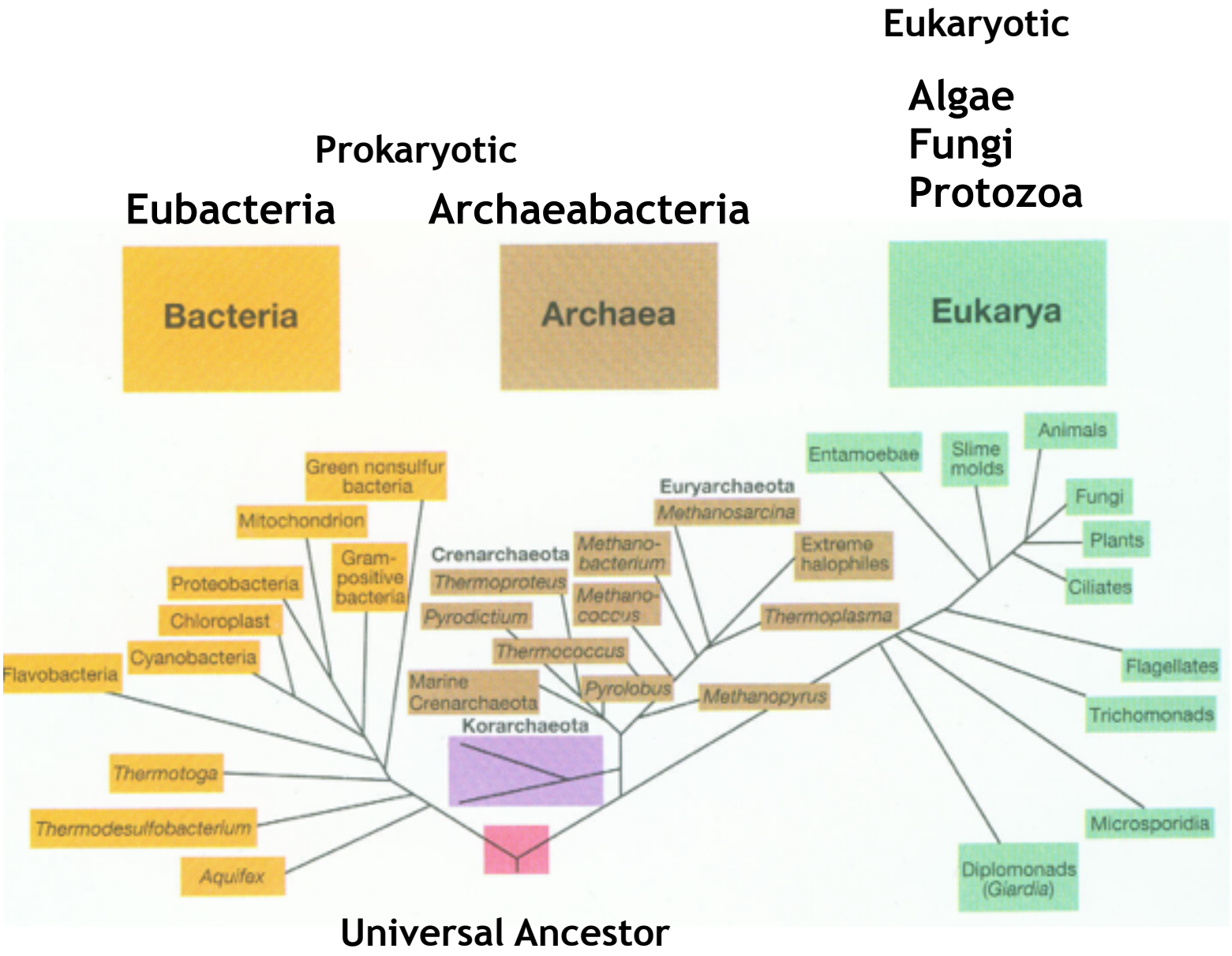


Microbial Diversity & *Pseudomonas aeruginosa*

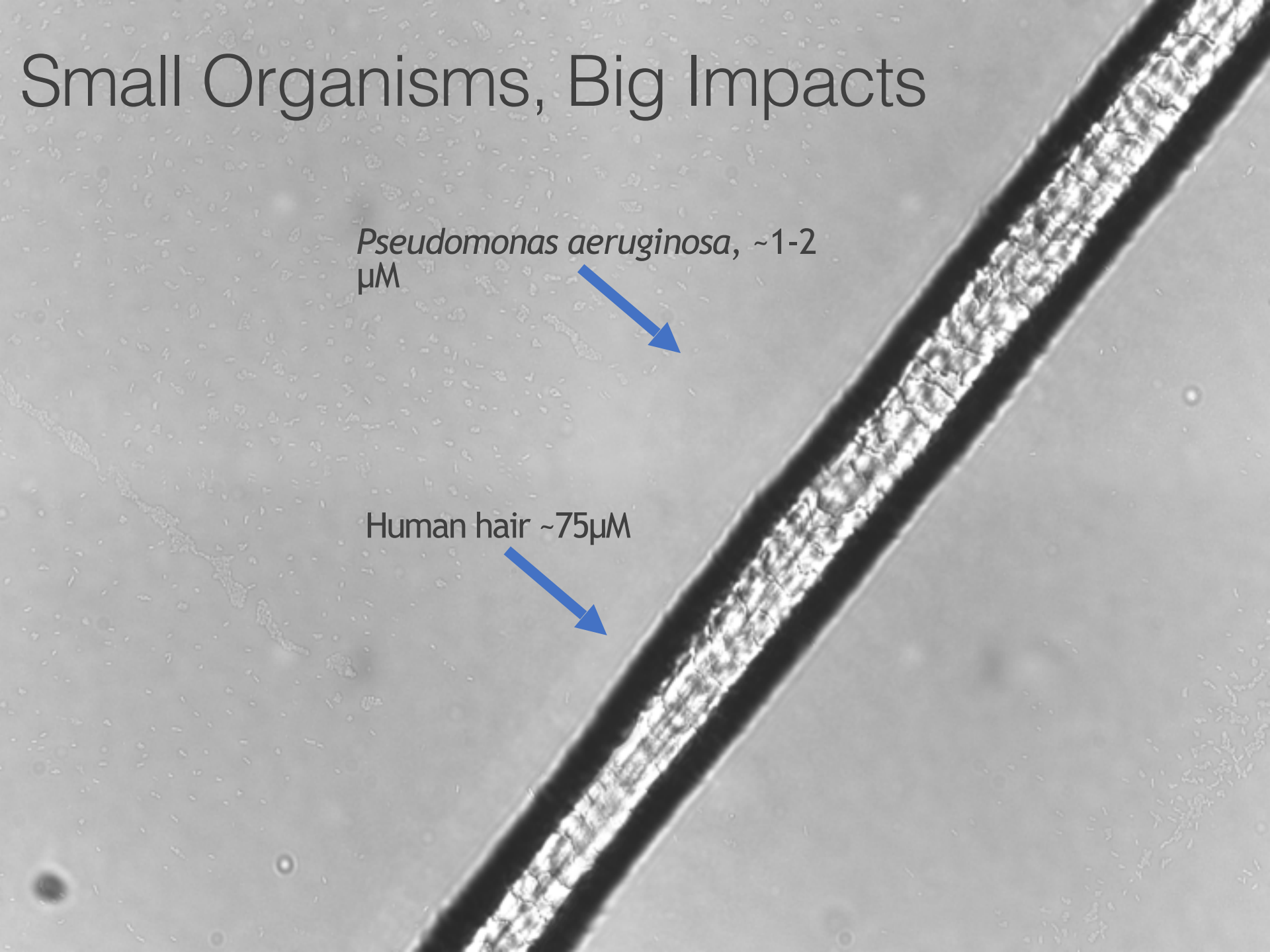
Jennifer Rattray, Sam Brown Lab @ GT

@jenniferbethann

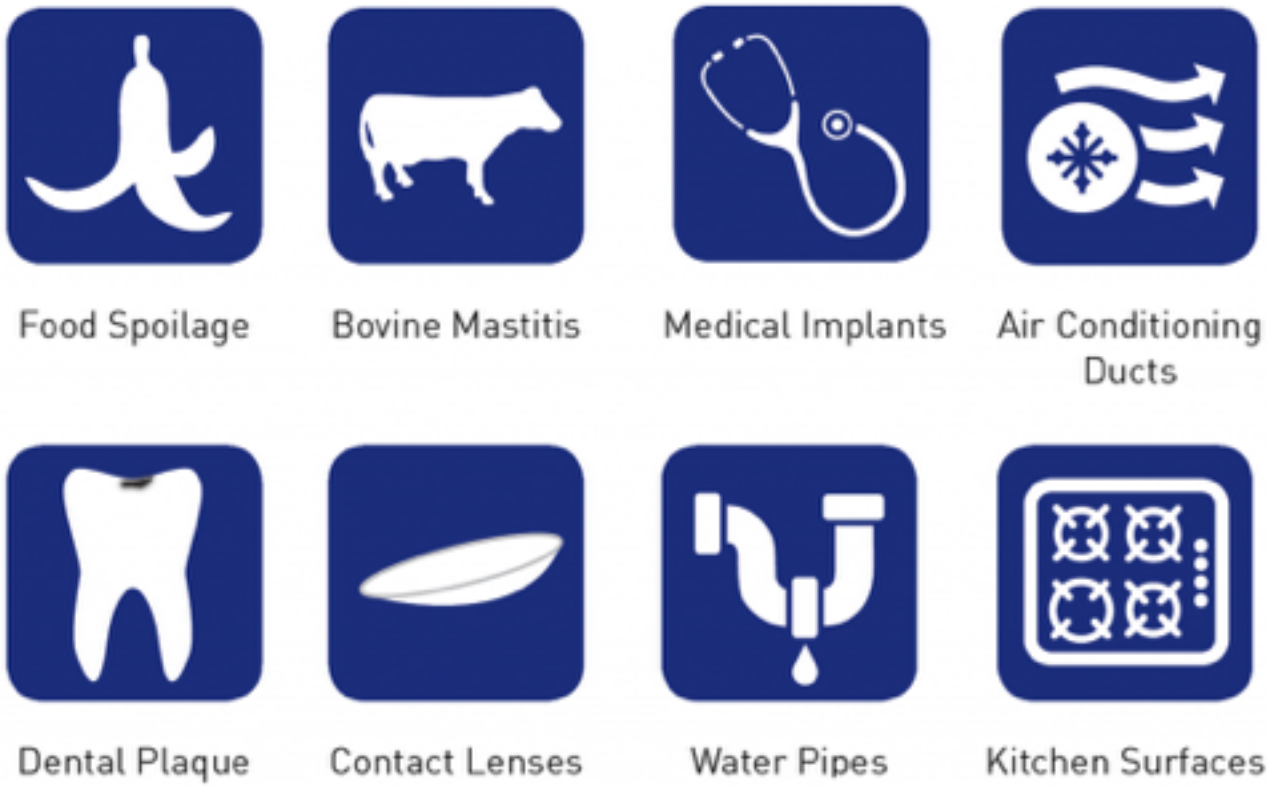
Phylogenetic classification of micro-organisms



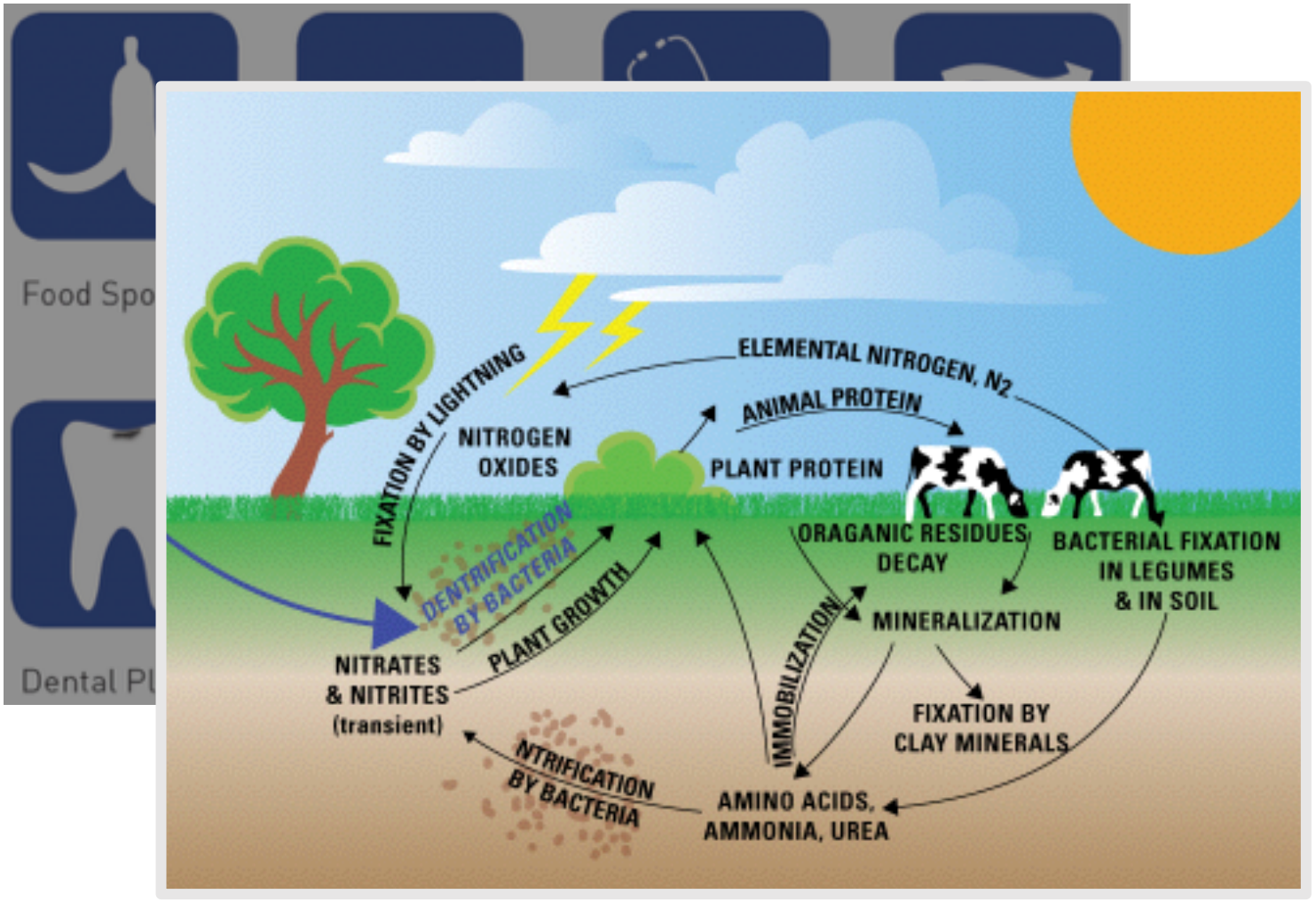
Small Organisms, Big Impacts



Small Organisms, Big Impacts

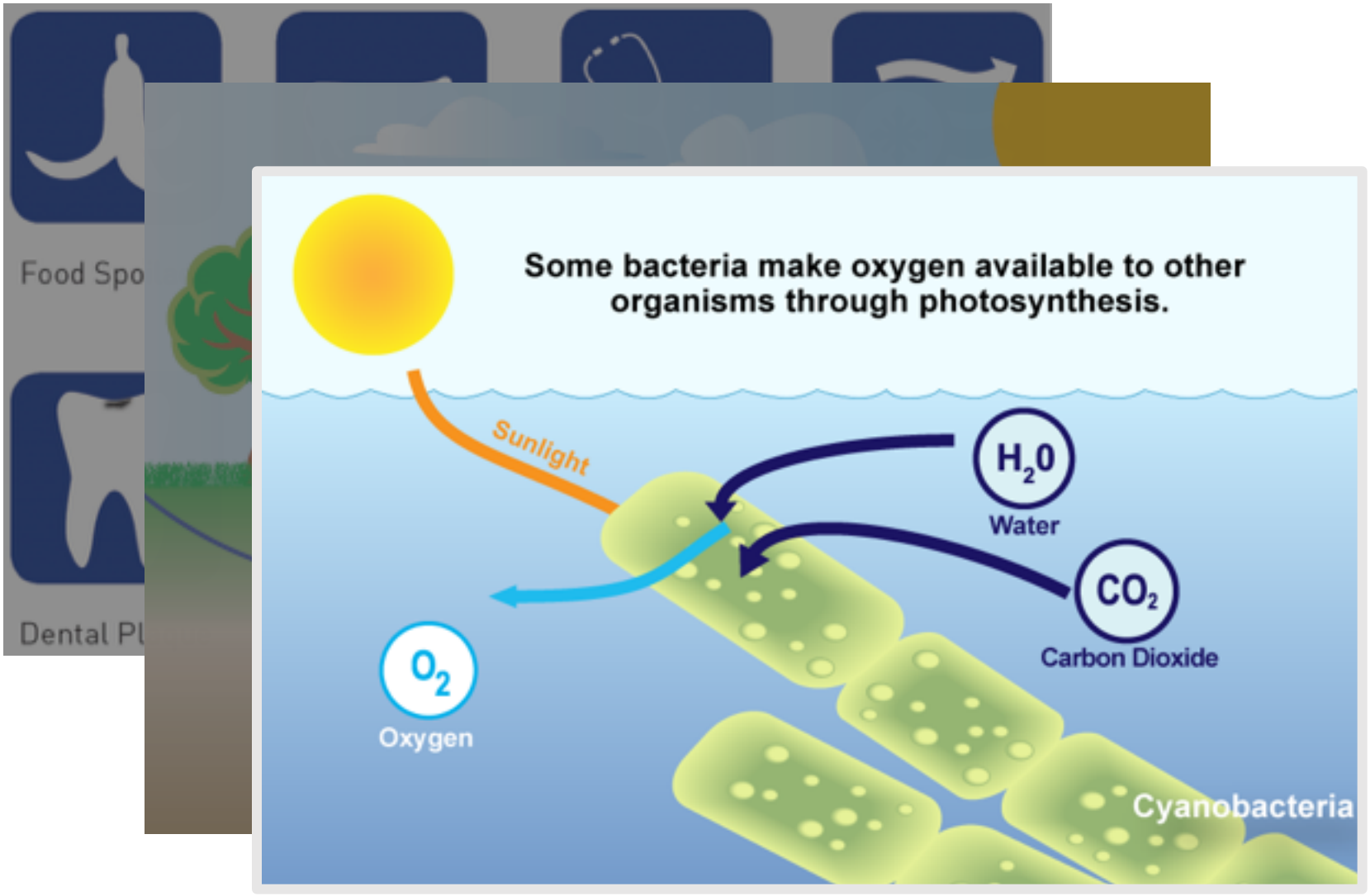


Small Organisms, Big Impacts

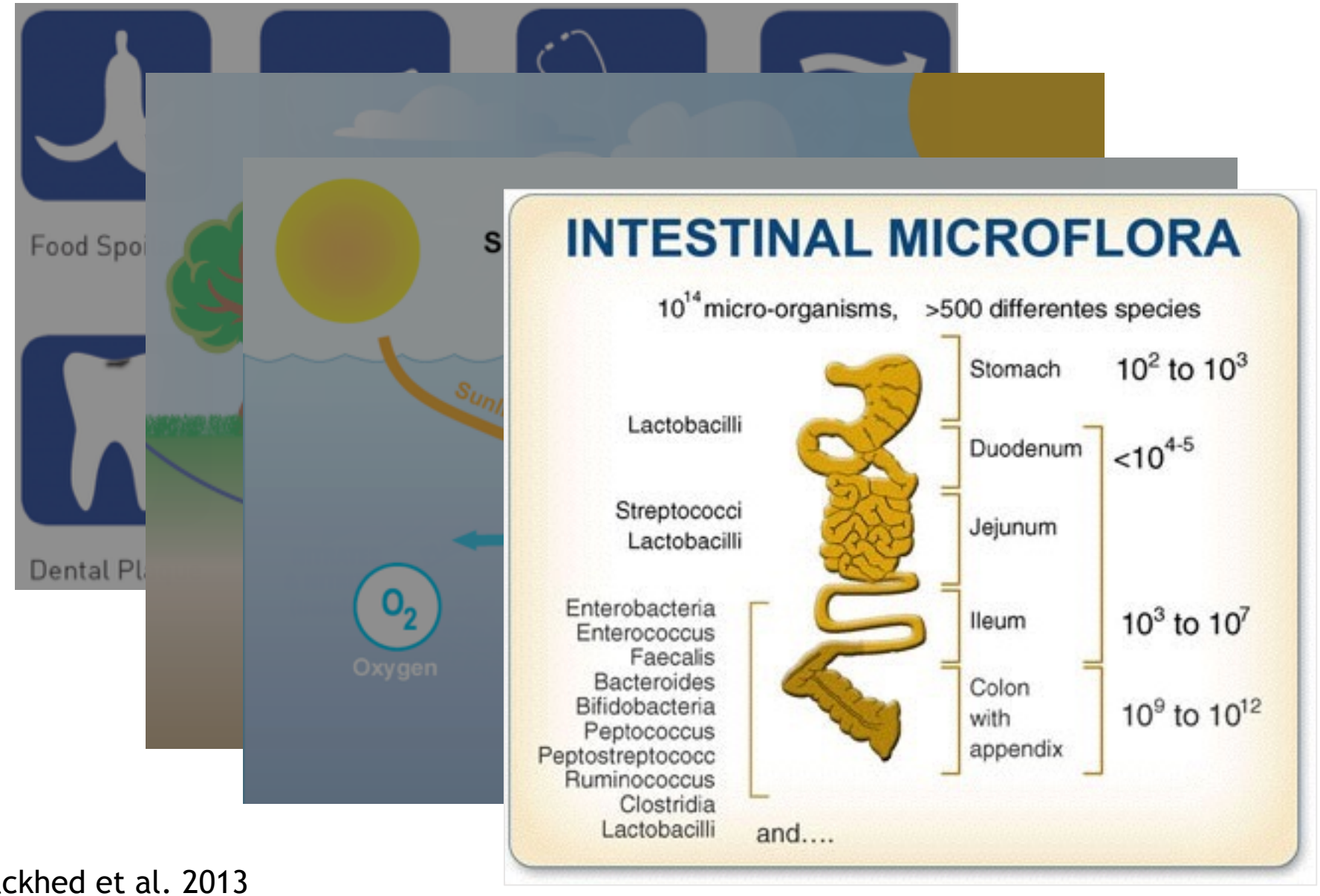


USGS SIR 2004-5144

Small Organisms, Big Impacts



Small Organisms, Big Impacts

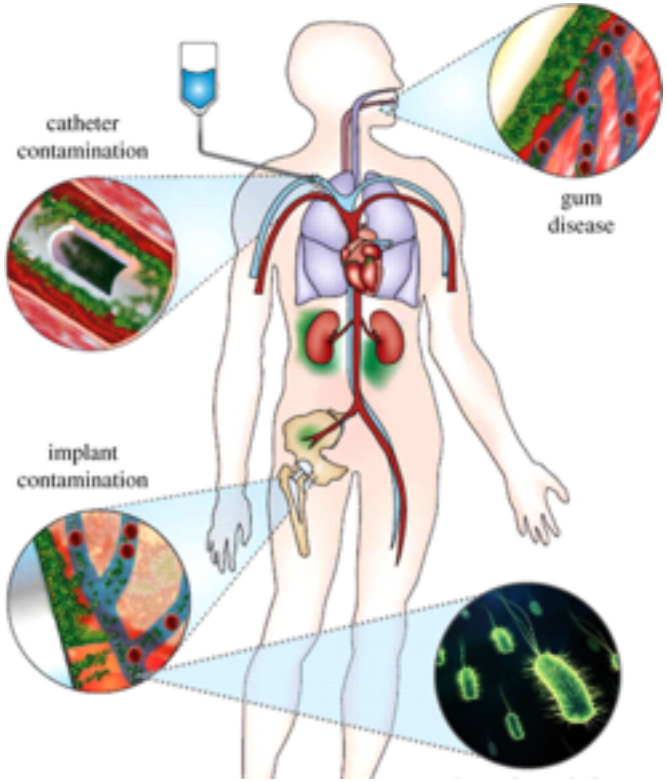


Bäckhed et al. 2013

Culture Characteristic

Bacteria can grow on… anything!

Liquid Biofilm Aggregate



Metabolism

Take in nutrients from the environment

glucose, lactose, other sugars, fats=lipids, proteins, toxic wastes, oils and petrol

Assimilate the nutrients into BIOMASS

DNA, proteins, carbohydrates and complex carbohydrates, lipids

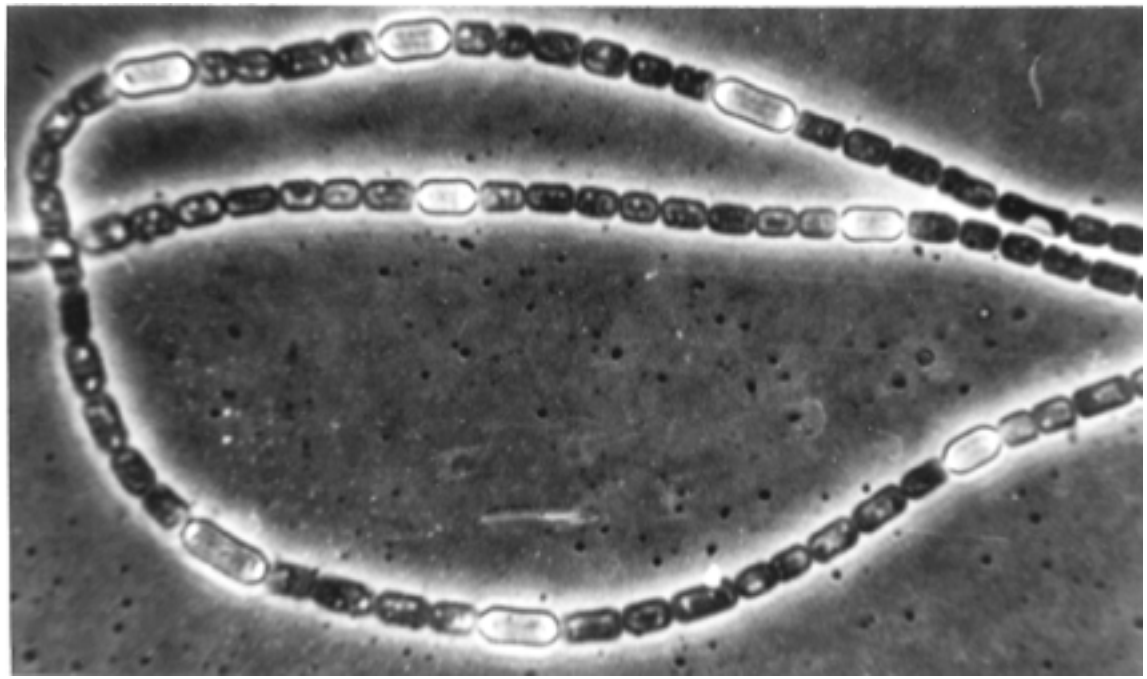
Release waste products into the environment

gases, alcohols, acids and organic compounds

Differentiation— to form distinct structures

***Bacillus* spp. endospore forming cells**
***Anabaena* spp. Cyanobacteria forming heterocysts**

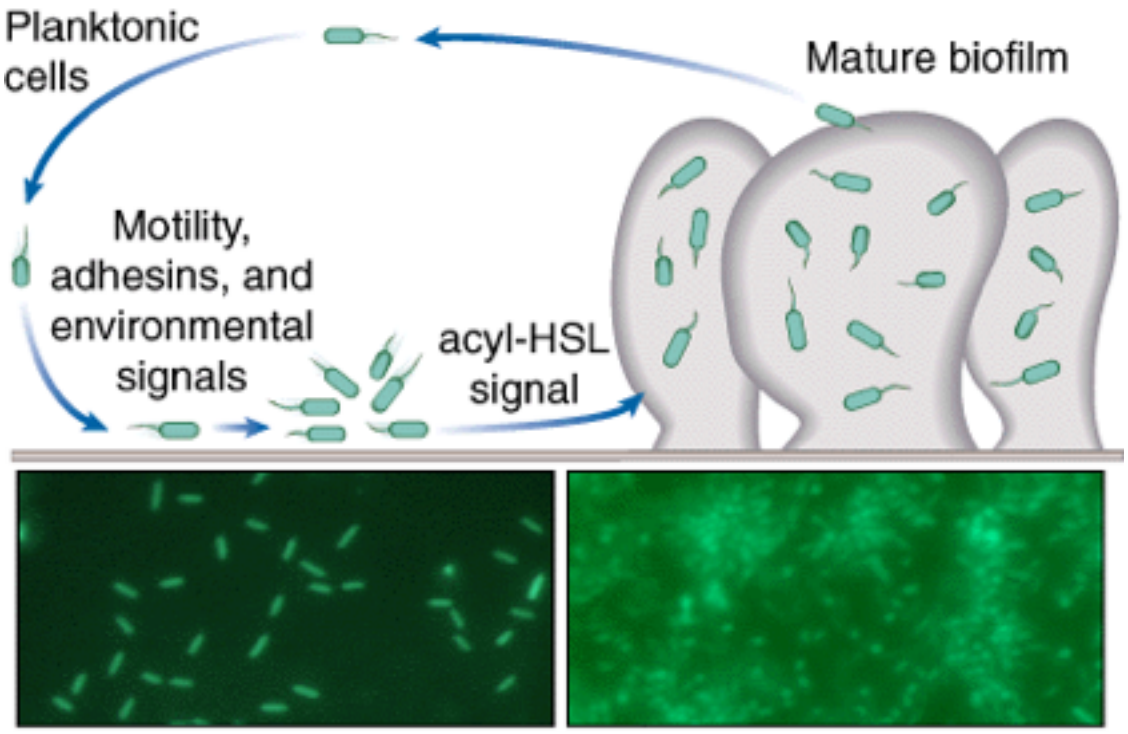
T.J. Deveridge



M. Dworkin

Communication

interaction with
other cells—response to other cells
Vibrio fischeri and Lantern fish



Kolter and Losick

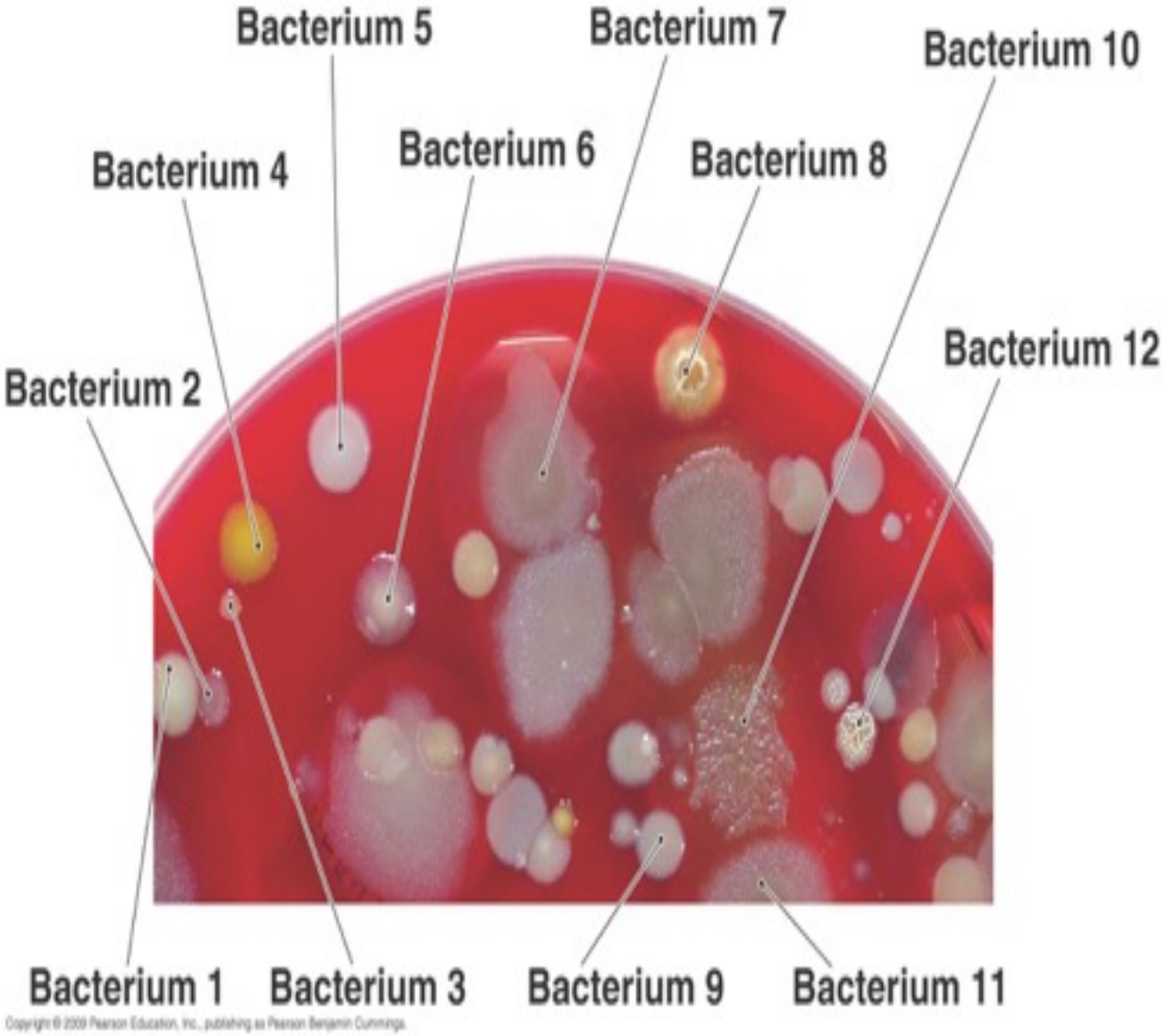
Vocab. Distinction

Genotype – how genes code for a specific trait

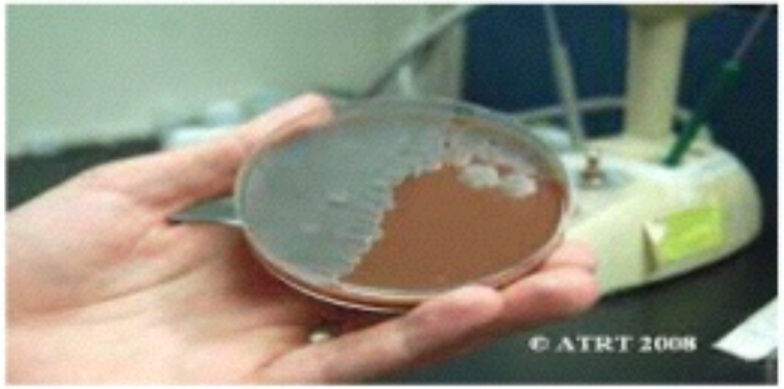
Phenotype – how the organism acts
(some ambiguity within the field)

Morphotype – physical appearance of cells/ colonies

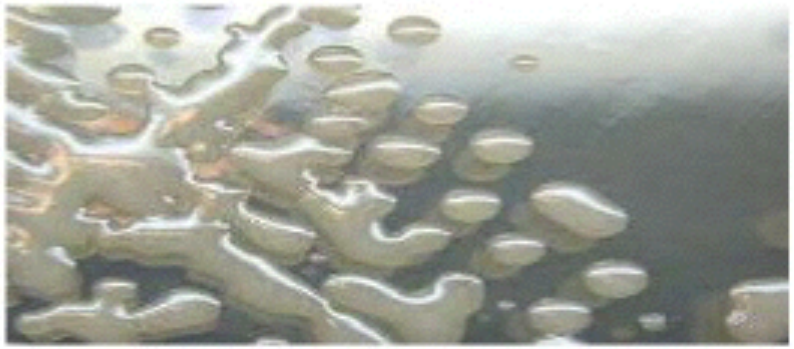
Phenotypic diversity

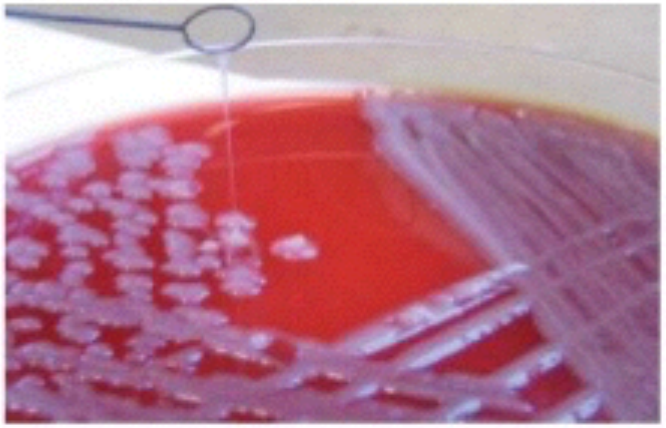


- **Texture of bacterial colony**



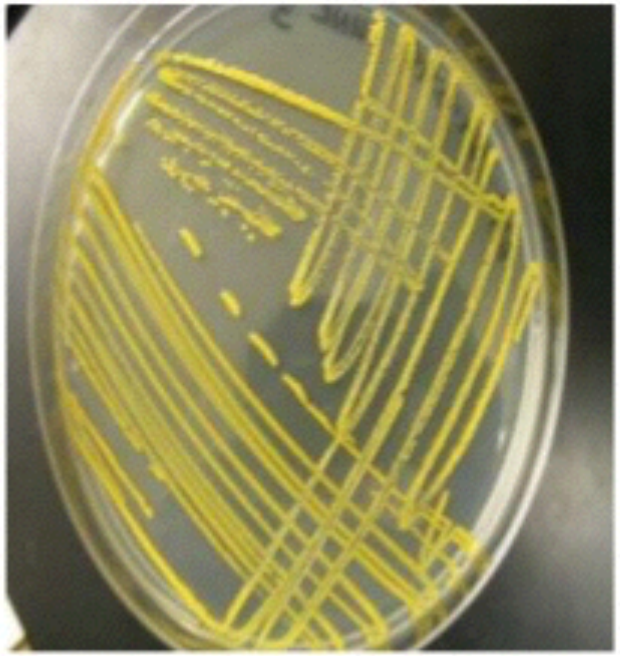
- Dry
- Moist
- Viscid (stick to loop)
- Mucoid (mucus-like)

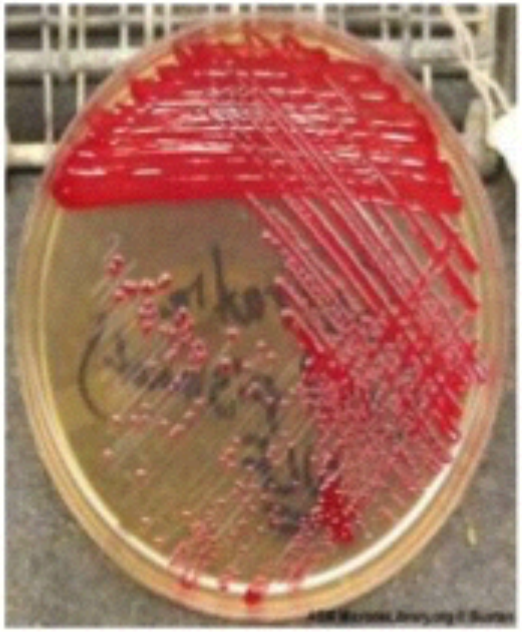




- **Colour of the colonies (pigmentation)**

  Some bacteria produce pigment when they grow in the medium.





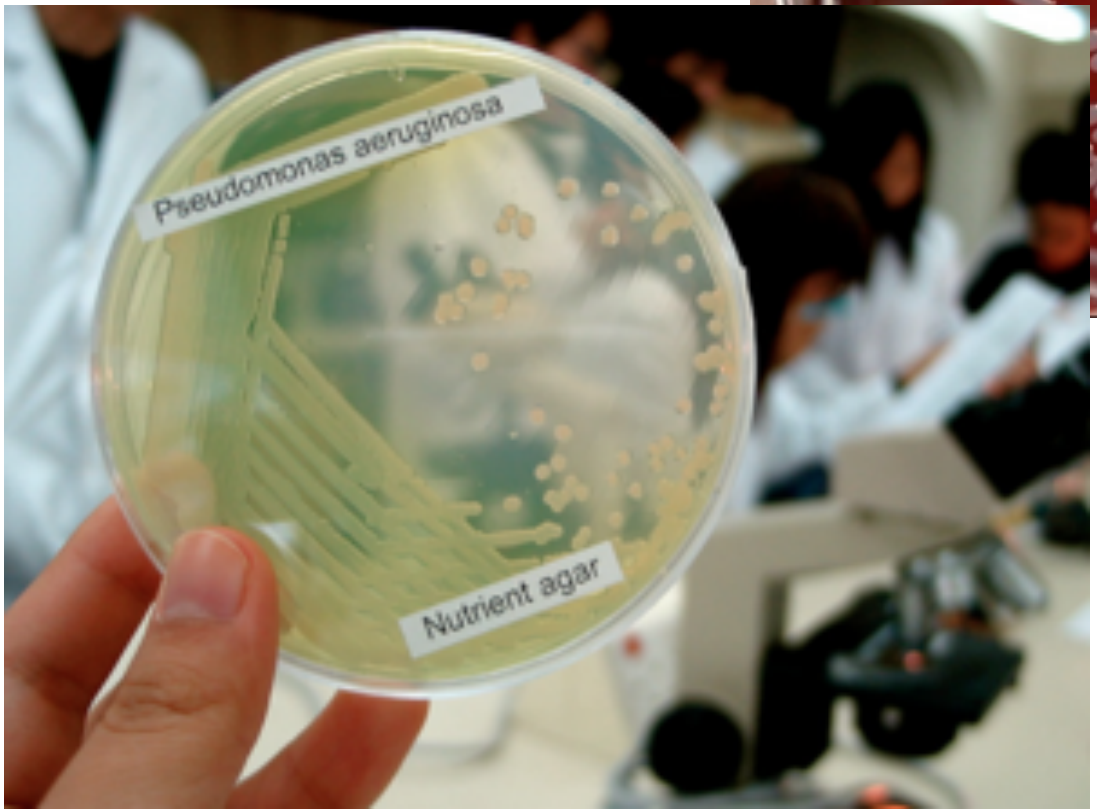
Pseudomonas aeruginosa

Considered “ubiquitous” in nature

Opportunistic pathogen
- Disruption of mucous membrane/skin
- Intravenous catheters & urinary catheters & cancer therapy
- Burn wound patients

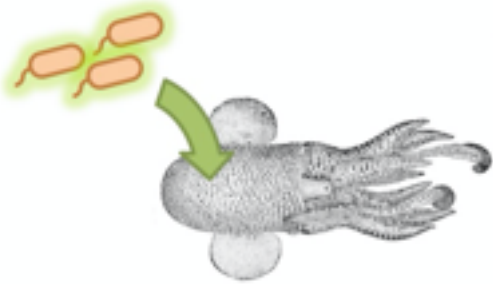
Incredibly diverse! High levels of phenotypic diversity.

Inherently resistant to many antibiotics and can evolve resistance to more readily.

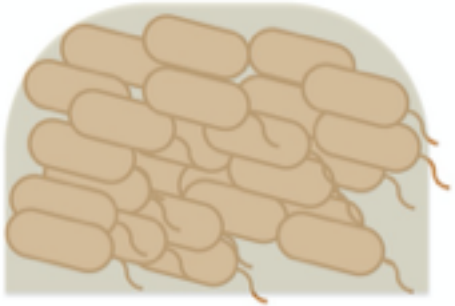


Color – pyocyanin, pyoverdine, pyorubin

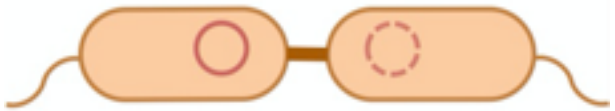
Collective Behaviors of Bacteria



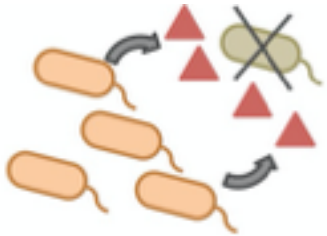
bioluminescence



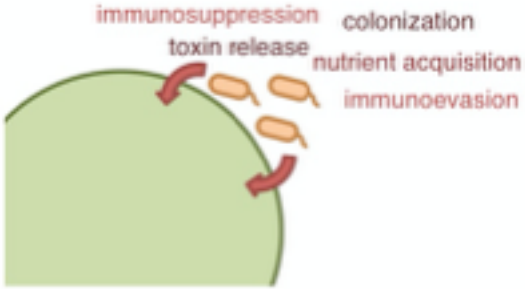
biofilm formation



conjugation



antibiotic production



virulence factors

Group dependent & group beneficial behaviors

https://sites.tufts.edu/quorumsensing/quorumsensing101/

Perron Isolate Library

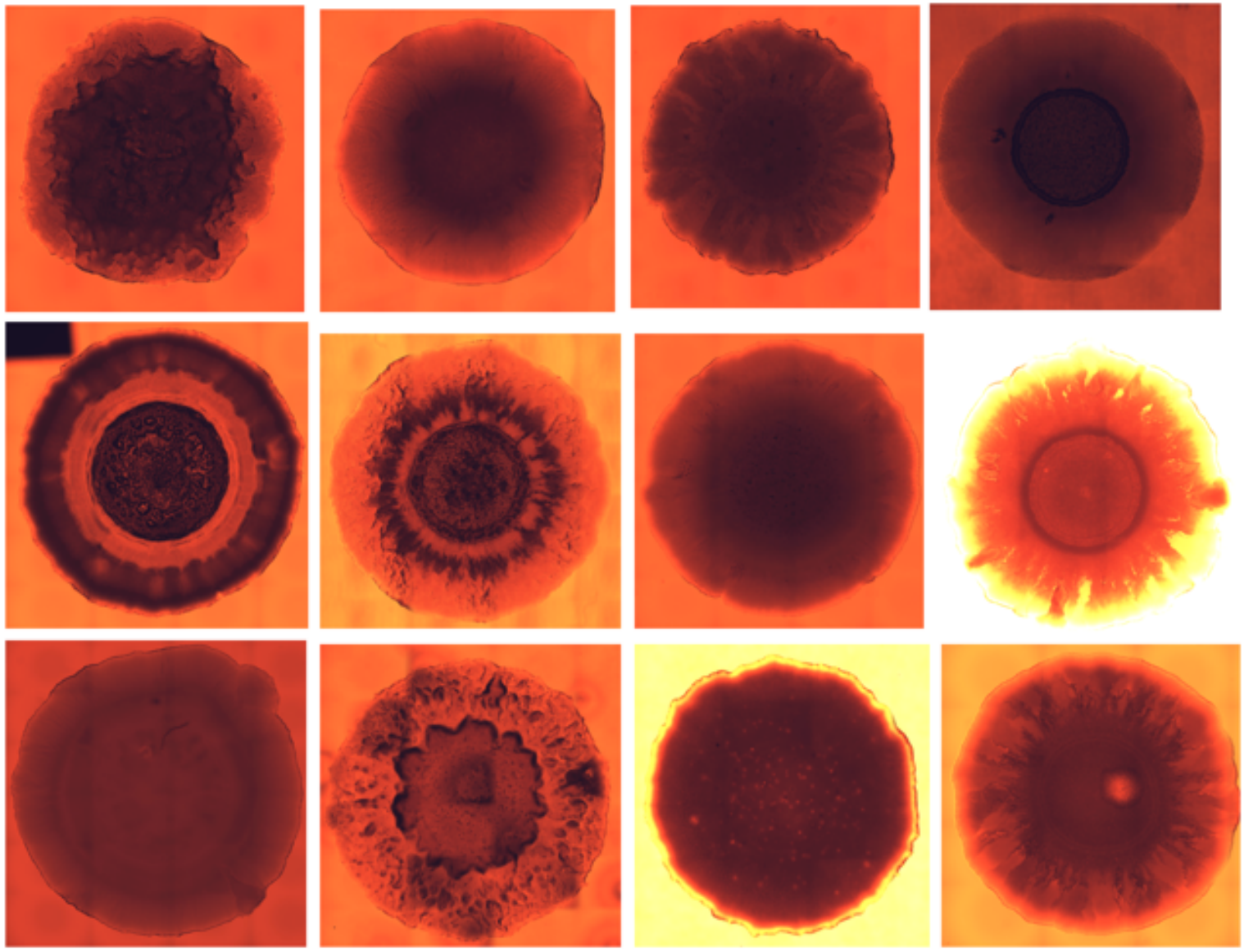
Niche (Nick)	
Environmental	30
Host	39
Cystic Fibrosis	5
Other	2
Sub-Niche (Jennifer)	
Infection/Clinical	26
Chronic	5
Host Associated	14
Fresh Water	10
Sea Water	12
Deep Sea Water	2
Surface Associated	5

Original ID	Location	Country	Isolation Date	Source	Niche
A9	Paris	France	1882-1918	Surgical bandage	Clinical
A10	Paris	France	1882-1918	Wound	Clinical
A11	Paris	France	1882-1918	Wound	Clinical
A13	Paris	France	1882-1918	Wound	Clinical
A15	Paris	France	1882-1918	Wound	Clinical
A17	Paris	France	1882-1918	Leg ulcer	Clinical
A19	Paris	France	1882-1918	Wound	Clinical
A237	Paris	France	1882-1918	Rabbit	Animal
M72	Bucarest	Romania	1965-1978	Faeces	Clinical
Mex2	Loltun	Mexico	2004	Cenote water	Fresh water
C5311	Vancouver	Canada	2002	CF-patient	Chronic/CF-patient
59.20	Cambridge	UK	pre 1936	Plant	Plant/Soil
CN573=PSE143	Tbilisi	Georgian Republic	1975	Pleural fluid	Clinical
CND03	Tbilisi	Georgian Republic	Unknown	Wound	Clinical
ESP06B	Brussels	Belgium	1993	Clinical non CF	Clinical
5BR2	De Haan	Belgium	1993	CF-patient	Chronic/CF-patient
C3128	Vancouver	Canada	2002	CF-patient	Chronic/CF-patient
PA01	Melbourne	Australia	1955	Wound	Clinical
PA7	Buenos Aires	Argentina	pre 1984	Wound	Clinical
ATCC27853	Boston	USA	1971	Blood	Clinical
Co380791	Cali	Colombia	2003	Blood	Clinical
Co398373	Cali	Colombia	2003	Hospital environme	Hospital environme
IC1	Unknown	India	Unknown	Dog	Animal
IDEXX Canine4	Unknown (IDEXX)	UK	2004	Dog	Animal
IDEXX Canine8	Unknown (IDEXX)	UK	2004	Dog	Animal
HL1999 grande colc	London	UK	1924	Ear	Clinical
CPHL8058	California	USA	1949	Unknown	Unknown
CPHL8203	London	UK	1950	Urine	Clinical
CPHL10299	Colindale	UK	1962	Faeces	Clinical
CPHL10662	London	UK	1969	Human	Clinical
CPHL11450	Kentucky	USA	1982	Unknown	Unknown
Tu61	Mediterranean Sea	Tunisia	2000	Sea water (coastal)	
UH1F grande colon	Jekyll Island	USA	2004	Turtle egg (interior)	Animal
J80UH1OS1	Jekyll Island	USA	2005	Turtle egg (exterior	Animal
Jp60	Suruga Bay (N2, 2(	Japan	2004	Sea water (coastal)	Saline water
Jp97	Pacific Ocean (N7,	Japan	2004	Sea water (open oce	Saline water
Jp100	Pacific Ocean (N7,	Japan	2004	Sea water (open oce	Saline water

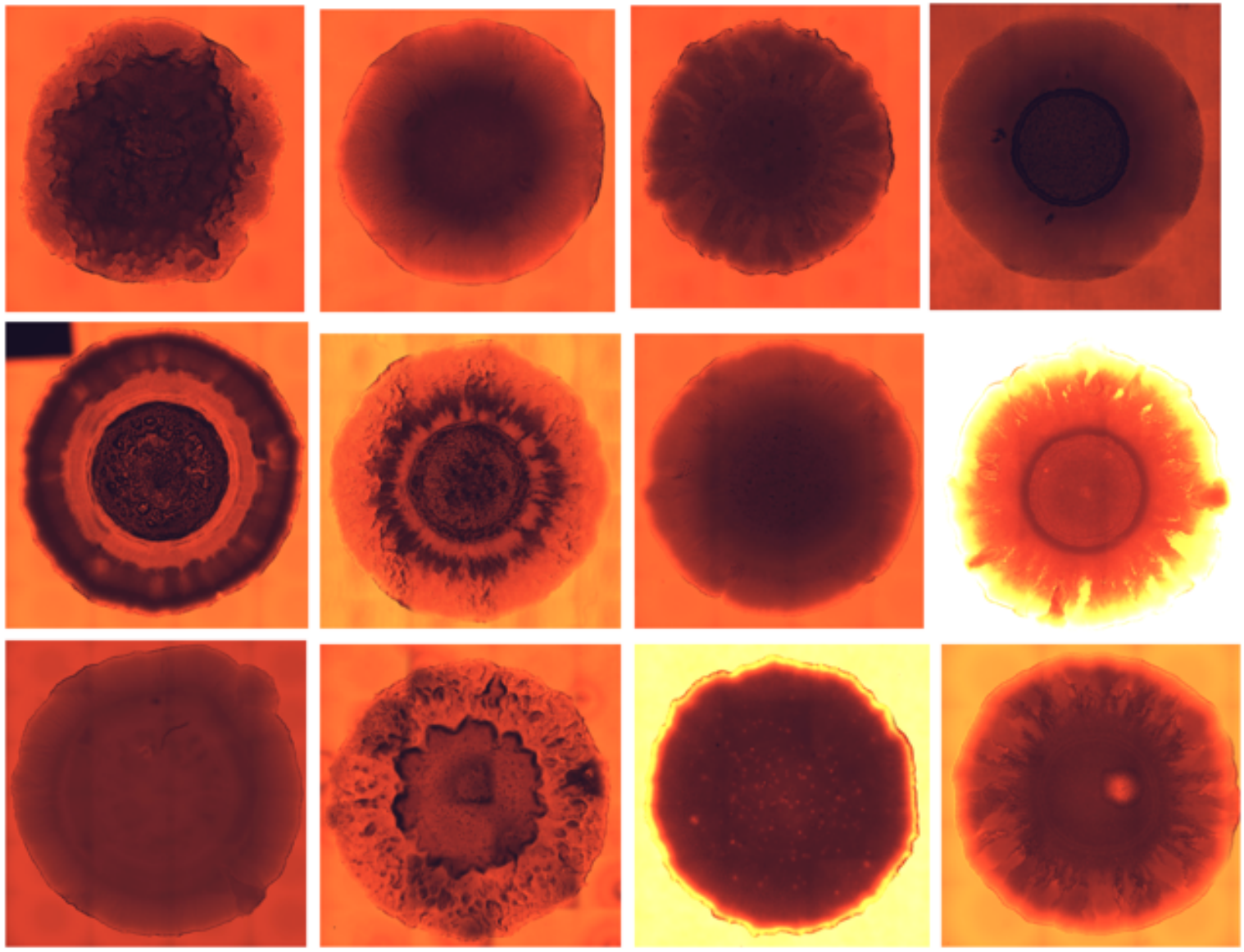
Phenotypes

strain	Strain ID
live	Live stain of biofilm fraction after 6 hrs growth (RFU)
dead	Dead stain of biofilm fraction after 6 hrs growth (RFU)
ld.od	OD of biofilm fraction after 6 hrs growth (Abs(600))
phe	Polysaccharide content of 6 hr biofilm (Abs)
od.avg	OD of plankton fraction after 6 hrs growth (Abs(600))
od.harvest	OD at harvest for VF production (OD), timed to late-exponential phase
ecr	Elastase production (Elastin-congo red assay)
pvd	pyoverdin production (RFU)
pch	pyochelin production (RFU)
staph.auc	Alicia thesis; inversely proportional to virulence against S. aureus
env	Environment of origin (cf = cystic fibrosis lung, host = host-associated, envir = abiotic)
cont.max.rat	max growth rate over 48-hr growth curve (OD/hr)
cont.max.od	carrying capacity (OD)
carb.max.rat	max rate with carbenicillin (64 ug/ml)
carb.max.od	carrying capacity with carbenicillin
toby.max.rat	max rate with tobramycin (2 ug/ml)
toby.max.od	carrying capacity with tobramycin
cont.lag	approximate lag time (hrs)
carb.lag	lag w/ carbenicillin
toby.lag	lag w/ tobramycin
cont.auc	Area under curve for 48 hr gc (Sum OD)
carb.auc	as above, with carbenicillin
toby.auc	as above, with tobramycin
carb.lag.delt	difference in lag between carbenicillin and control
toby.lag.delt	difference in lag between tobramycin and control
bfrac	fraction biofilm after 6 hr growth (ld.od+(ld.od+od.avg))
ecr.n	normalized elastase
pch.n	normalized pyochelin
pvd.n	normallized pyoverdin
sa.vir	inverse of staph.auc => proportional to staph virulence

Morphotypes



Inter-colony variation

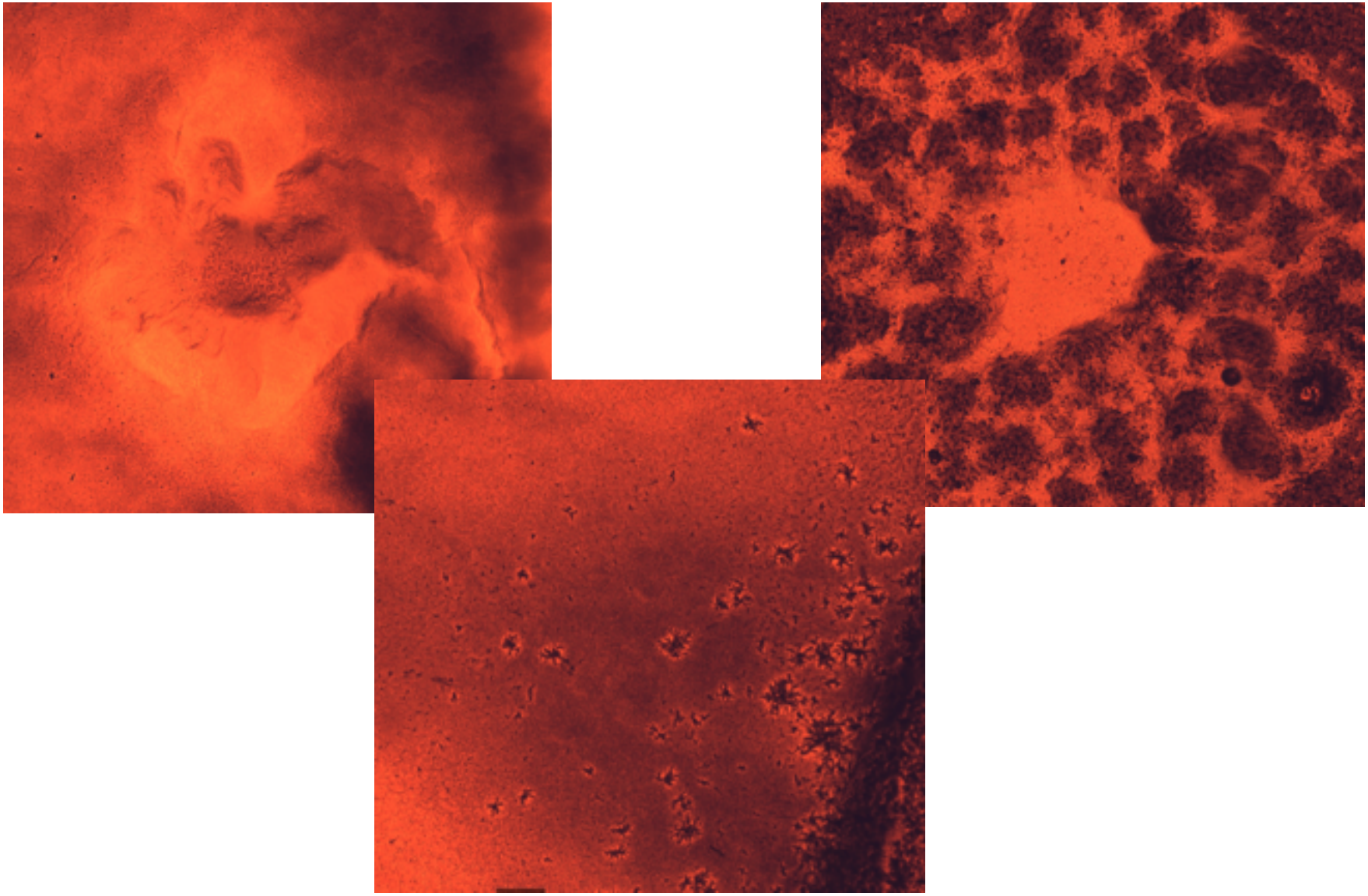


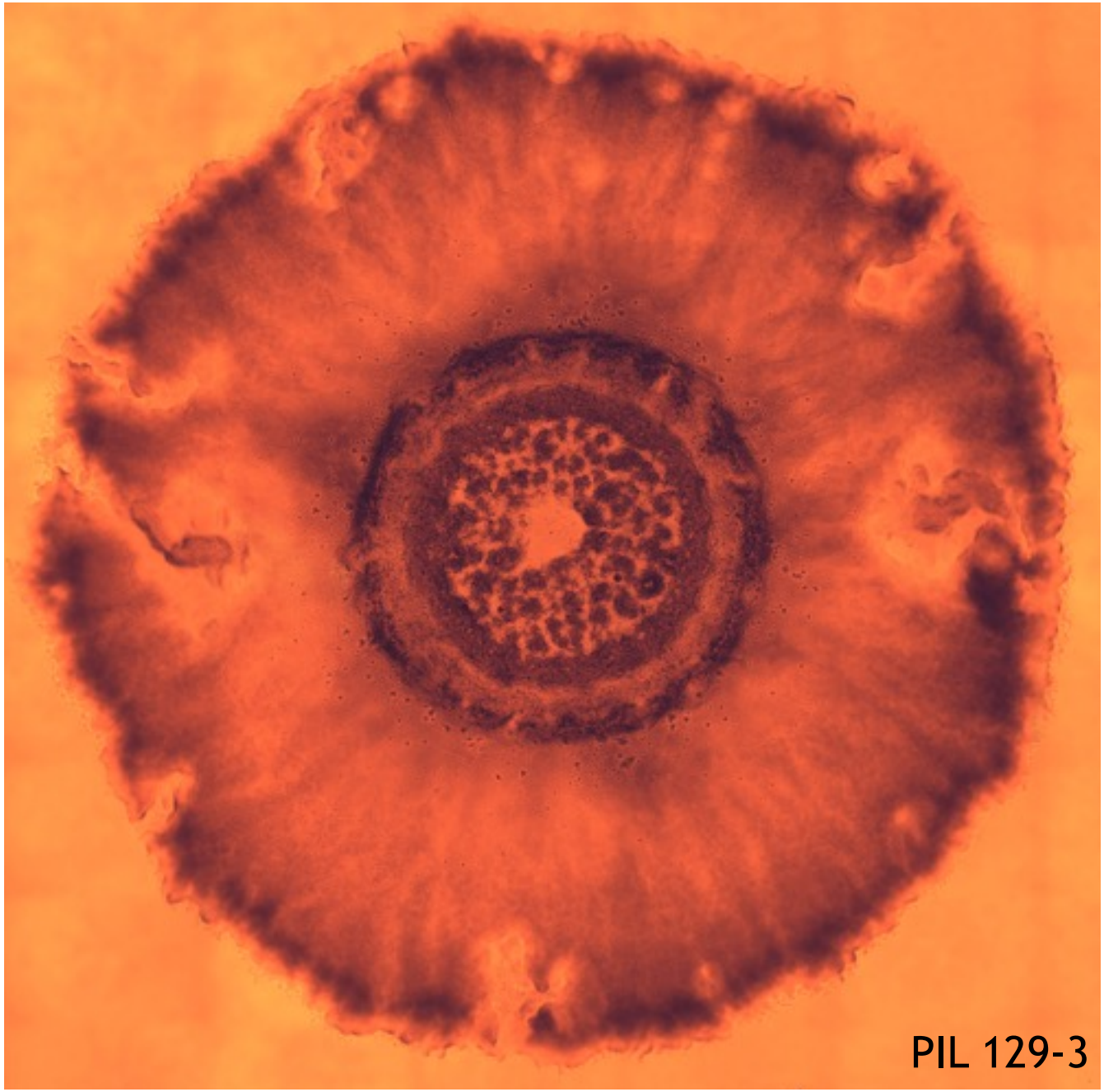
Goal:

Can we get any information about phenotype from morphotype?

Can we make medically relevant assumptions?

Intra-colony variation




PIL 129-3