



waag society

institute for art, science and technology



BioHack Academy Microbiology

Picture by Bas Uterwijk



Growing bacteria



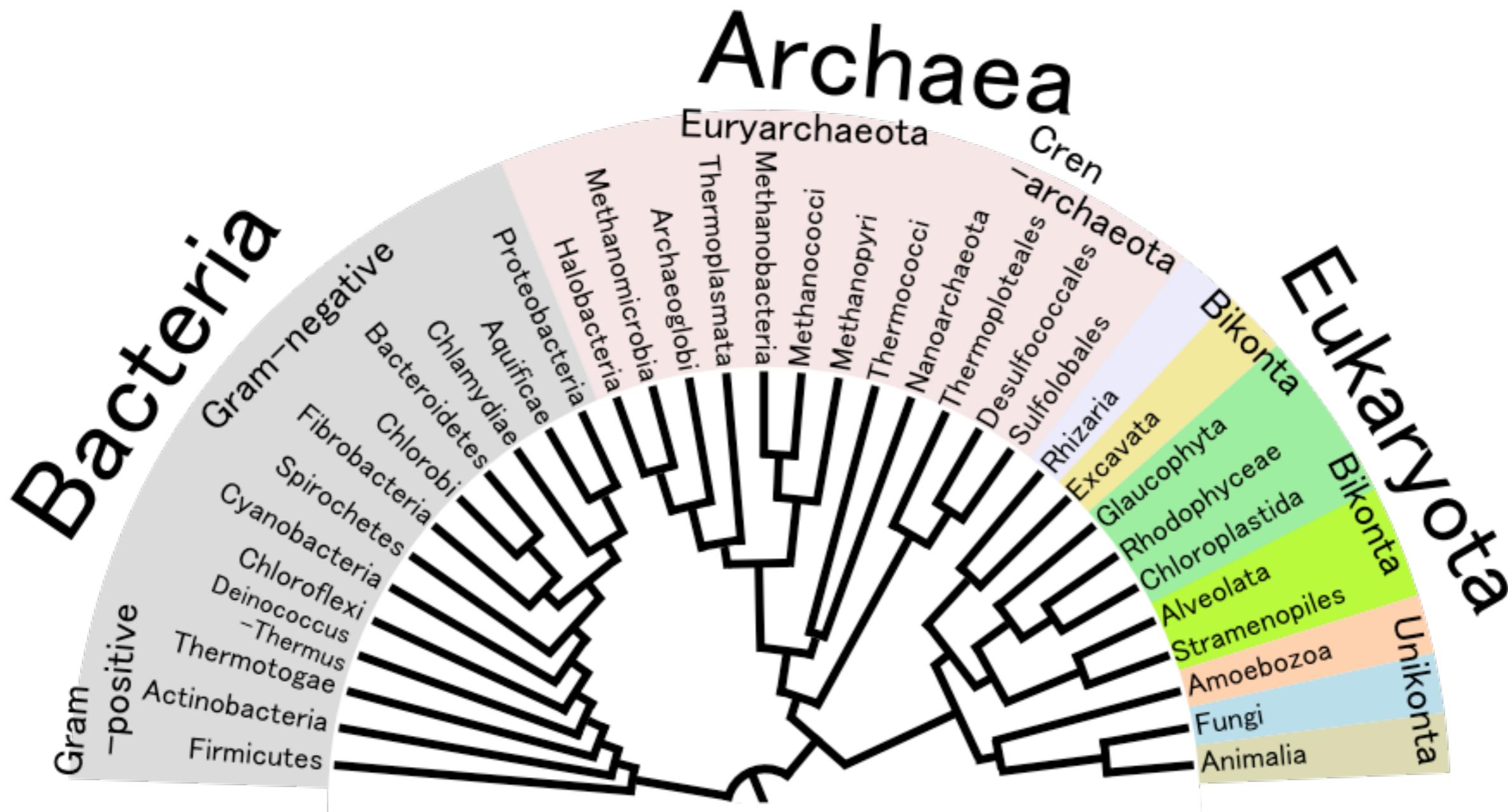


Sonja Baumel





Phylogeny of the living world



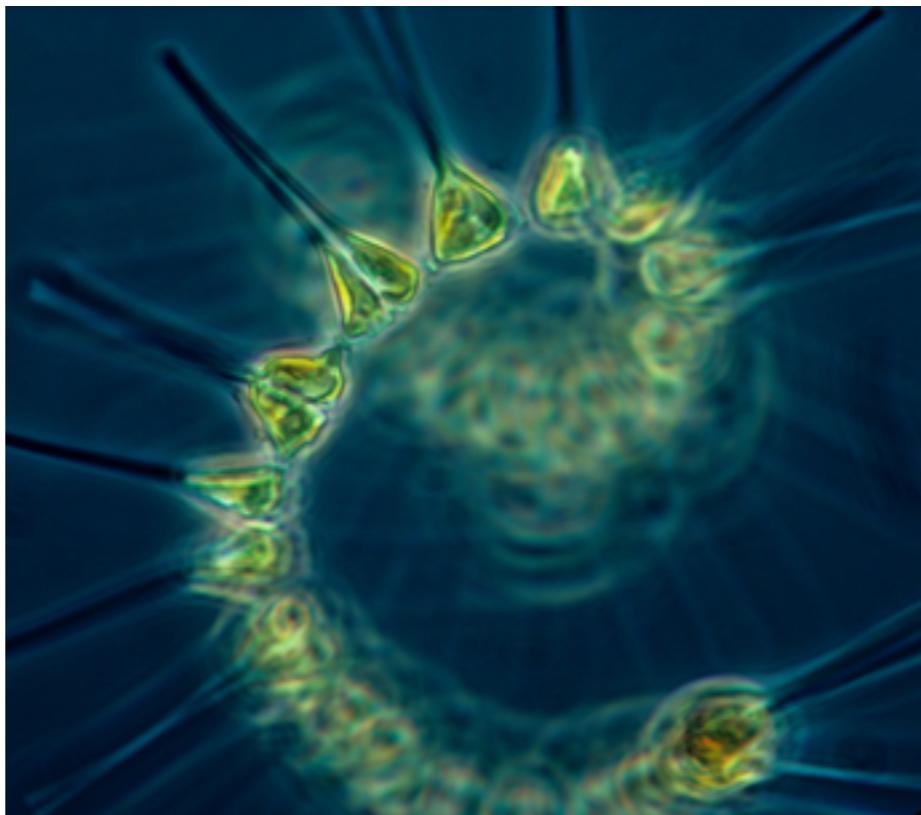


Definition of life

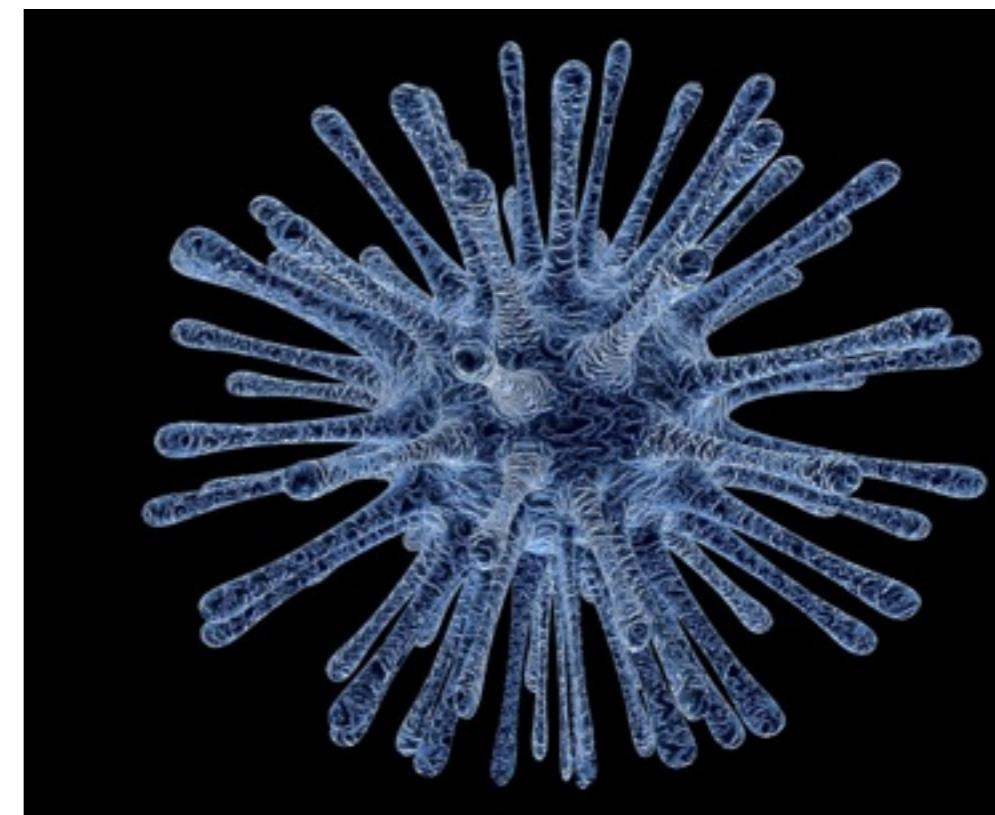
unicellular
(single cell)



multicellular
(cell colony)



acellular
(lacking cells)





Advantage of being small

- Large surface to volume ratio
- Simple structure
- Quick distribution
- Short generation time
- Huge metabolic diversity
- Ability to swab genes





Exercise

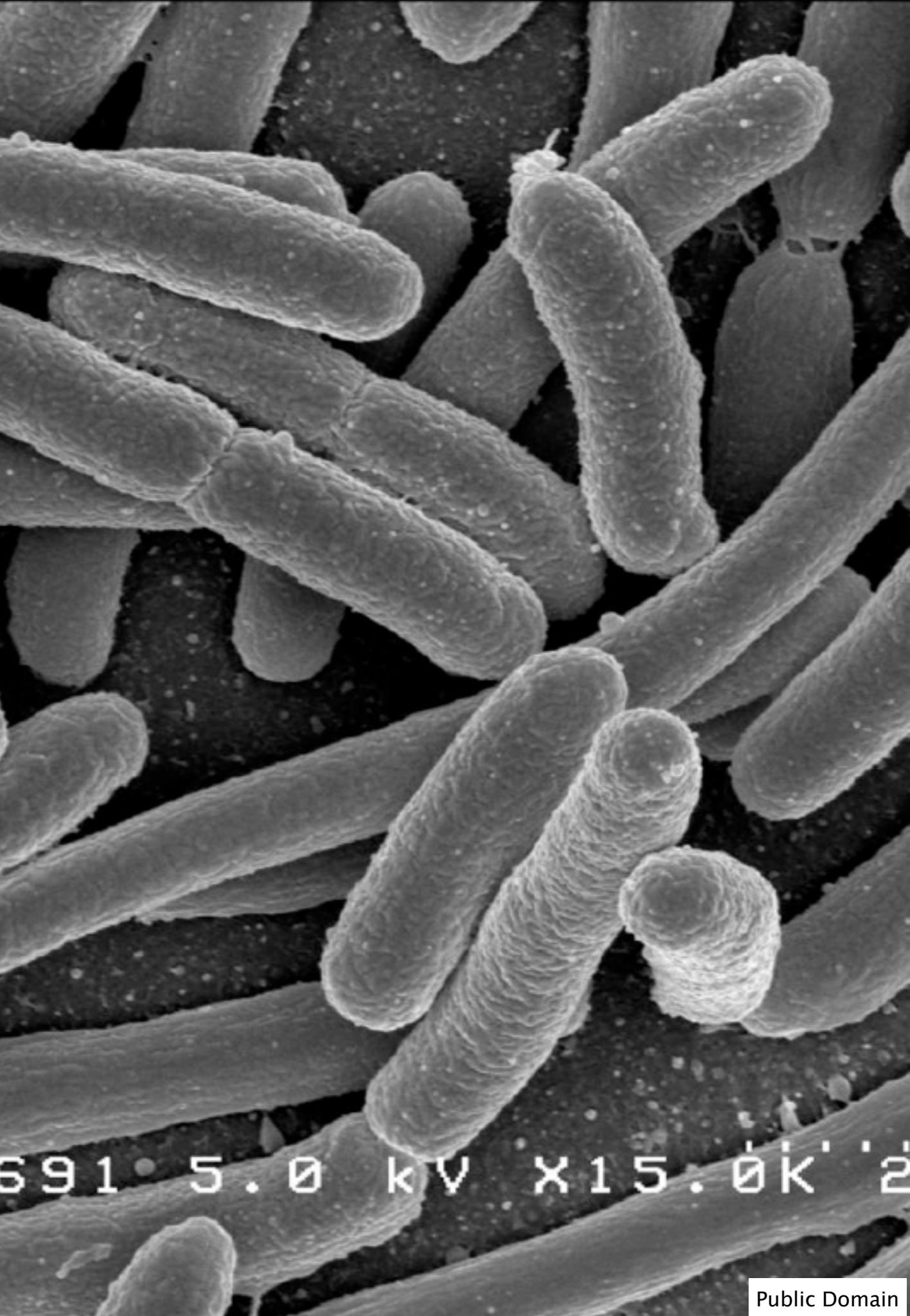
E. coli weighs
 3.0×10^{-13} gr.

Dimension:

- Height $2.0 \mu m$
- Diameter $0.8 \mu m$

Let's assume E. coli is shaped like a cylinder

What is the surface area?





Cylinder formulas

$$\text{Top area} = \pi \times r^2$$

$$\text{Bottom area} = \pi \times r^2$$

$$\text{Side area} = 2 \times \pi \times r \times h$$

$$\text{Total surface area } A = 2\pi r^2 + 2\pi h$$

$$\text{Volume } V = \pi \times r^2 \times h$$



Solution exercise 1

$$1 \text{ gr. of } E. coli \doteq \frac{1}{3 \times 10^{-13}} = 3.33 \times 10^{12} \text{ cells}$$

Surface:

$$\text{Length } L = 2 \times 10^{-6}$$

$$\text{Radius } r = 0.4 \times 10^{-6}$$

$$2 \times \pi \times r \times L + 2 \times \pi \times r^2 = 20 \text{ m}^2$$

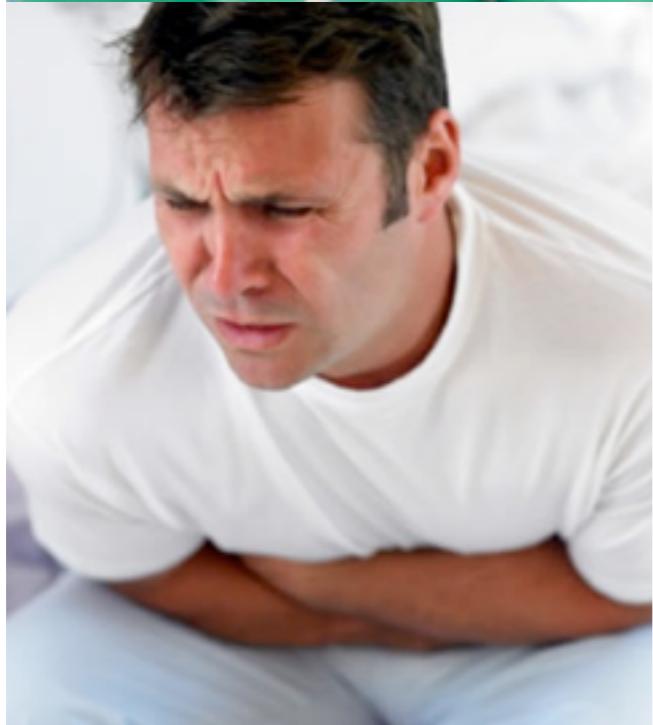


Microorganisms: Role in our daily live





Microorganisms: Role in our daily live





Sulfur (purple) bacteria bloom



Buse Lake 3 – Cal Kimona Brown



Cyanobacteria (algae)



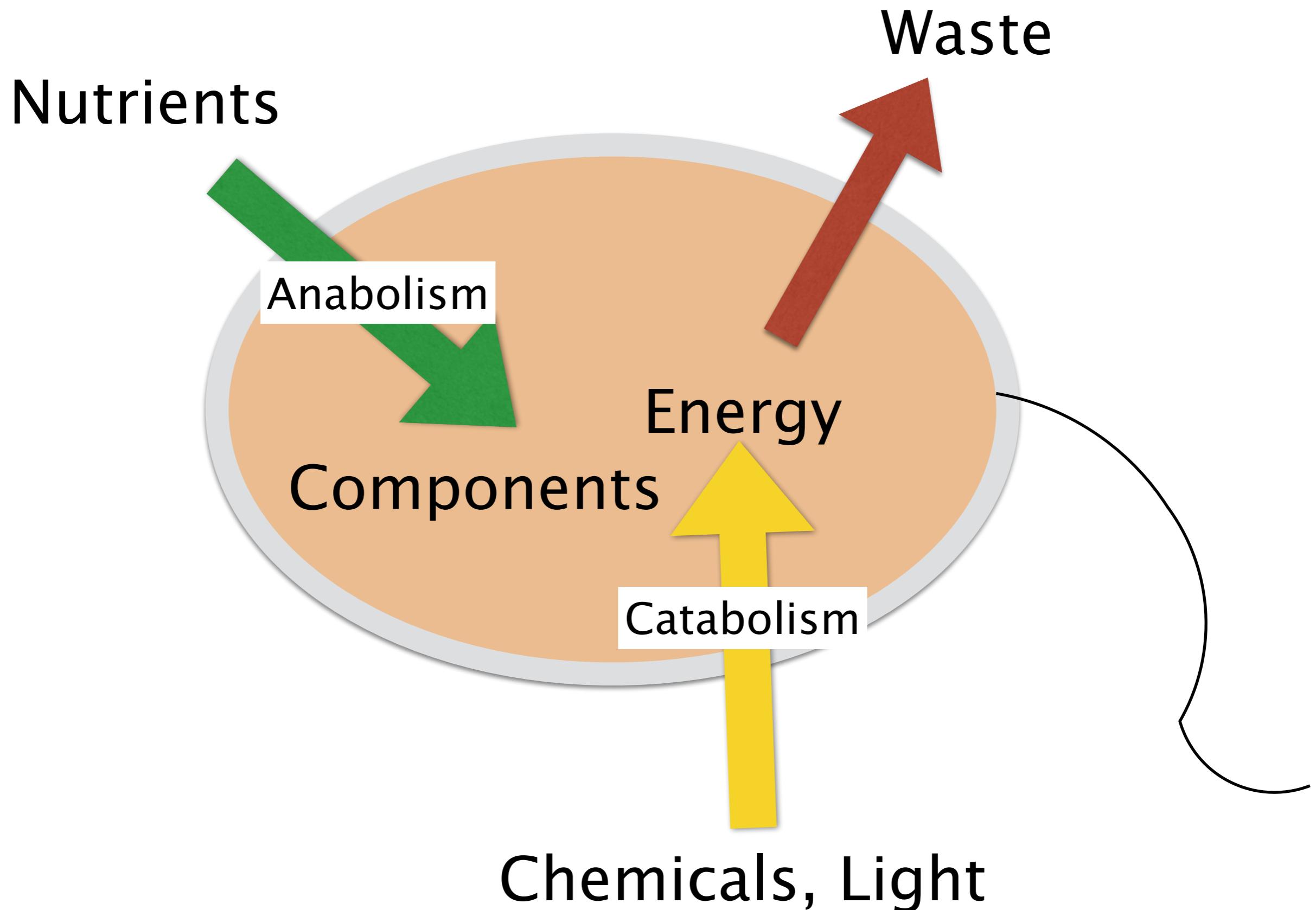


Fixate nitrogen





Cellular Metabolism





What to produce in a biofactory?

- Cells -> Biomass -> Food
- Metabolites -> Ethanol -> Food
- Antibiotics -> Pigments -> Paint
- Light
- Cell structures -> Cellulose -> Material



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Biohack Academy Strains

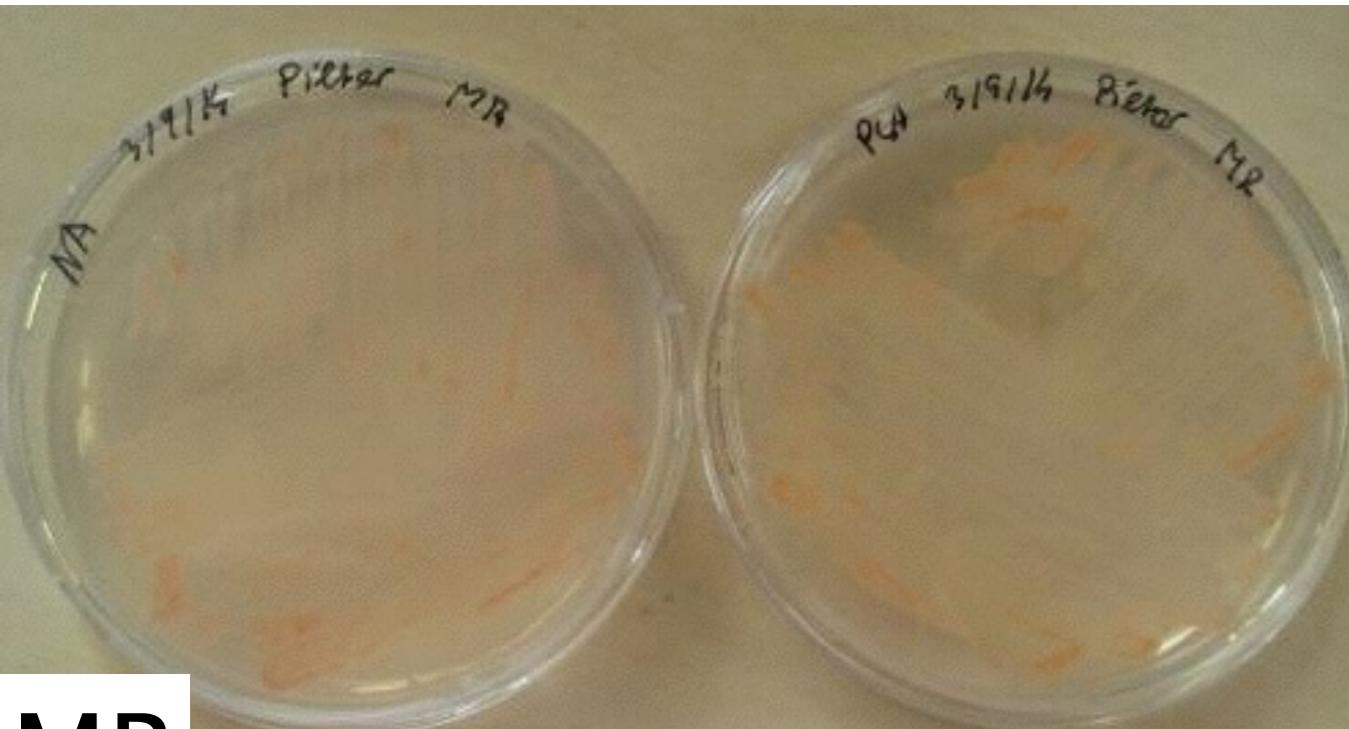
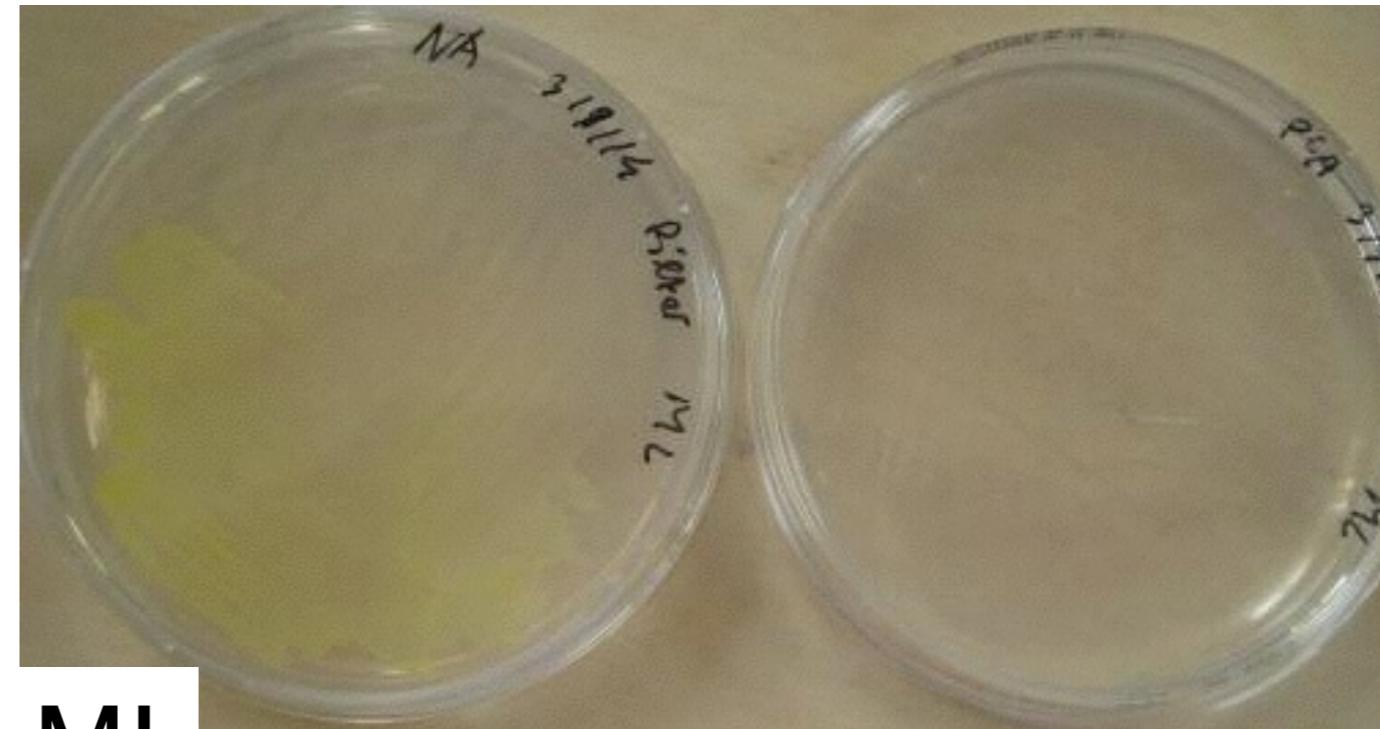
Meet the Microbes



Pigmented bacteria

Micrococcus luteus (ML)
Janthinobacterium lividum (JL)
Micrococcus roseus (MR)

Pigments
Antibiotics



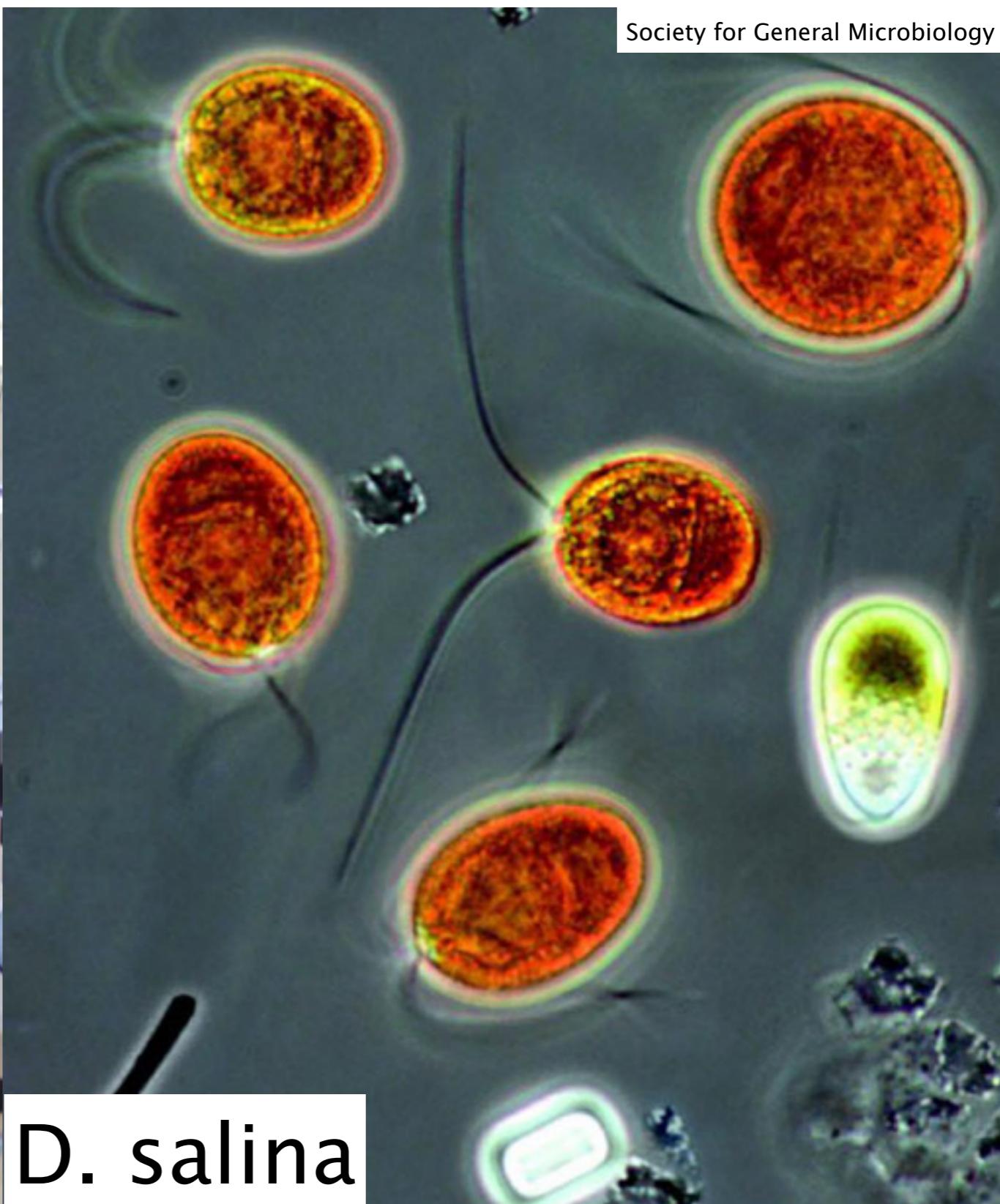


Algae

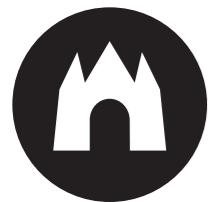
Pigments
Food



Spirulina maxima



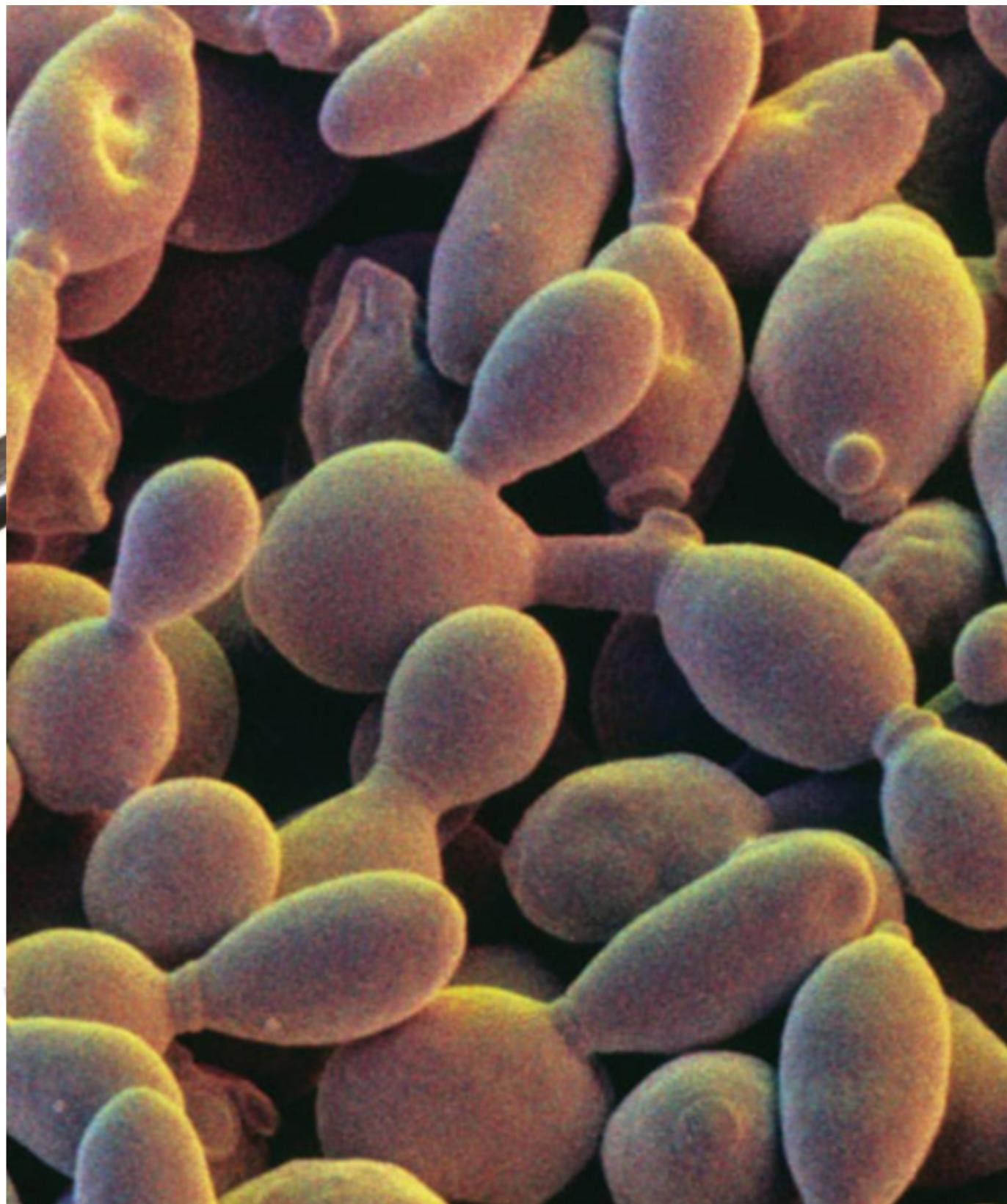
D. salina



Yeast



Alcohol
CO₂

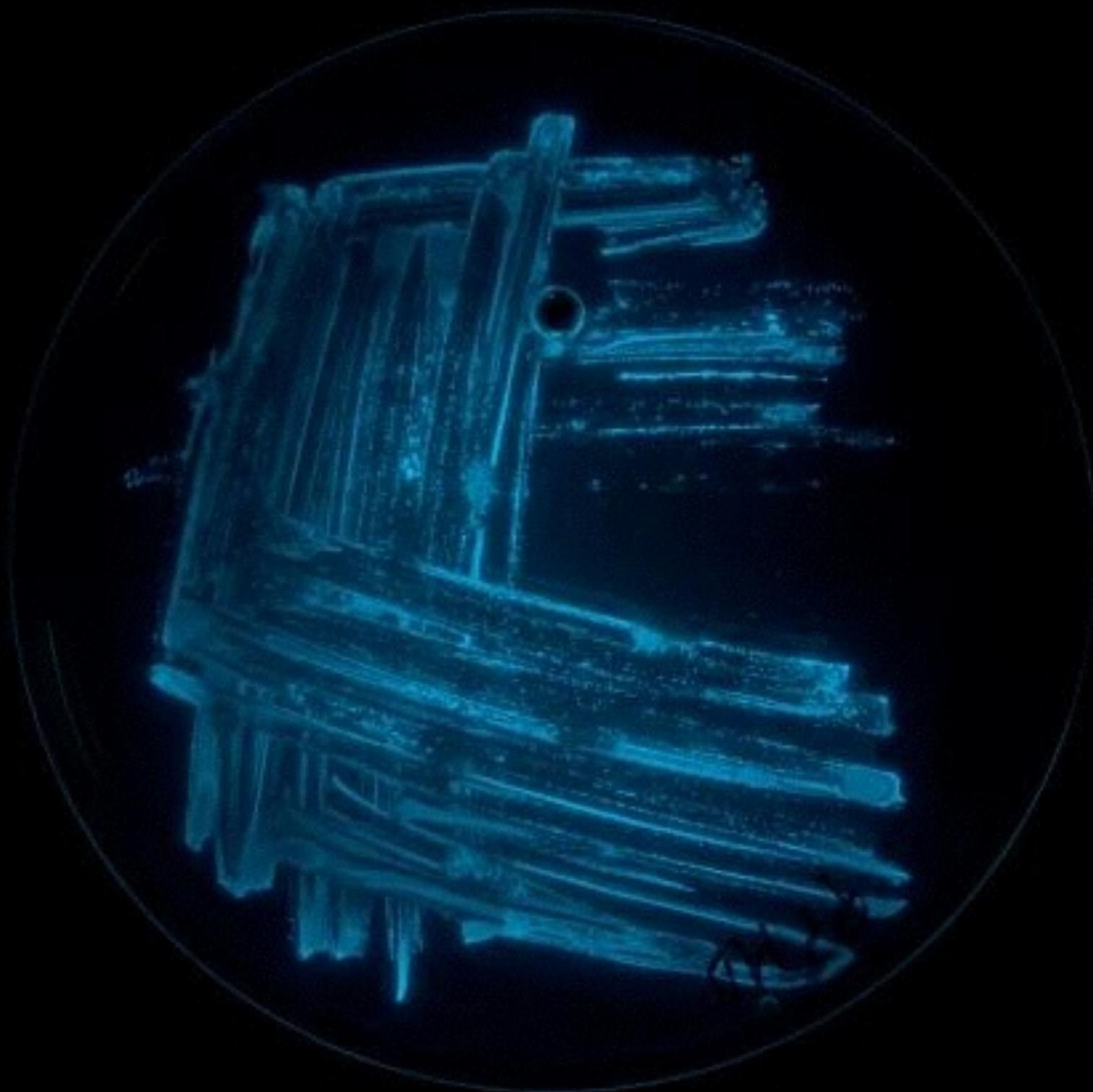


Light



Photobacterium phosphoreum

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SCOBY

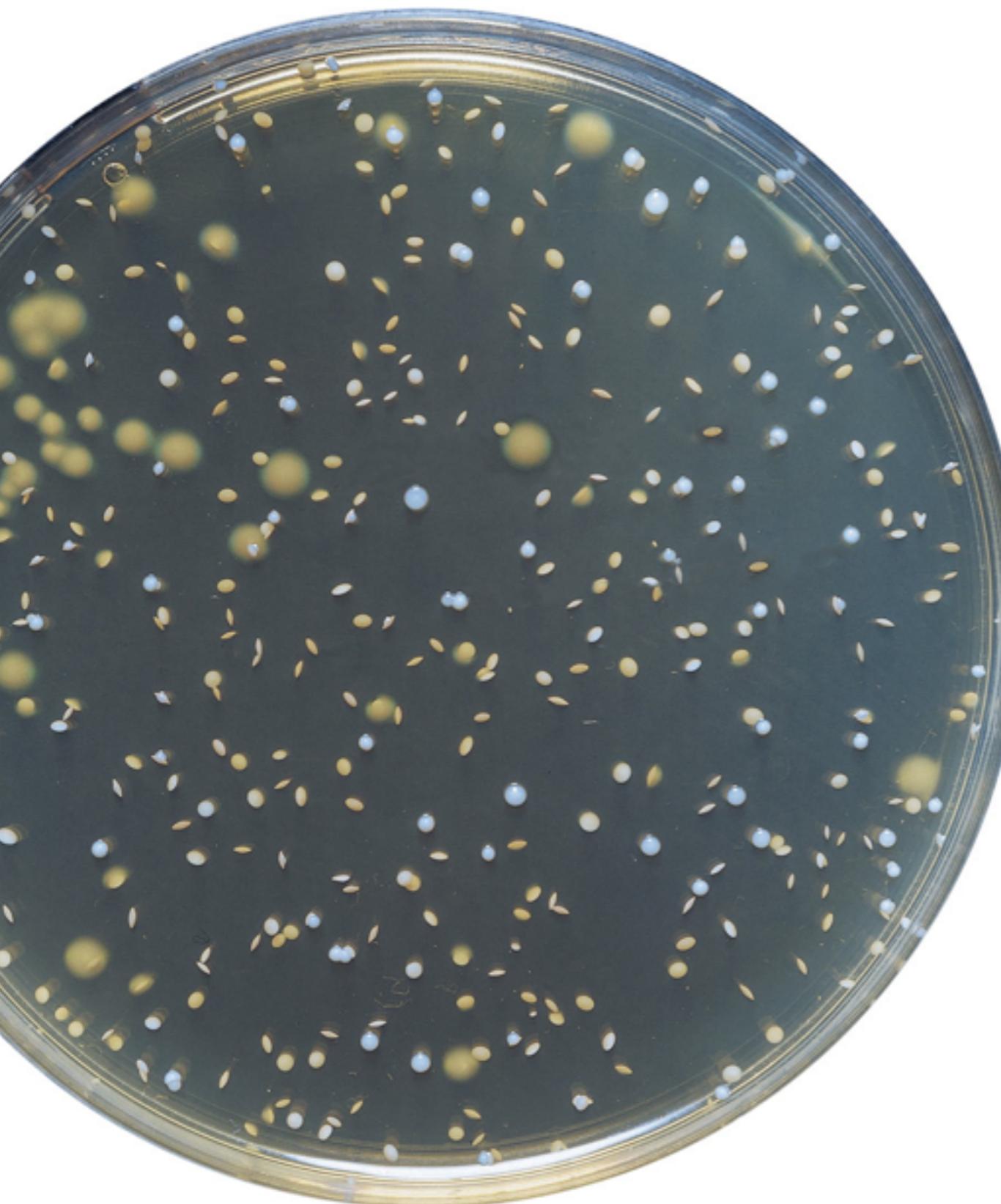
Cellulose
Vinegar



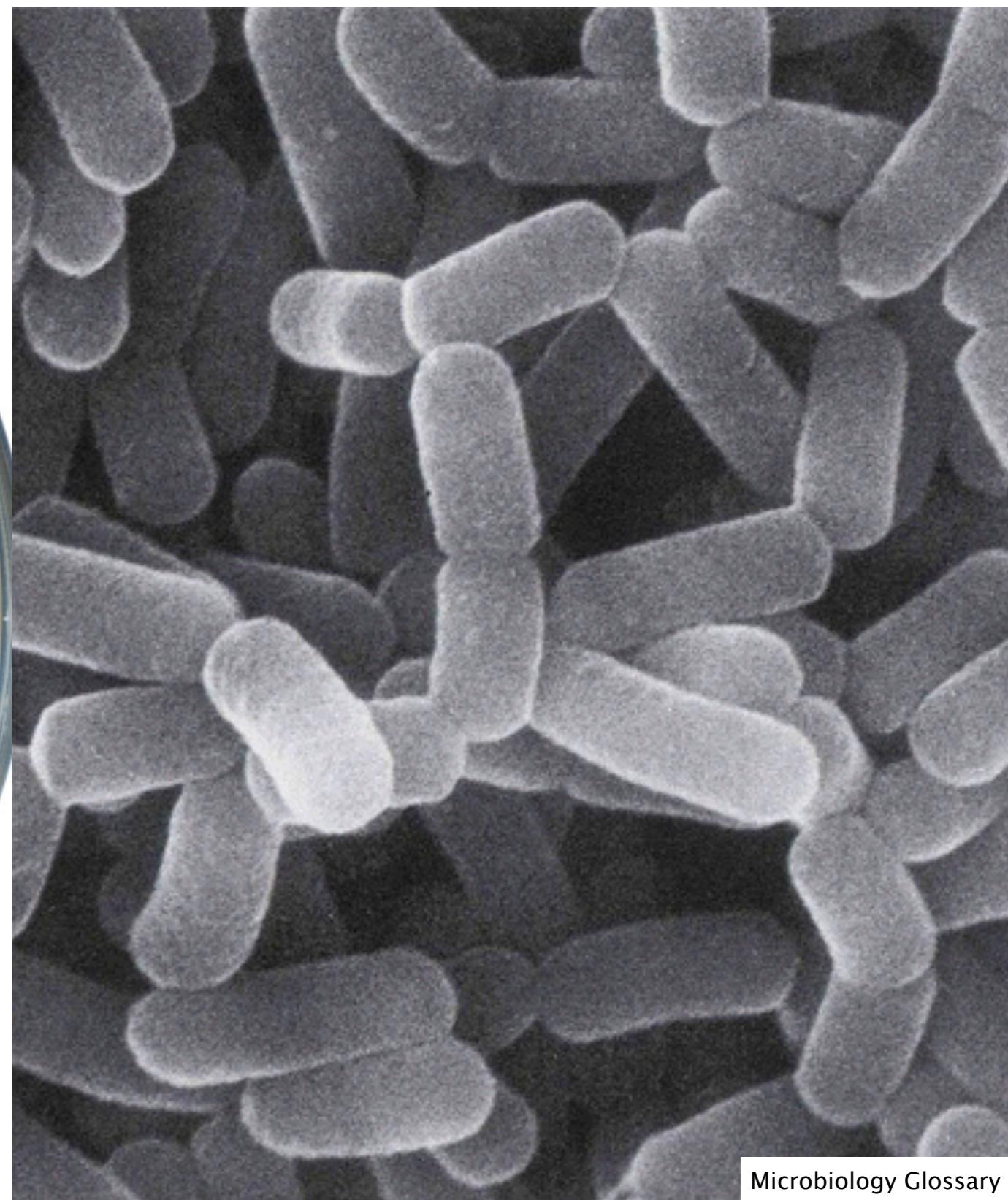
Symbiotic Culture of Bacteria and Yeast



Lactobacillus



Yoghurt
Lactic acid





Classification

- Bio safety level number indicates the level of regulations that need to be in place to prevent contamination.
- Types of organisms allowed per level:
 - 1) Well characterized non pathogenic organisms to humans
 - 2) Micro organisms with high infection doses, and known cures
 - 3) Micro organisms with low infection doses, and known cures
 - 4) Micro organisms with extremely low infection doses, severe disease and no cure





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