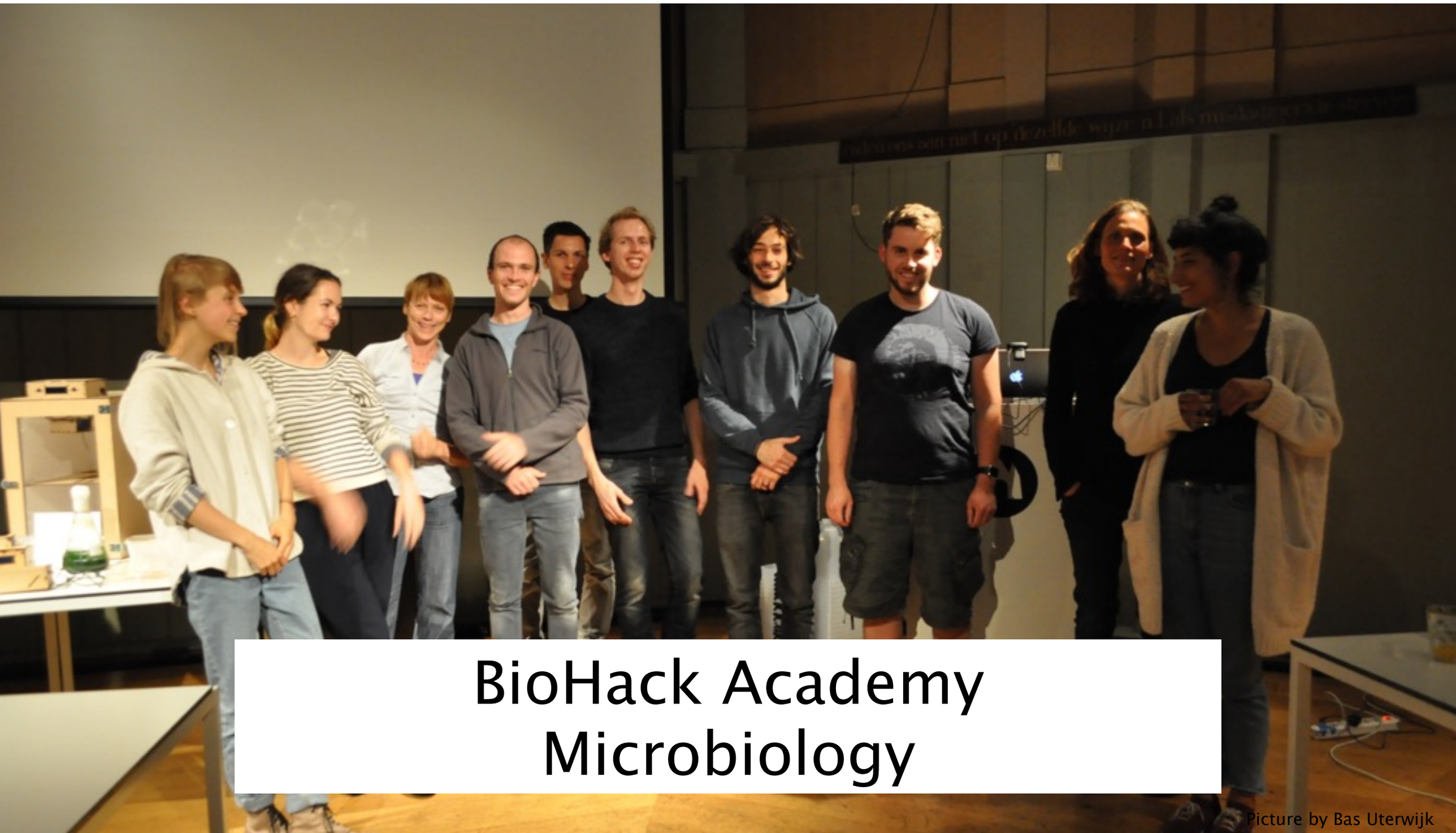
waag society

institute for art, science and technology



BioHack Academy
Microbiology

Picture by Bas Uterwijk

BHA in the wild

More fabbing?

1-WEEK INTENSIVE 'HANDS-ON' INTRODUCTION TO DIGITAL FABRICATION METHODS APPLIED TO THE CRAFTS.

With the support of the Creative Europe programme of the European Union

CALL FOR APPLICATIONS

As part of our 'Made@EU' European Commission sponsored project, we are able to offer a highly subsidized five-day intensive 'hands-on' introduction to 3-D digital fabrication systems for professionals working with traditional crafts and the decorative arts.

The purpose of these workshops is to introduce participants to the potential of 3-D digital technologies - allowing them to understand how they might be integrated into their existing workflows, and helping them to evaluate the benefits they might bring to their particular form(s) of practice.

Participants will be introduced to an array of computer-controlled tools. Facilities will vary across sites, but typically will include: CNC milling and laser cutting, 3D printing (additive manufacturing), 3D scanners as a means to capture digital information, computer-aided-design, and physical computing to control sensors and actuators with the help of micro-controllers well as a brand new industrial robotic arm and a full woodworking workshop.

RESIDENCY AND EXHIBITION PROGRAMME

Participants who complete the workshop will be invited to submit proposals for a fully funded 4-8 weeks residency. (These could be part time or full time, with flexible schedules as agreed with applicants). Selected residency candidates will be supported to complete an investigative body of work, with opportunities for final exhibition and dissemination in Plymouth, Barcelona and Paris, and most likely at additional international events. Depending on production needs, possibilities also exist for fully funded placements (including travel, board and lodging) with all the 'Made@EU' partners, the Institut d'Arquitectura Avançada de Catalunya, (IAAC), Barcelona, ENSCI les Ateliers, Paris and the Plymouth College of Art (PCA).

Growing bacteria

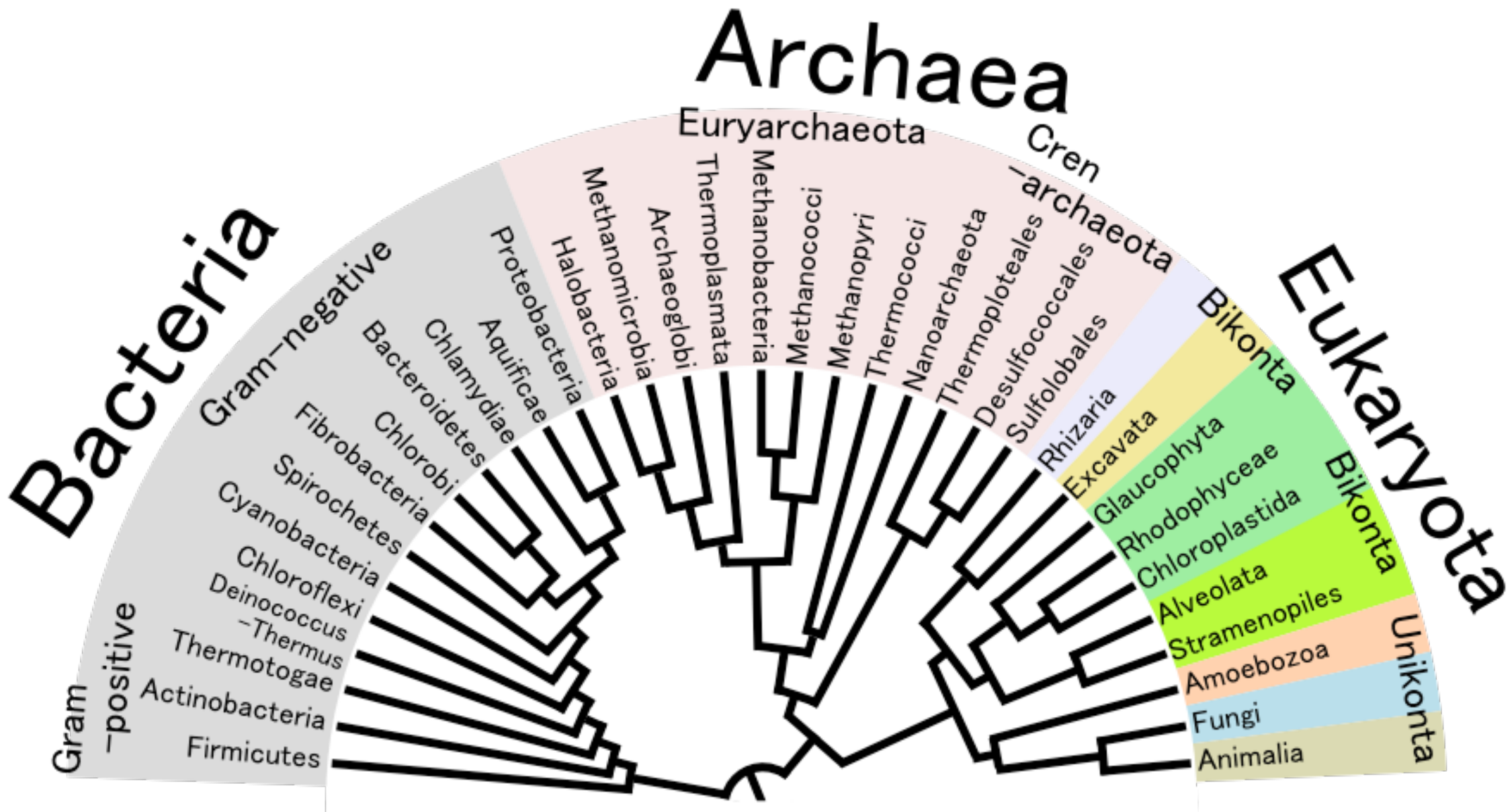
Dan Izzo - YouTube License

Sonja Baumel

Pictures by Cassander Eeftinck Schattenkerk

Fossil Stromatolite

Phylogeny of the living world

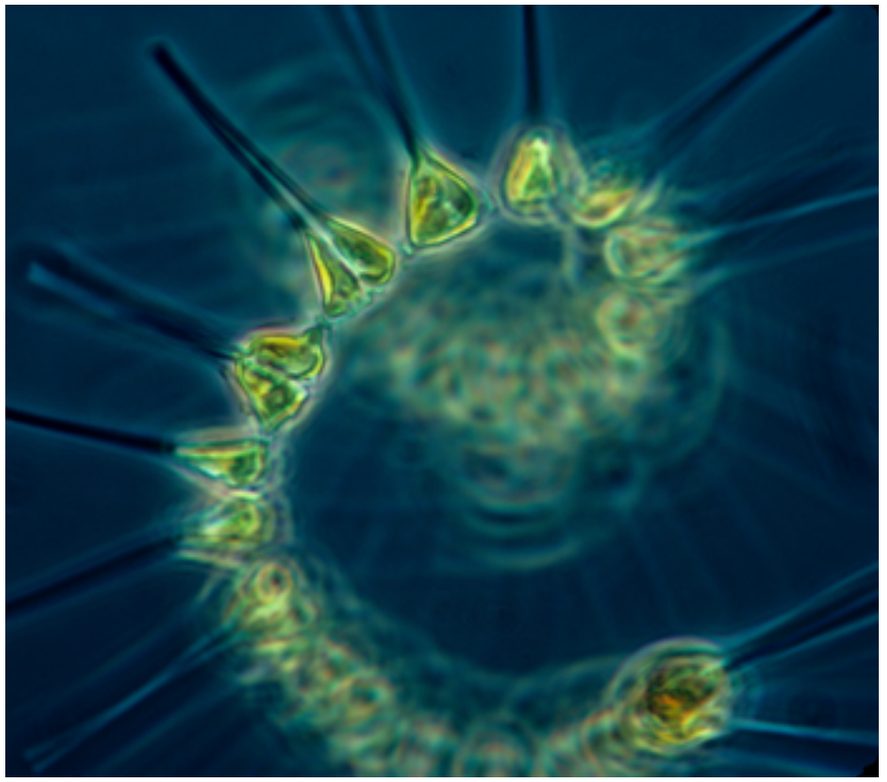


Definition of life

unicellular
(single cell)

NIAID - CC-BY 2.0

multicellular
(cell colony)



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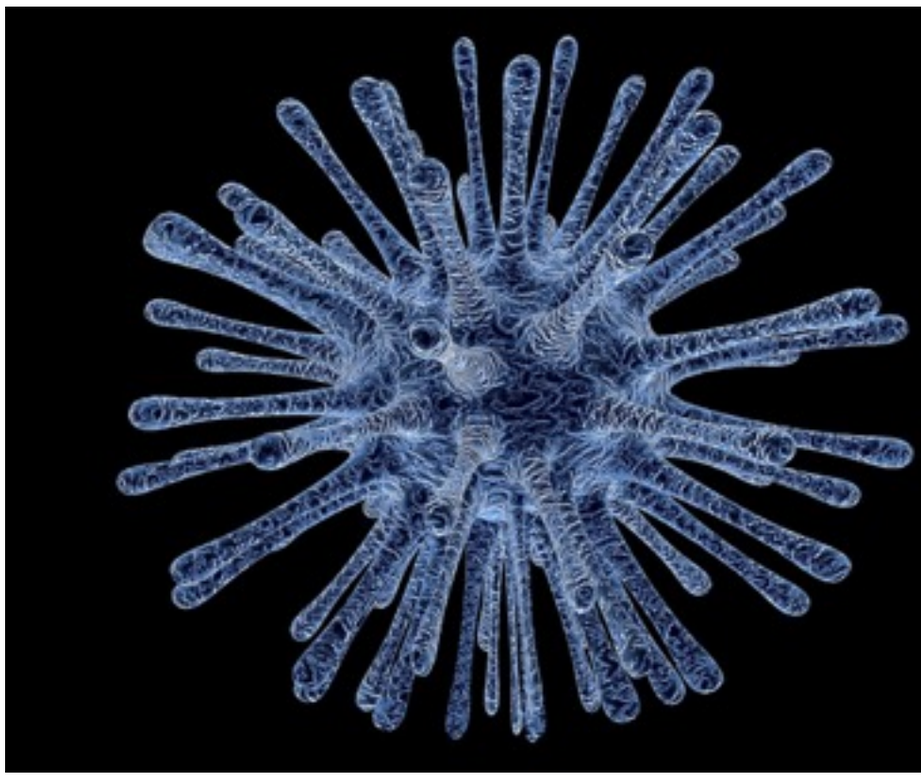
acellular
(lacking cells)



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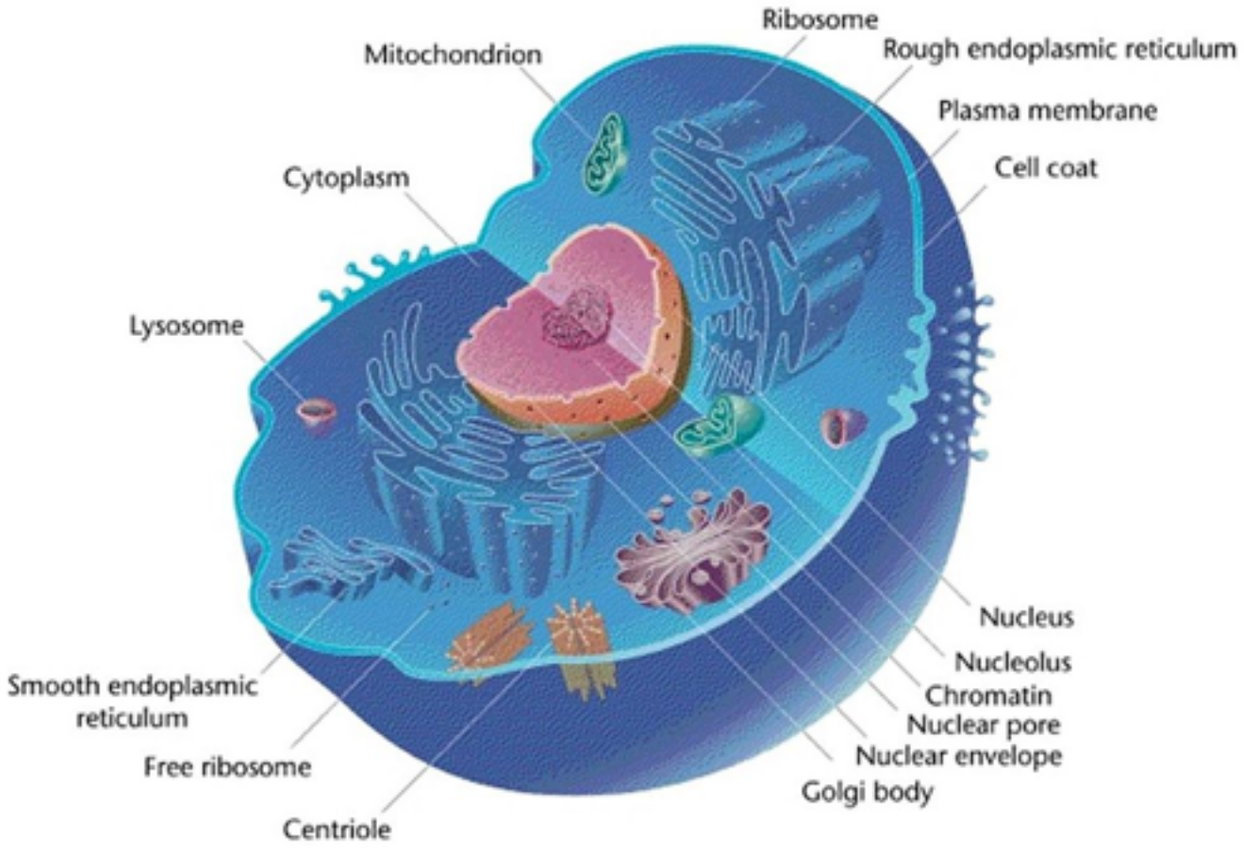
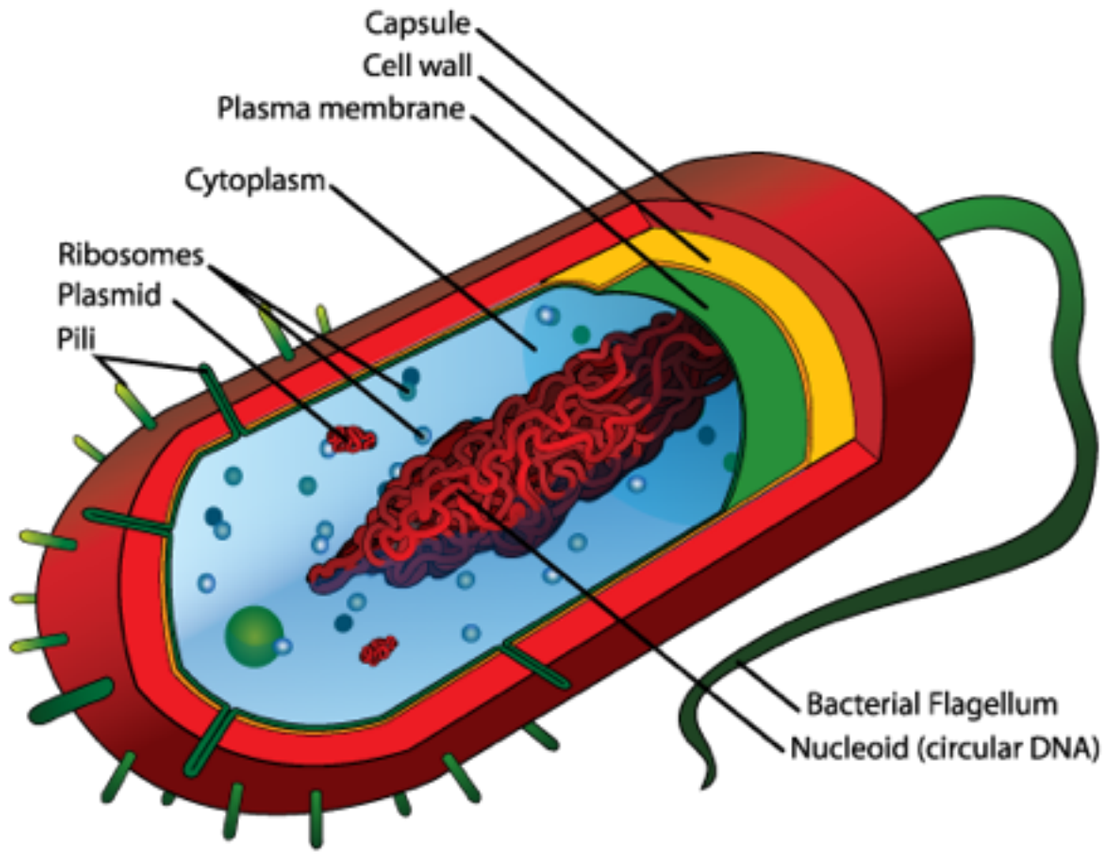
Two main categories

Eukaryotic cell



Marion - CC-BY-SA 3.0

Prokaryotic cell



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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

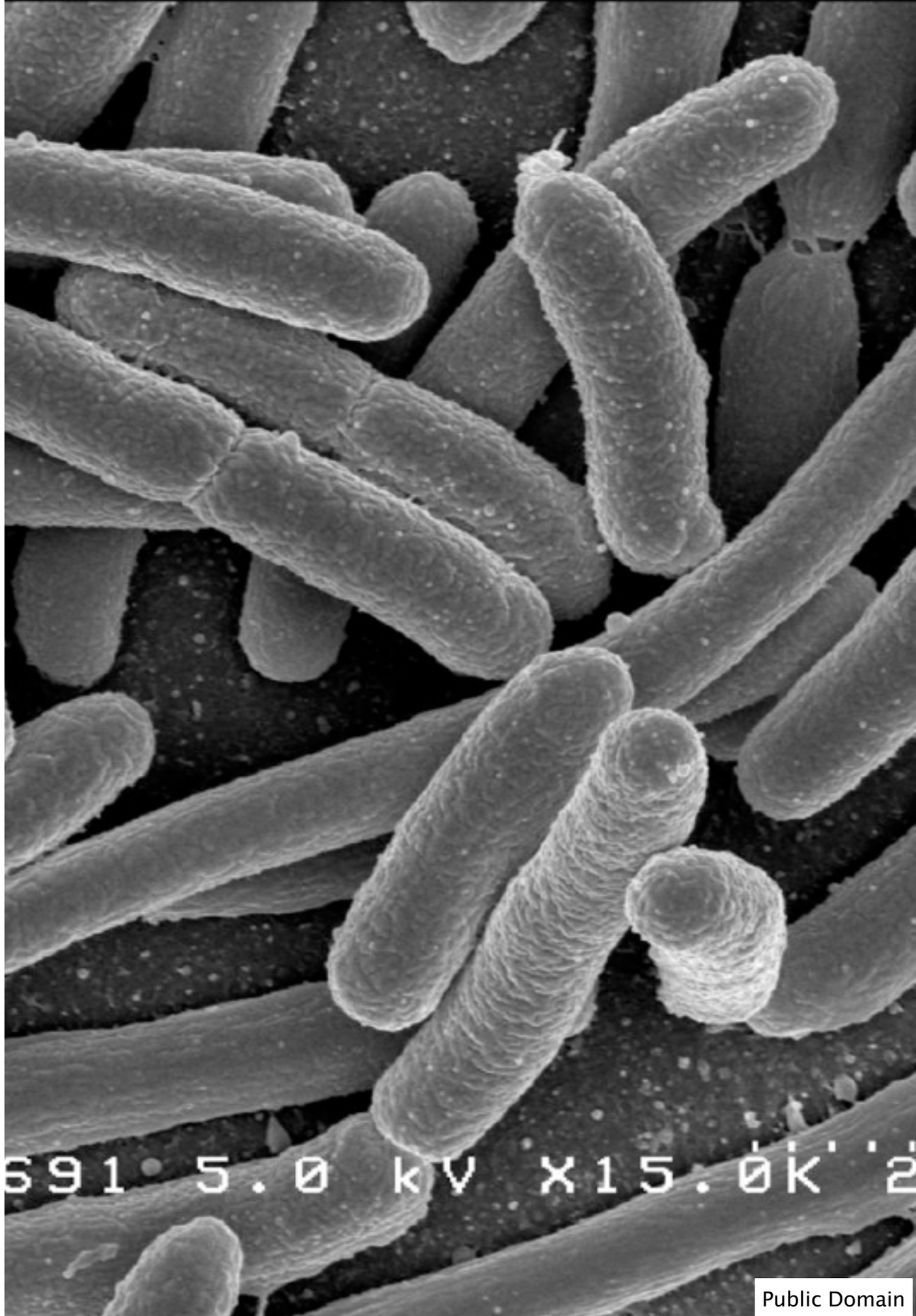
$3.0 \times 10^{-13} gr.$

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 of 1 gram of E. coli cells?



Cylinder formulas

$$Top\ area = \pi \times r^2$$

$$Bottom\ area = \pi \times r^2$$

$$Side\ area = 2 \times \pi \times r \times h$$

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

$$Volume\ V = \pi \times r^2 \times h$$

Solution exercise 1

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

Surface:

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

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

$2\times\pi\times r\times L + 2\times\pi\times r^2 = 20\,m^2$

Microorganisms: Role in our daily live

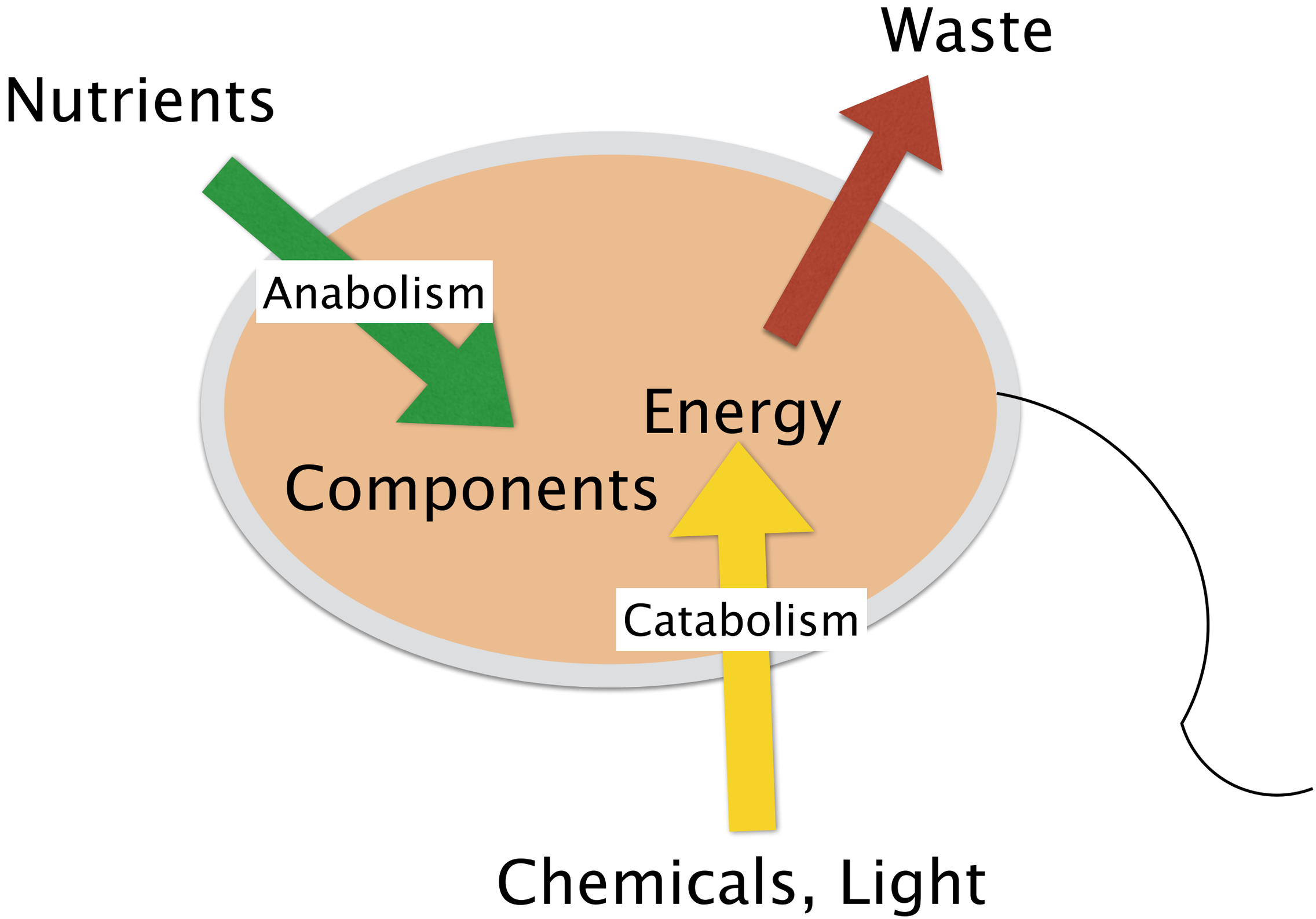
Microorganisms: Role in our daily live

Sulfur (purple) bacteria bloom

Buse Lake 3 - Cal Kimona Brown

Cyanobacteria (algae)

Cellular Metabolism



What to produce in a biofactory?

- Cells -> Biomass -> Food
- Metabolites -> Ethanol -> Food
- Antibiotics -> Pigments -> Paint
- Enzymes -> Catalysts / Drugs
- Light
- Cell structures -> Cellulose -> Fibers / Material

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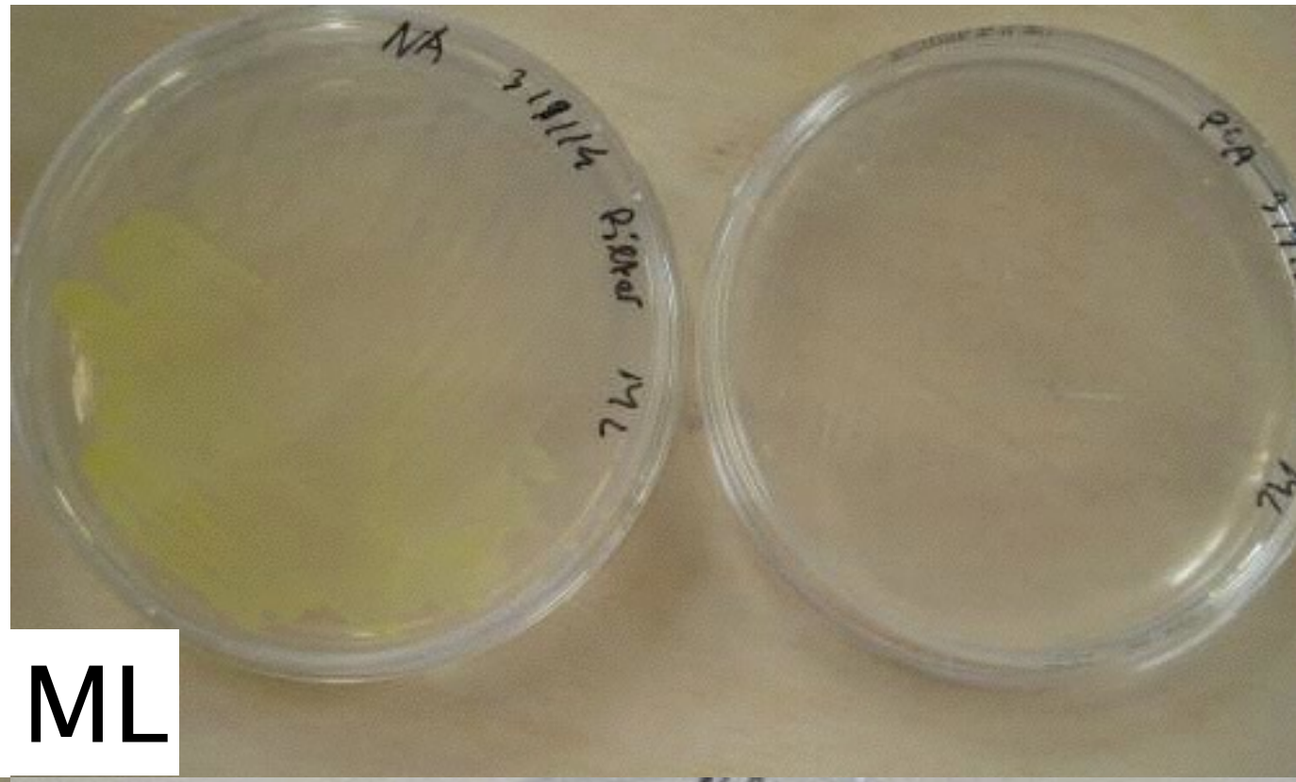
Biohack Academy Strains

Meet the Microbes

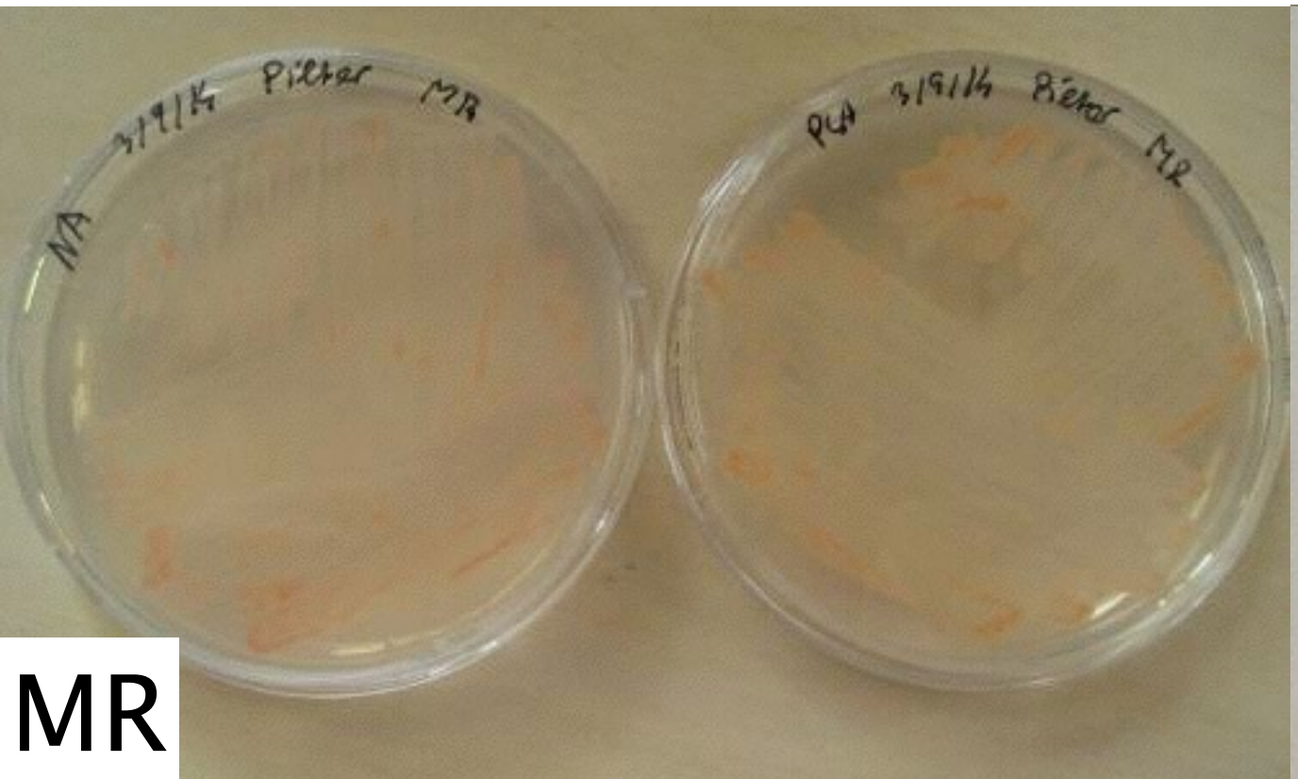
Pigmented bacteria

Pigments
Antibiotics

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



ML

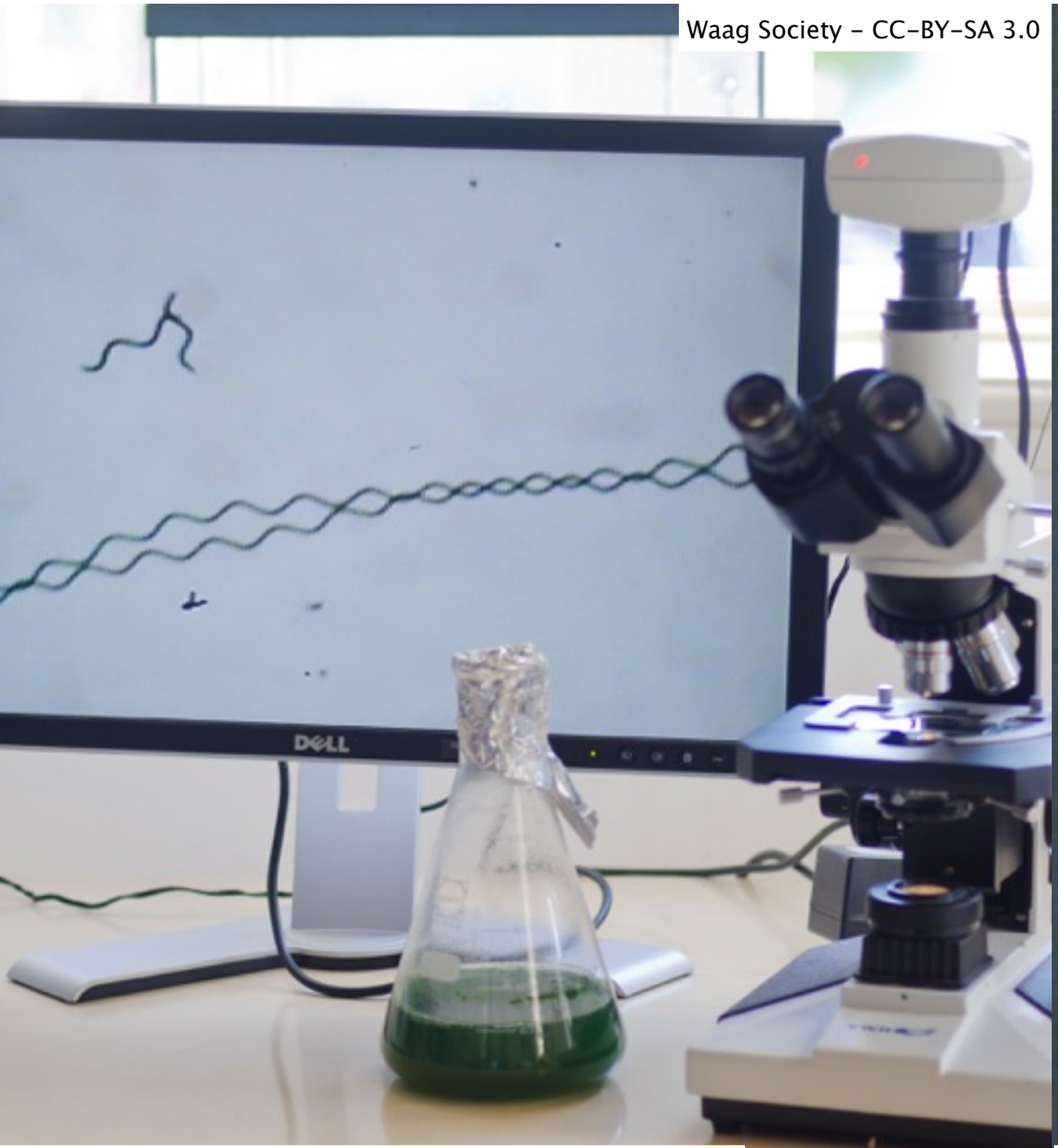


MR

JL

Algae

Pigments
Food



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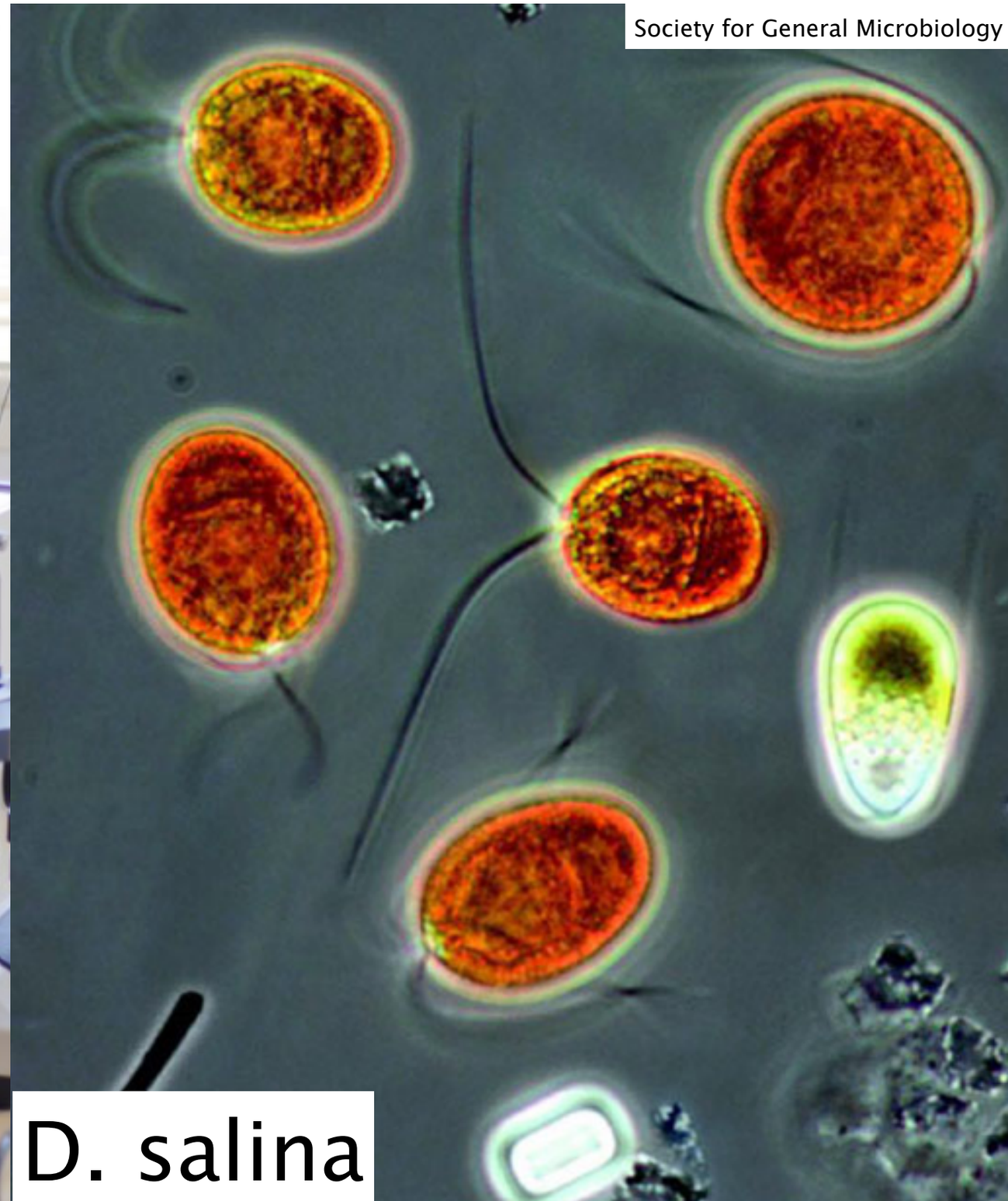
Spirulina maxima

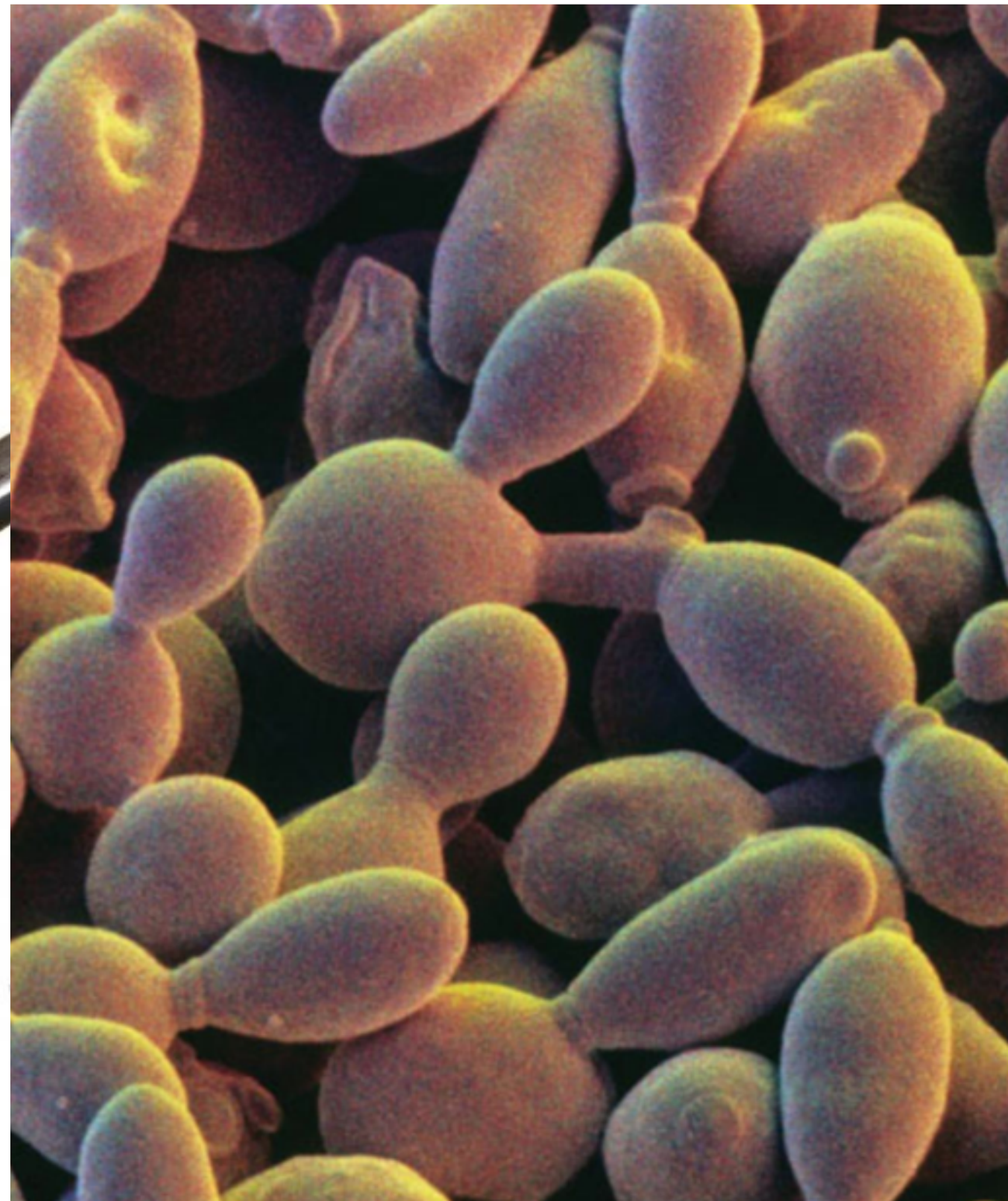


Society for General Microbiology

D. salina

Yeast

Alcohol
CO2



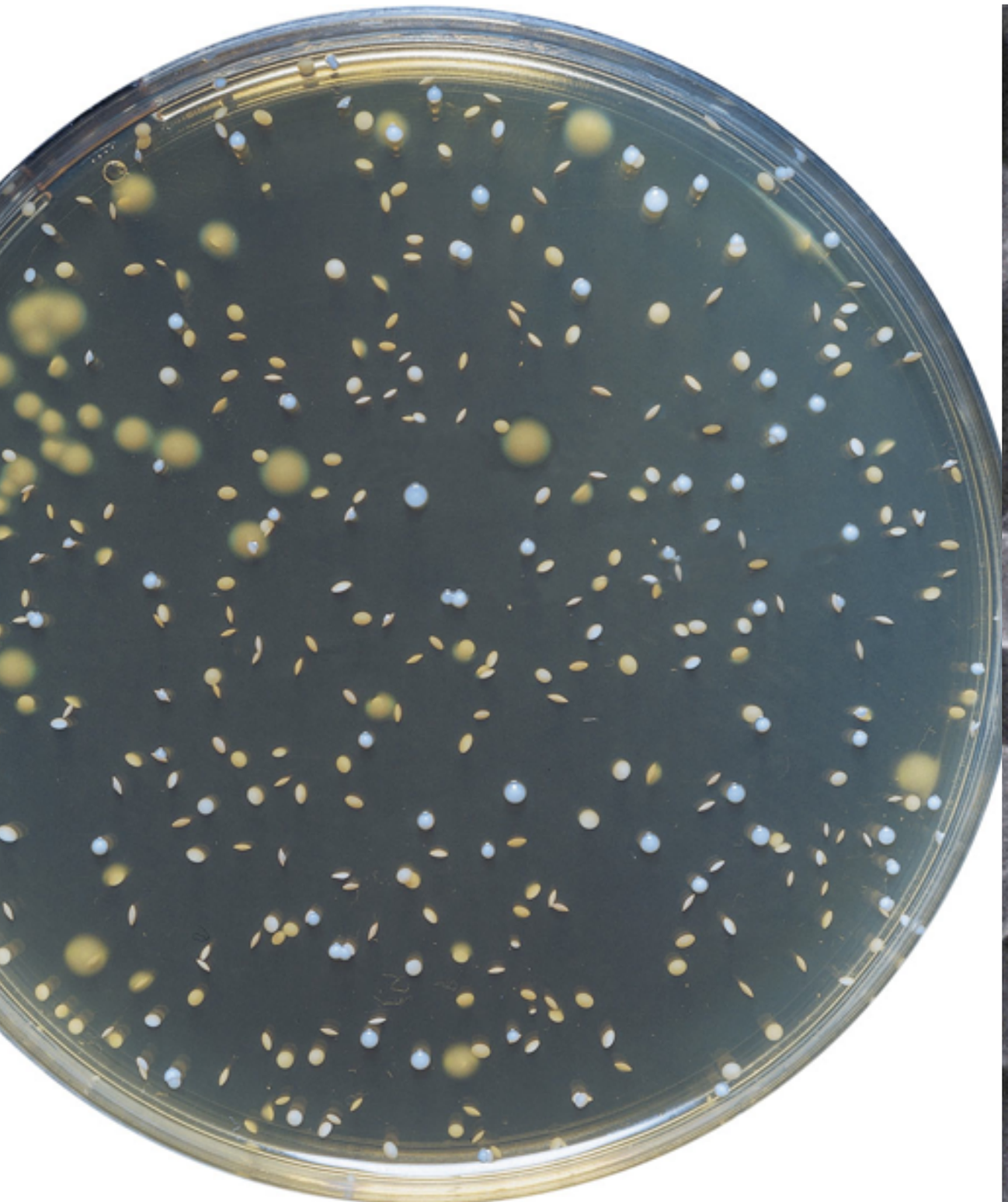
SCOBY

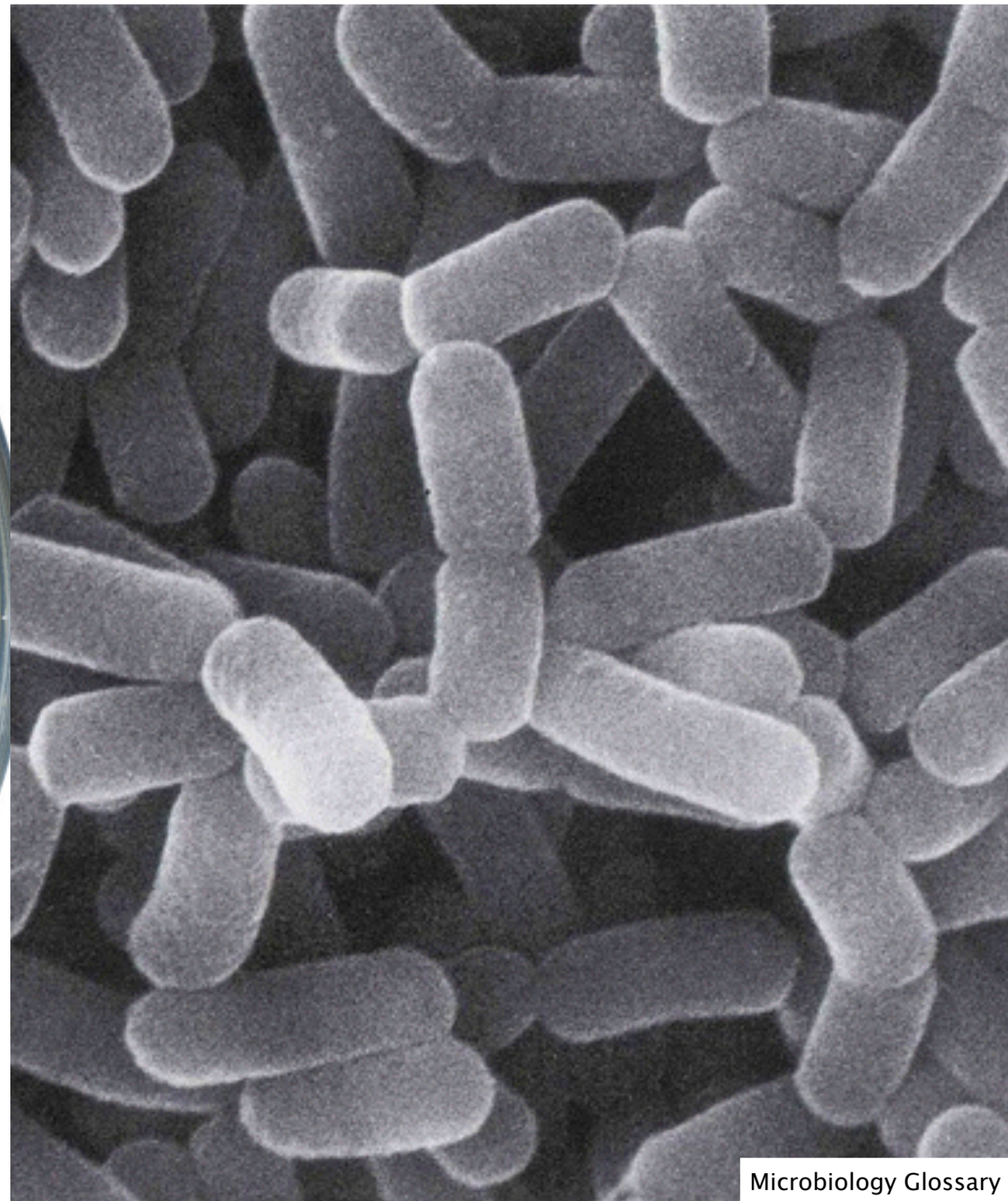
Cellulose
Vinegar

Symbiotic Culture of Bacteria and Yeast

Lactobacillus

Yoghurt
Lactic acid





Mycelium

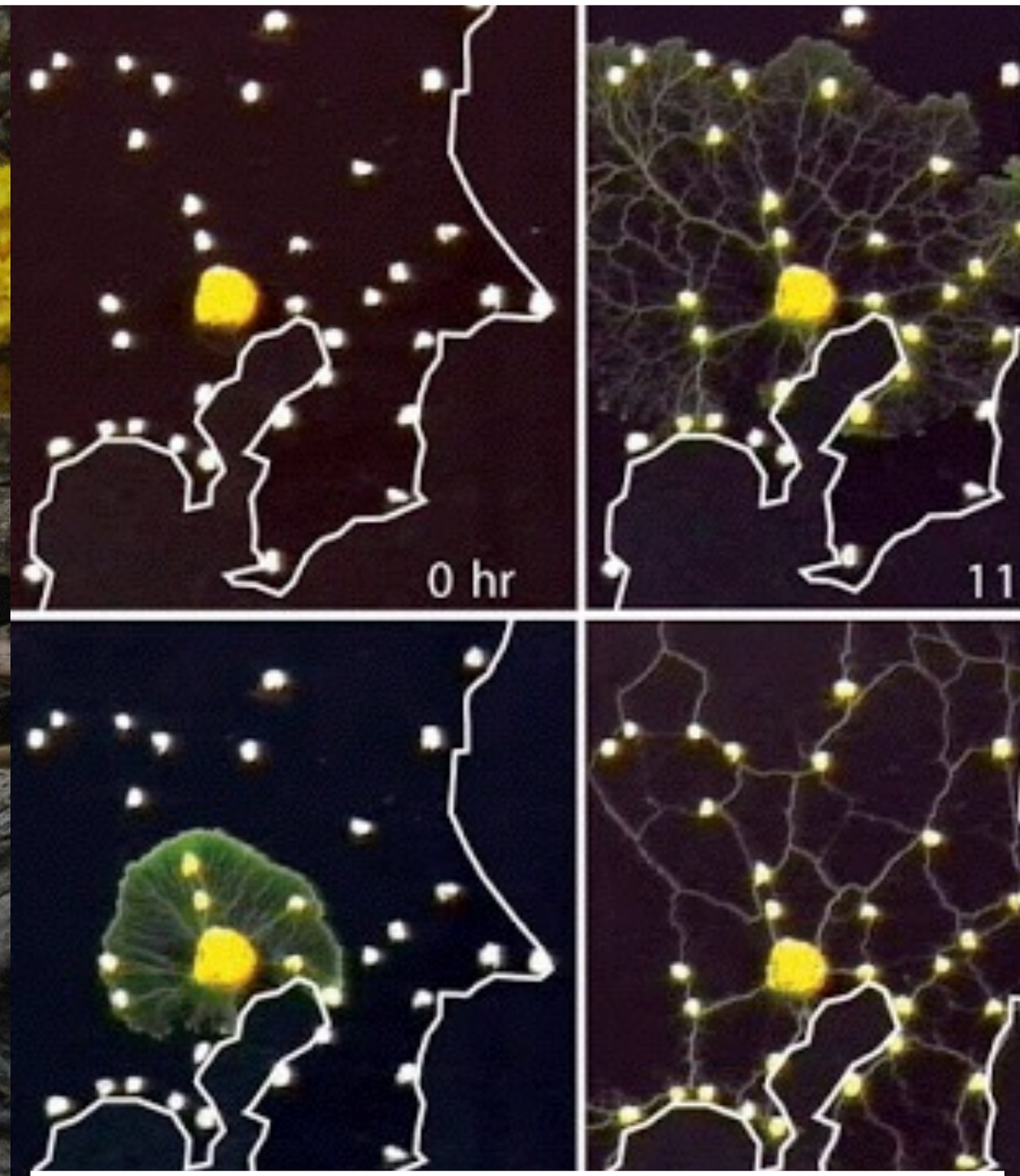
Fibers

Rob Hille - CC-BY-SA 3.0

Eric Klarenbeek - CC-BY 3.0

Slime mold

Lawrence Durell Wade, M.D. - CC-BY-SA 3.0



http://suttonhoo.blogspot.nl/2010/01/slime-mold-that-transgressed-tokyo.html

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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BYOM

- Bring your own microbe
  - Non-pathogenic
  - Class 1

Please note

- Only non-pathogenic microbes are used in the Academy

- **Wash your hands** before and after experimenting
- **Do not eat or drink** next to the microbes