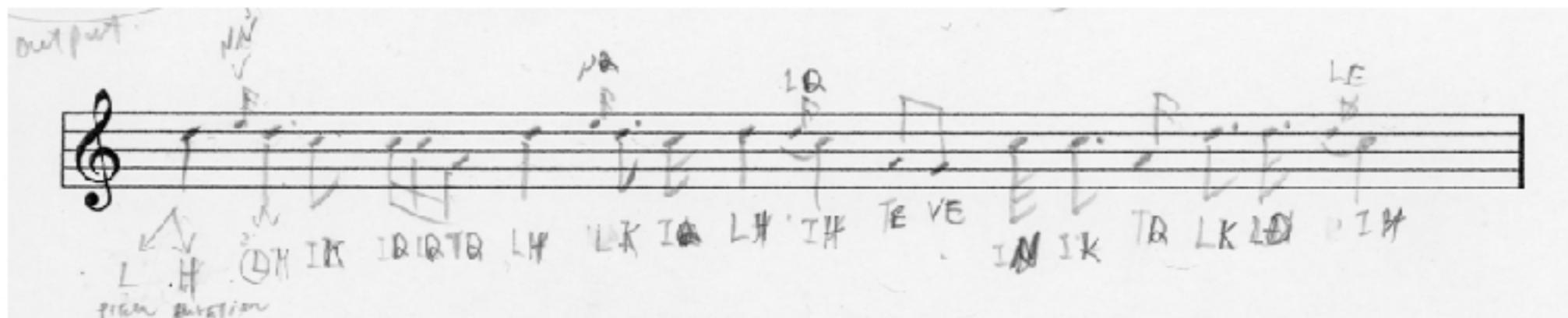


**biohack
academy**



Music DNA encoding

1. 音楽をDNA塩基配列に変換 Encoding Music to DNA Sequence



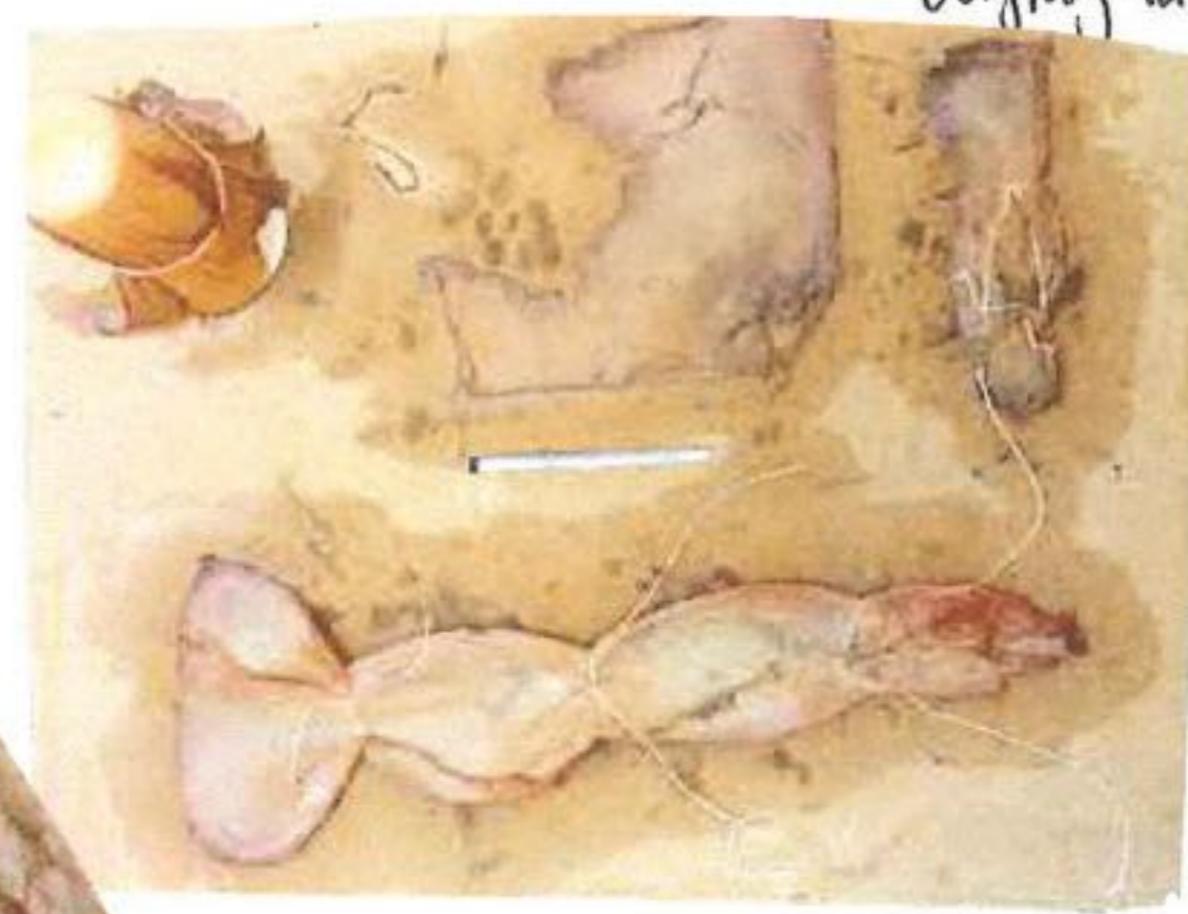
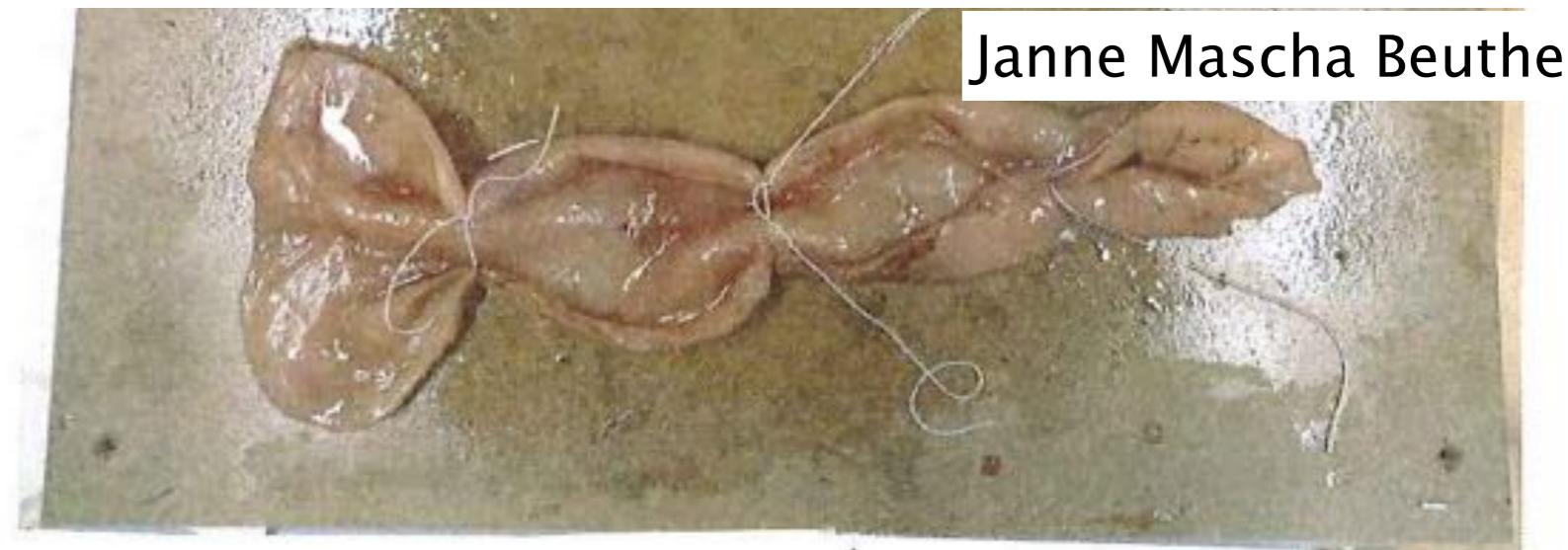
| Note No. | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | |
|----------------|-------------------|----------|-------------------|----------|-------------------|----------|-------------------|----------|-------------------|----------|-------|-------|
| | Pitch (Frequency) | Duration | | |
| Pitch/Duration | D5 | 1/4 | F5 | 1/32 | D5 | 1/4-1/8 | C5 | 1/8+1/16 | C5 | 1/16 | C5 | 1/16 |
| Amino Acid - | L - 1 | H - 1 | N - 1 | N - 2 | L - 2 | M - 1 | - 1 | K - 1 | I - 2 | Q - 1 | I - 3 | Q - 2 |
| DNA codon | TTA | CAT | AAT | AAC | TTG | ATG | ATT | AAA | ATC | CAA | ATA | CAG |



TTACATAATAACTTGATGATTAAATCCAAATACAG…

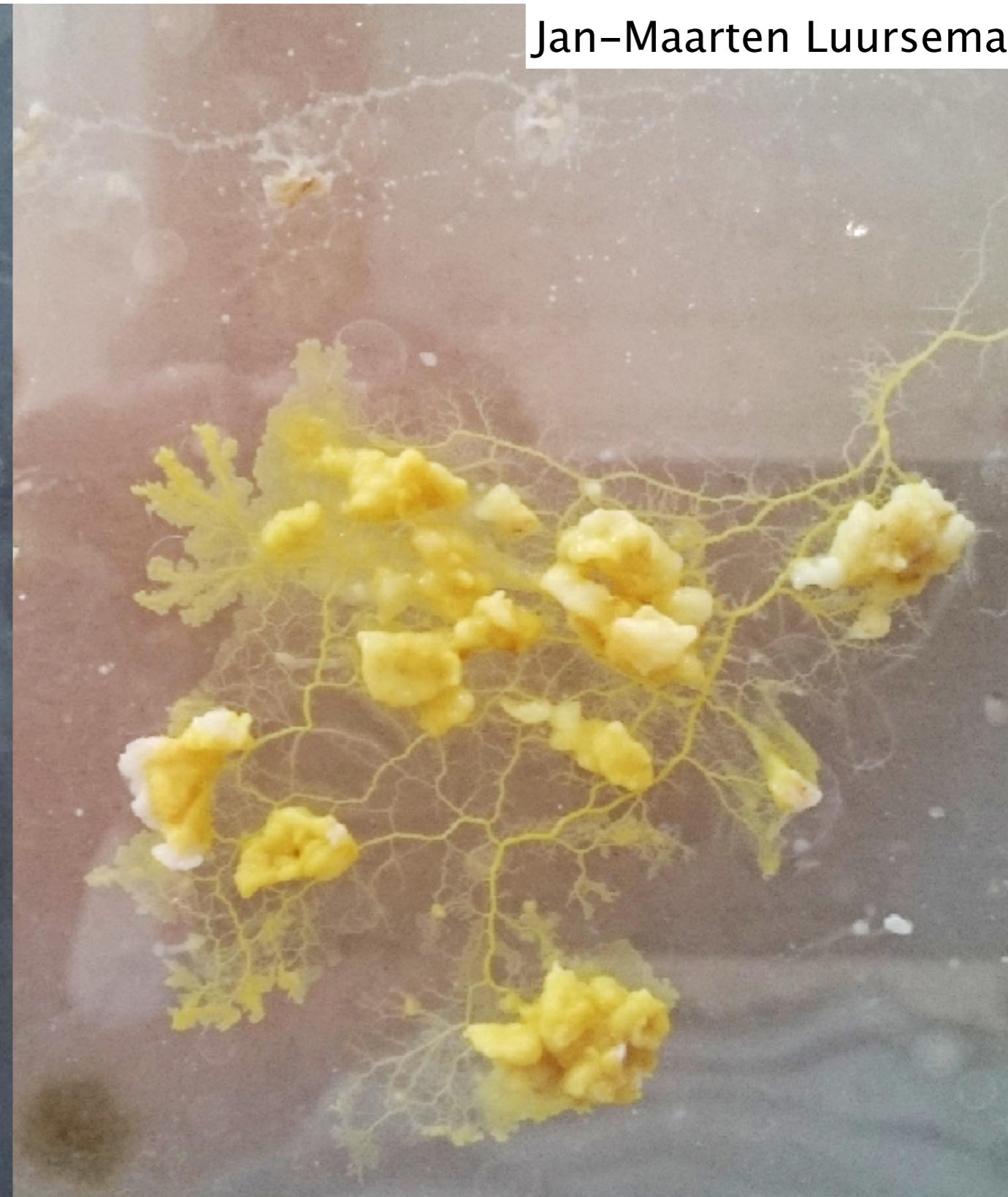


Experimenting with biomaterials





Design intelligent infrastructure



Jan-Maarten Luursema

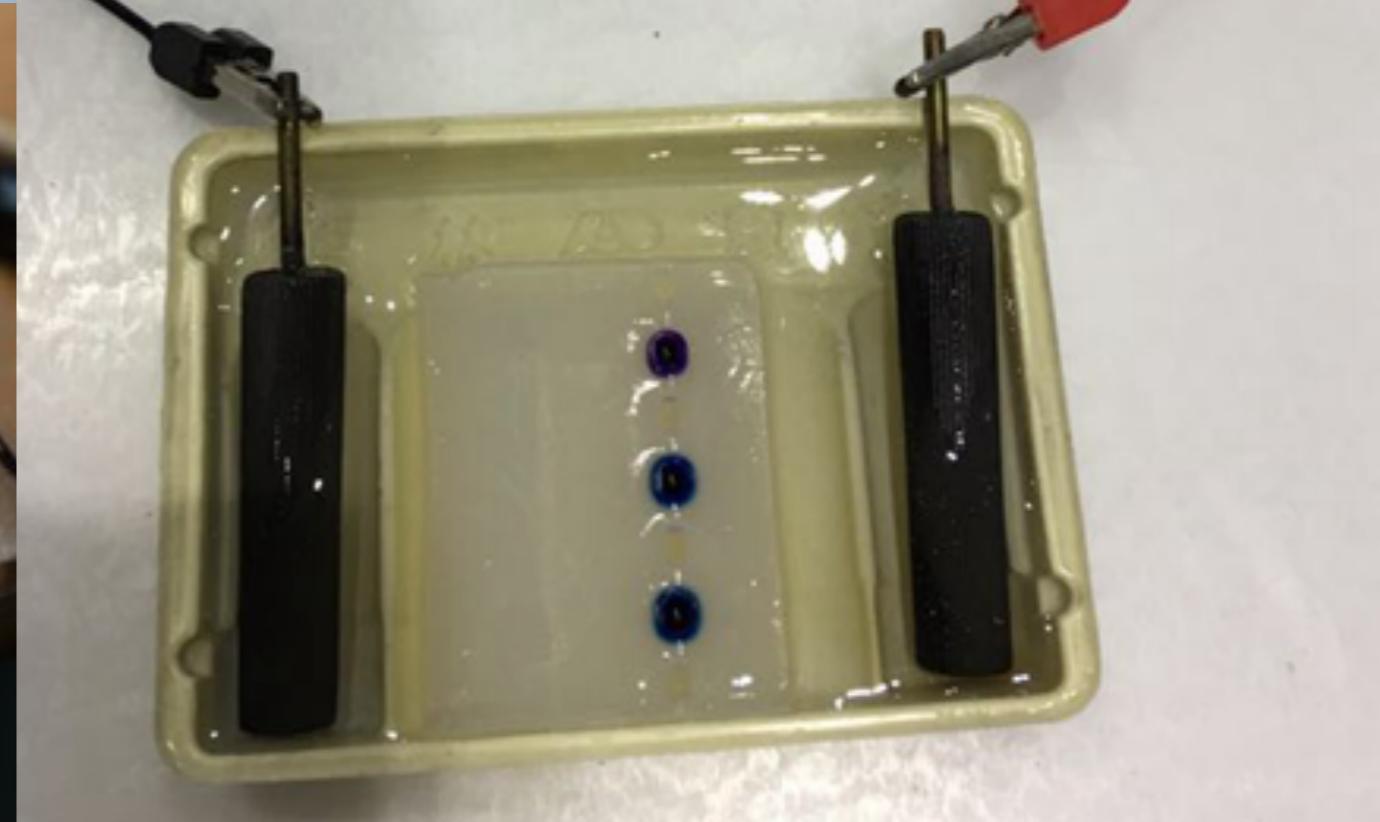
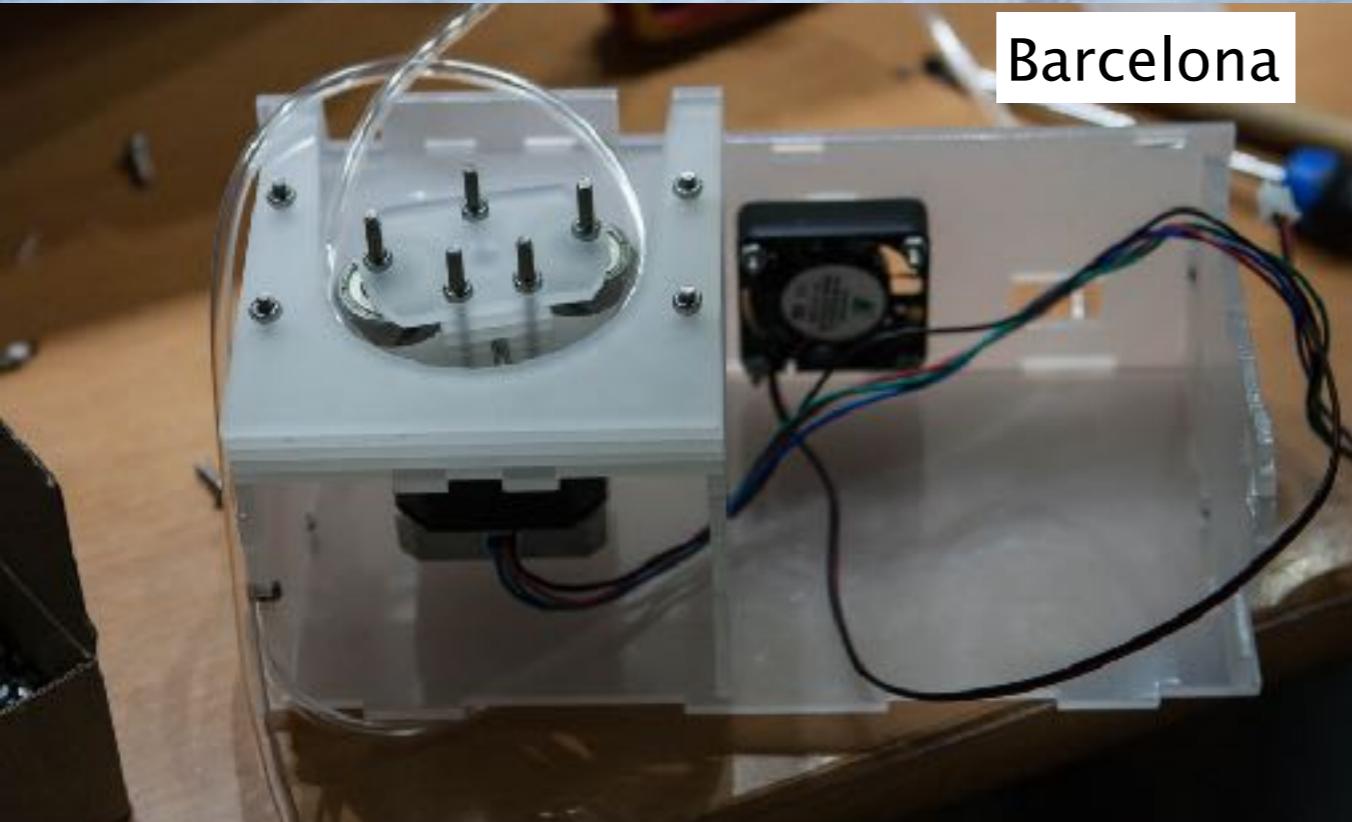
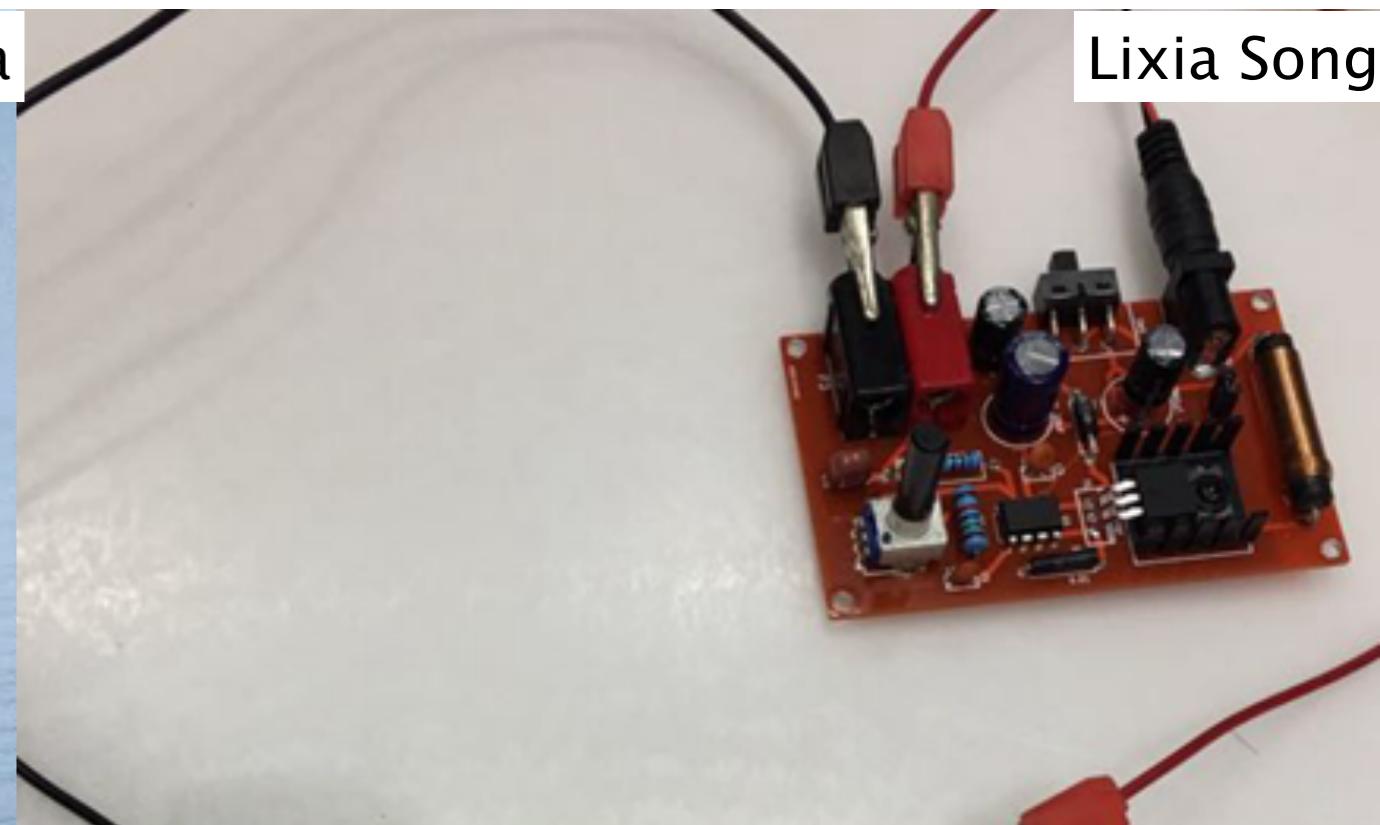


DIY Biohack Academy kit



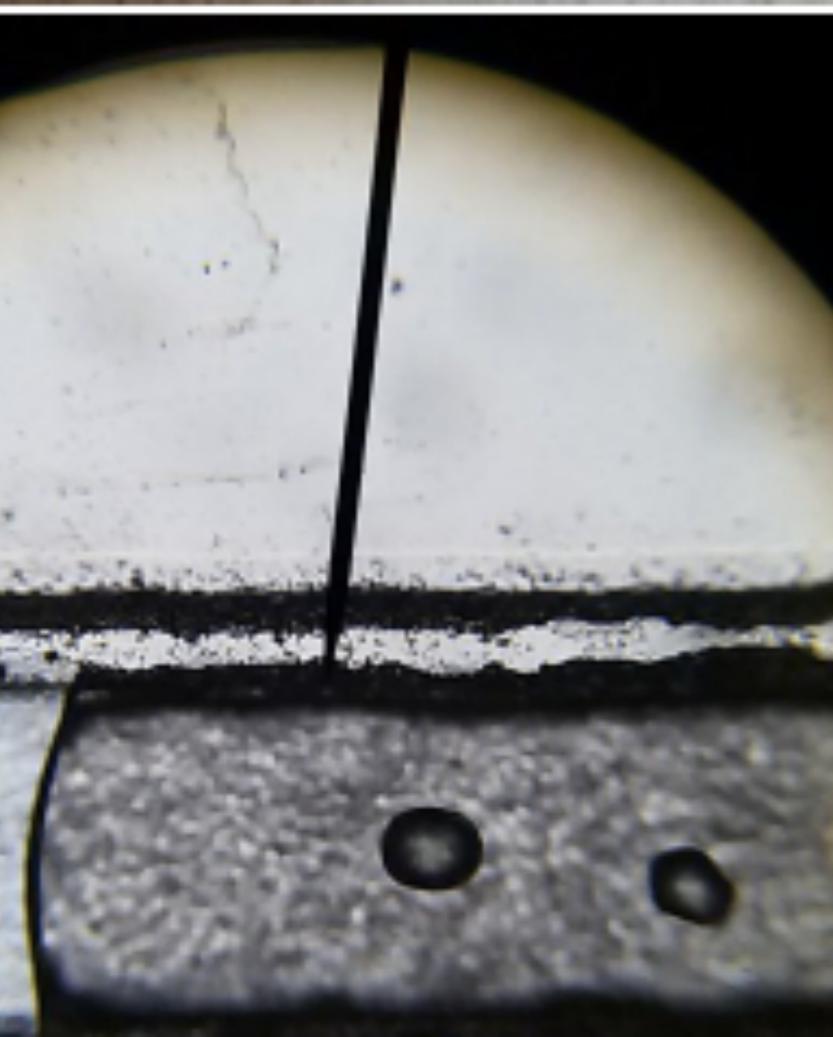
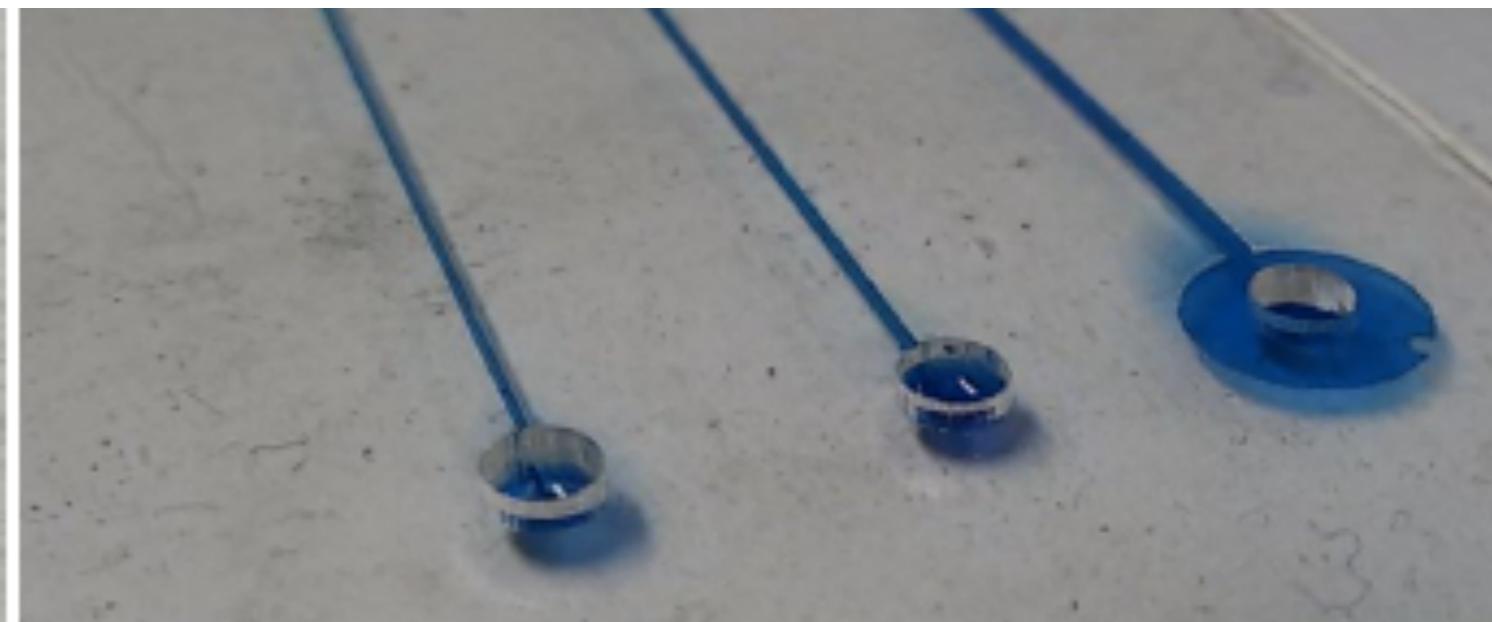


Invent new lab tools



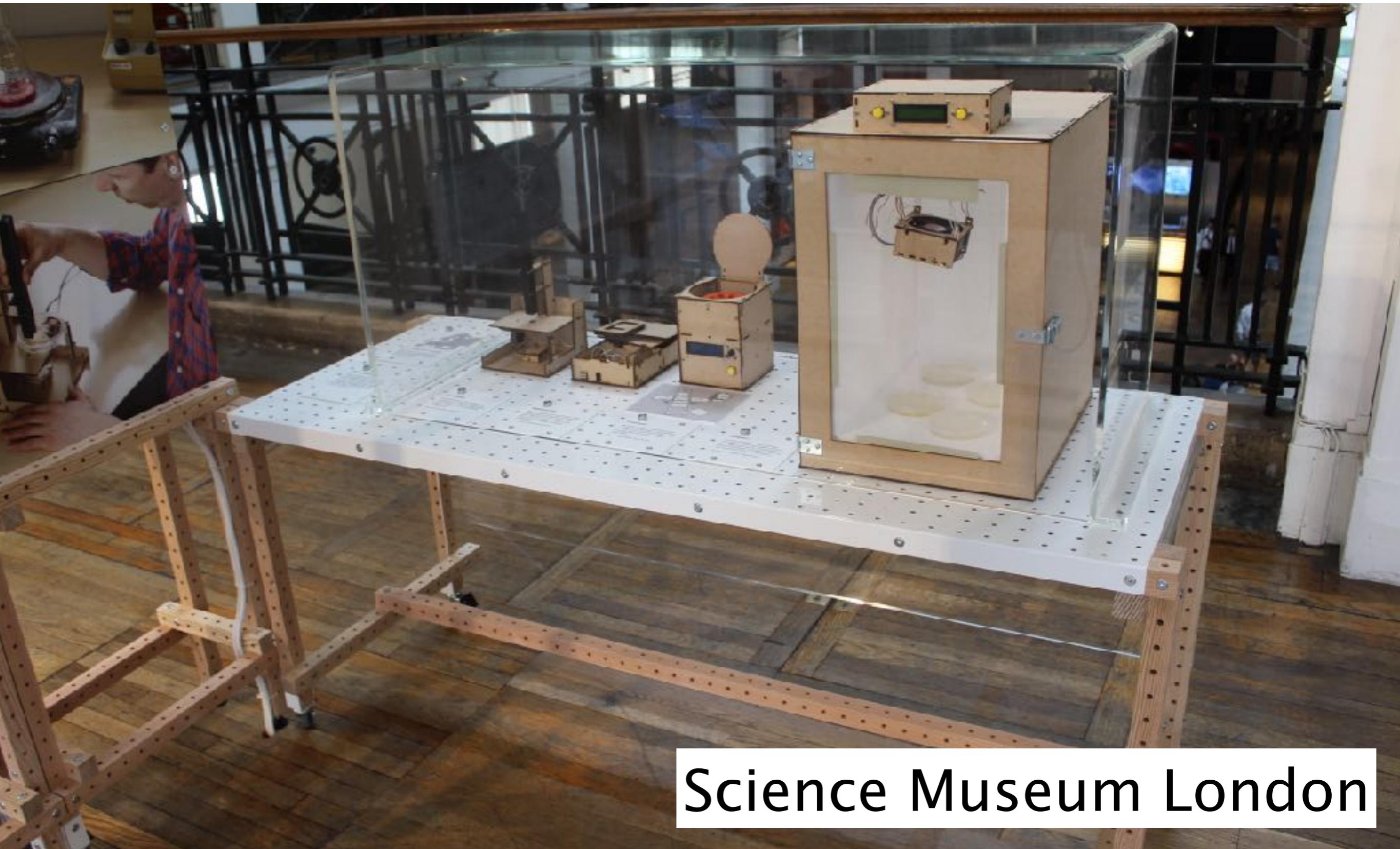


Experiment with microfluidic chips





End up in galleries & museums



Science Museum London



Today's schedule

- Introduction
- Microbiology



The goal of this BioHack module

Skills you will learn:

- Molecular biology
- Chemical and biological safety
- Documentation

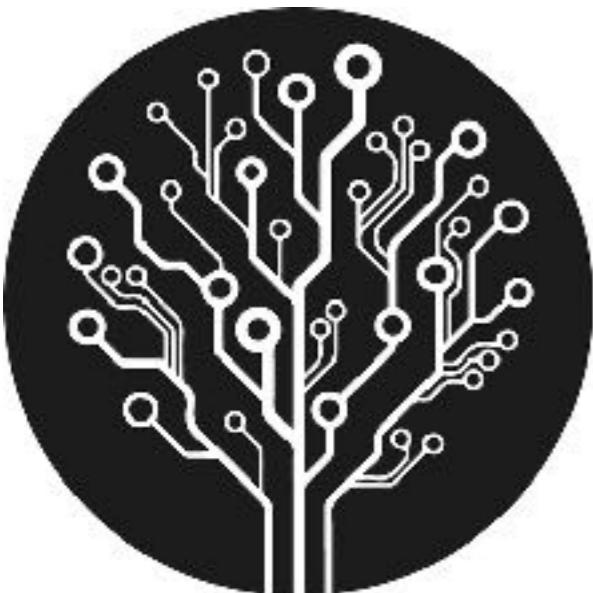
Learning to work with organisms:

- Slime mold
- *Janthinobacterium lividum*
- Kombucha



Syllabus

- <http://biohackacademy.github.io/bha5/class/kea/>
 - Slides
 - Instructions for the organisms
 - Video links
 - To be added: Your Documentation sites



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Microbiology



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What is life?



Is this alive?





Is this alive?



Is this alive?





Some characteristics of life

Reproduction

Heredity

Adaptation

Energy consumption

Internal self-regulation

genetic information

Cell devision



Growing bacteria



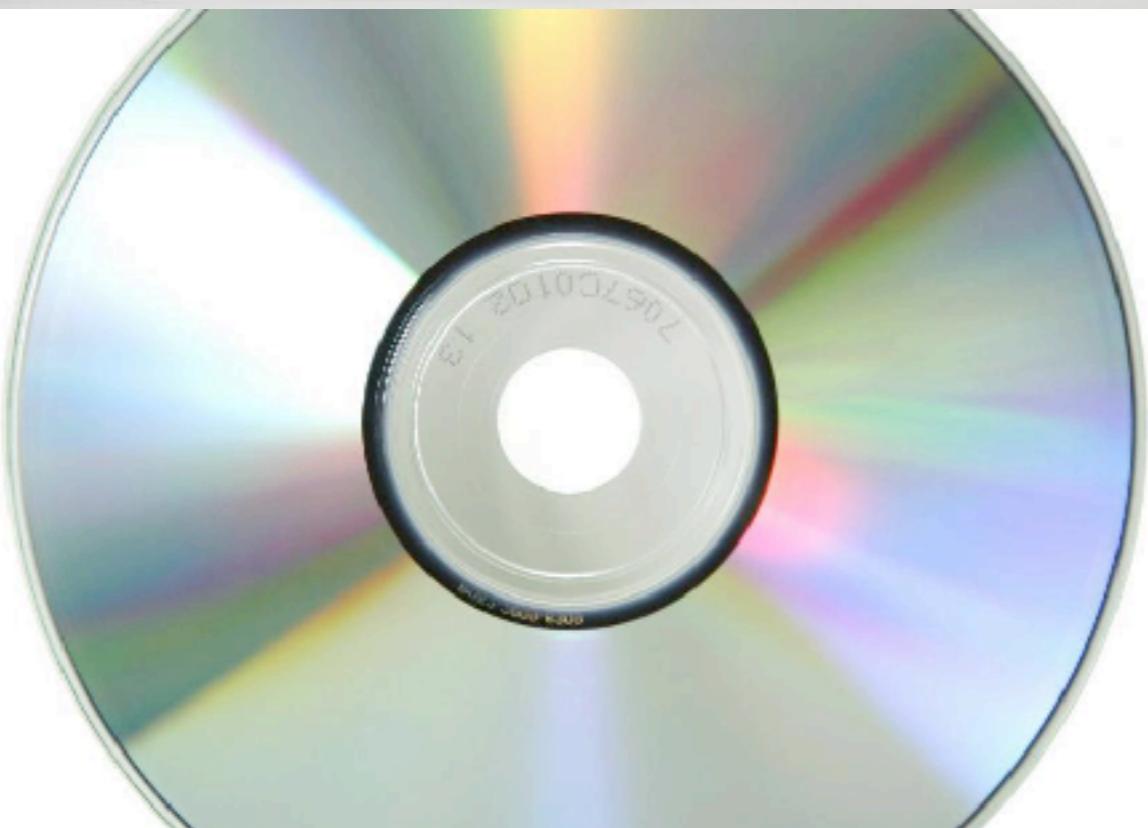


Terike Haapoja. "Entropy," 2004





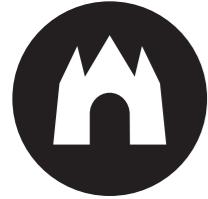
Information carrier





Life sticked to the same standard





Concepts related to life

Sustainability, environmental justice

Complexity, intelligence

Evolution

Symbiosis, parasitizing

Disease, death

Sociology, human behaviour

Human relation to ecology

Digitization

Origin of life

Ownership



Microbiology

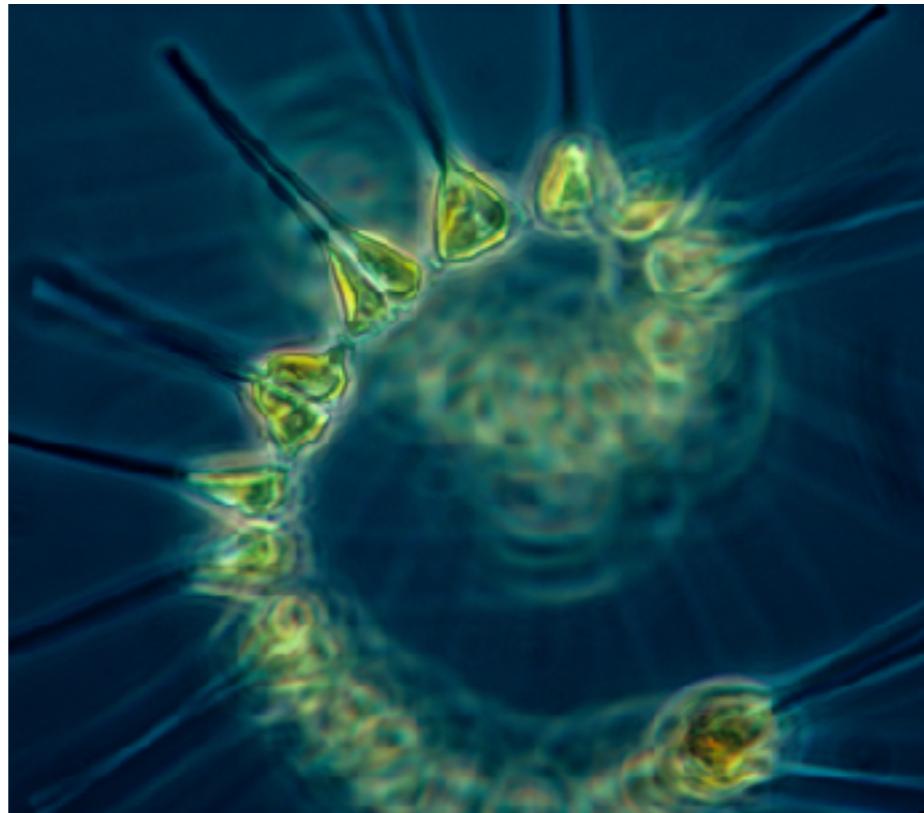


Definition of life

unicellular
(single cell)



multicellular
(cell colony)



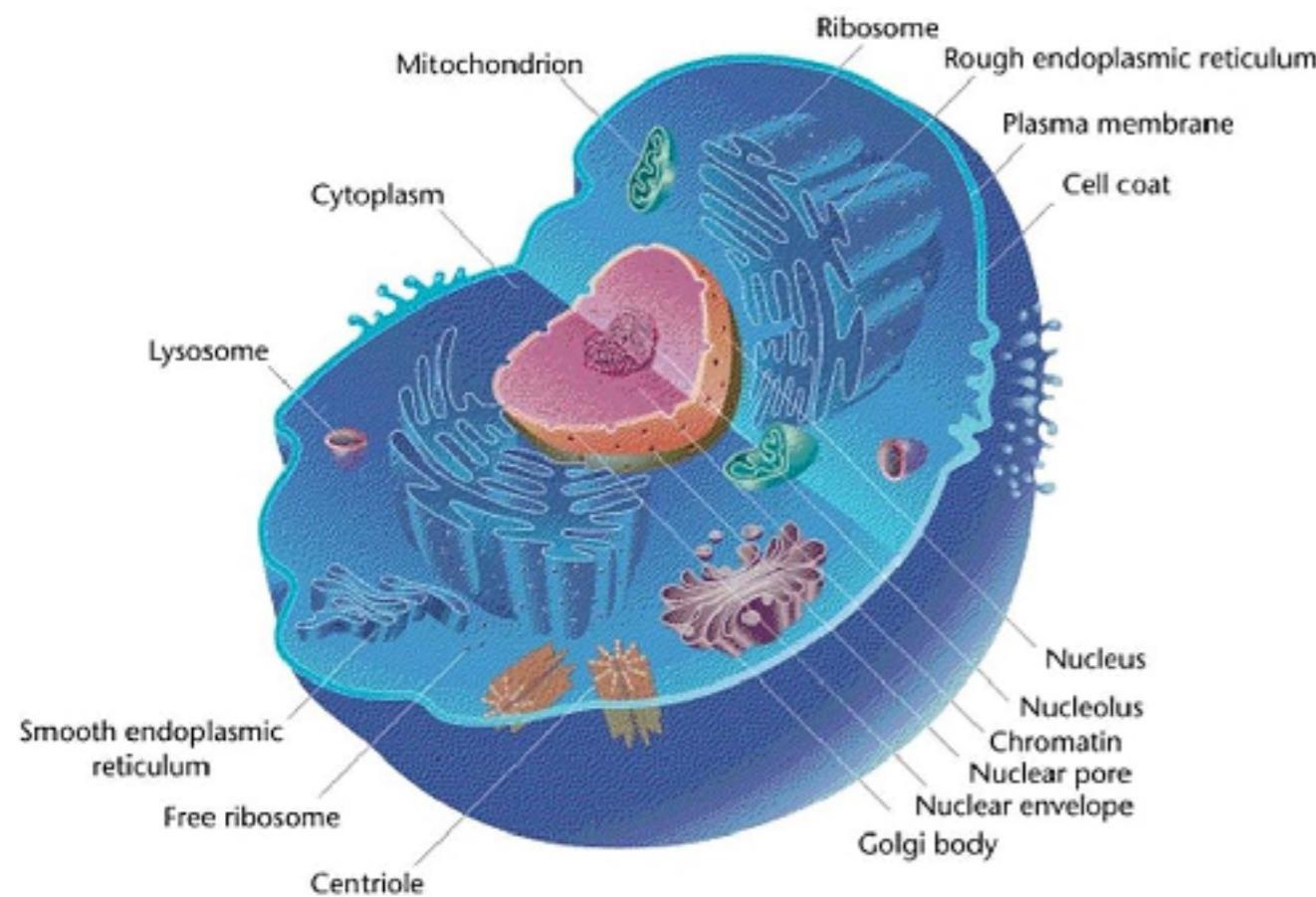
acellular
(lacking cells)



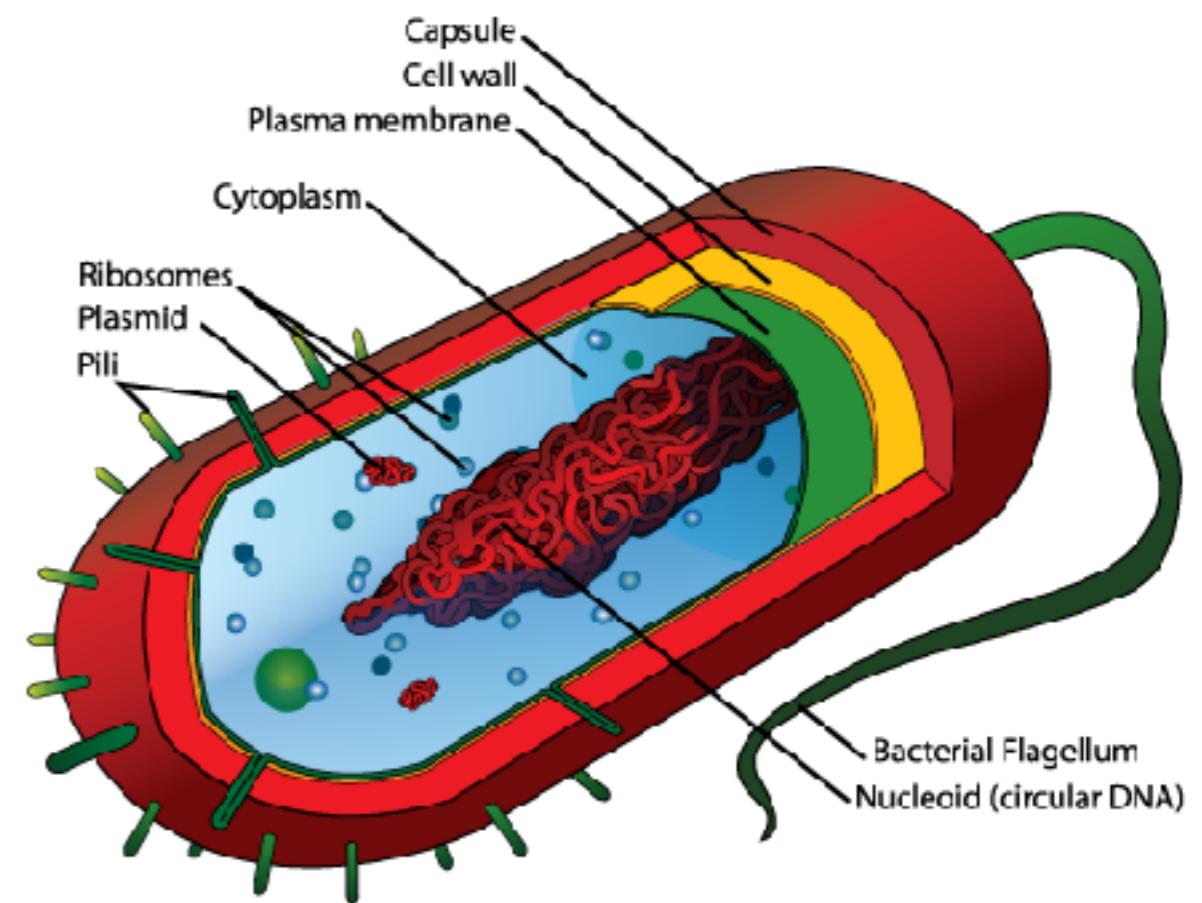


Two main categories

Eukaryotic cell



Prokaryotic cell



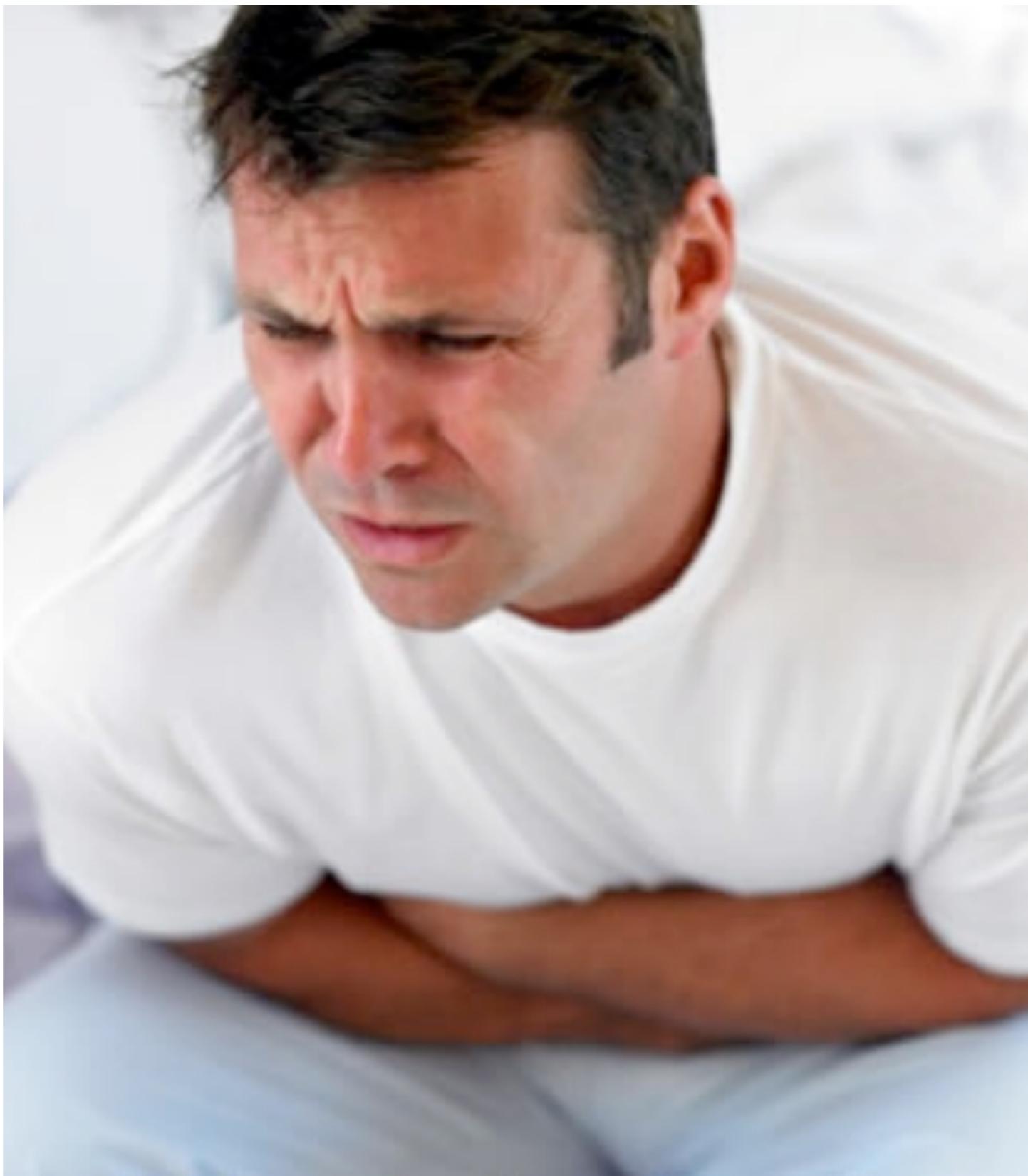


Microorganisms: Role in our daily live





Microorganisms: Role in our daily live





Sulfur (purple) bacteria bloom



Buse Lake 3 – Cal Kimona Brown



Cyanobacteria (algae)

Pollution?



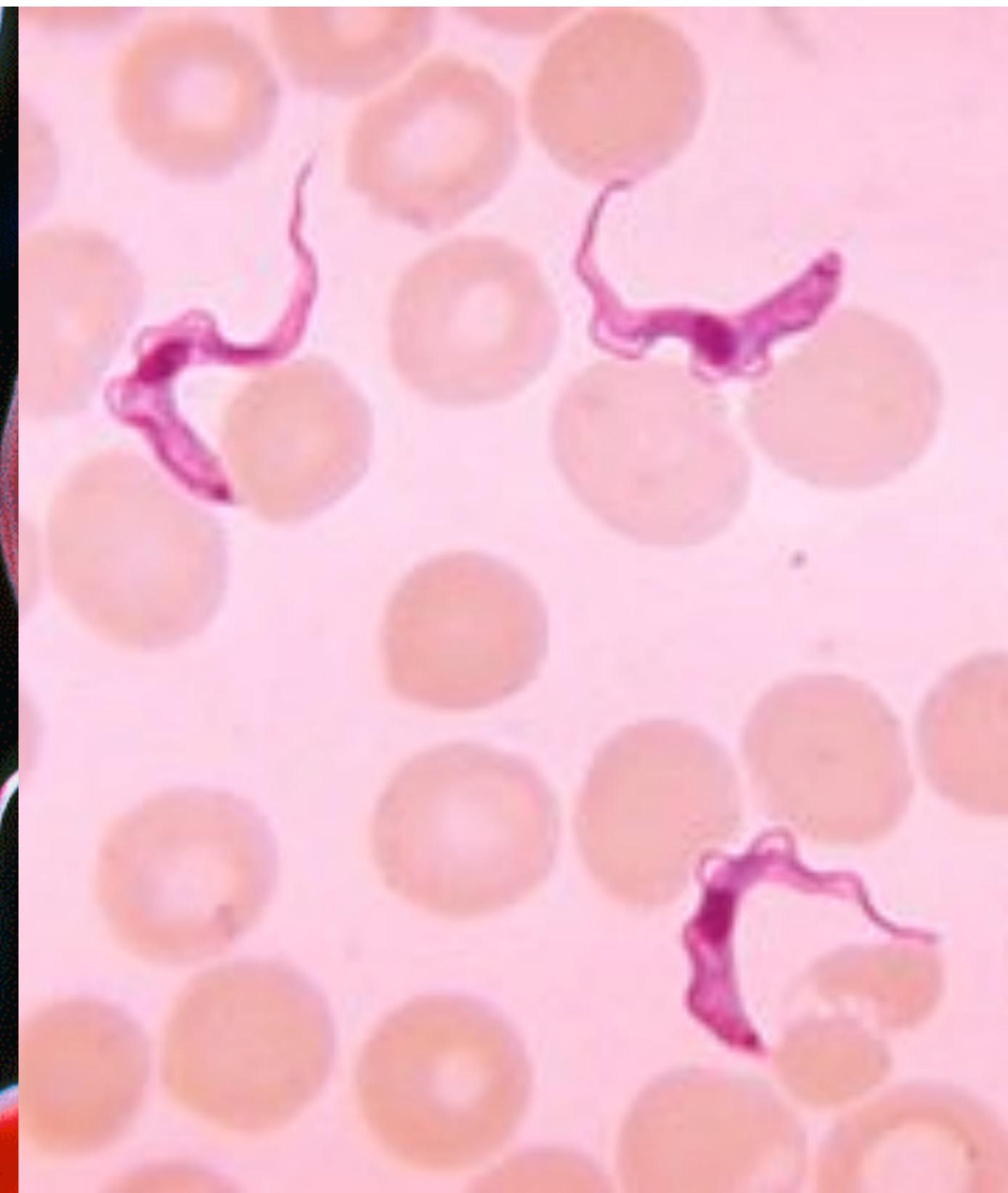
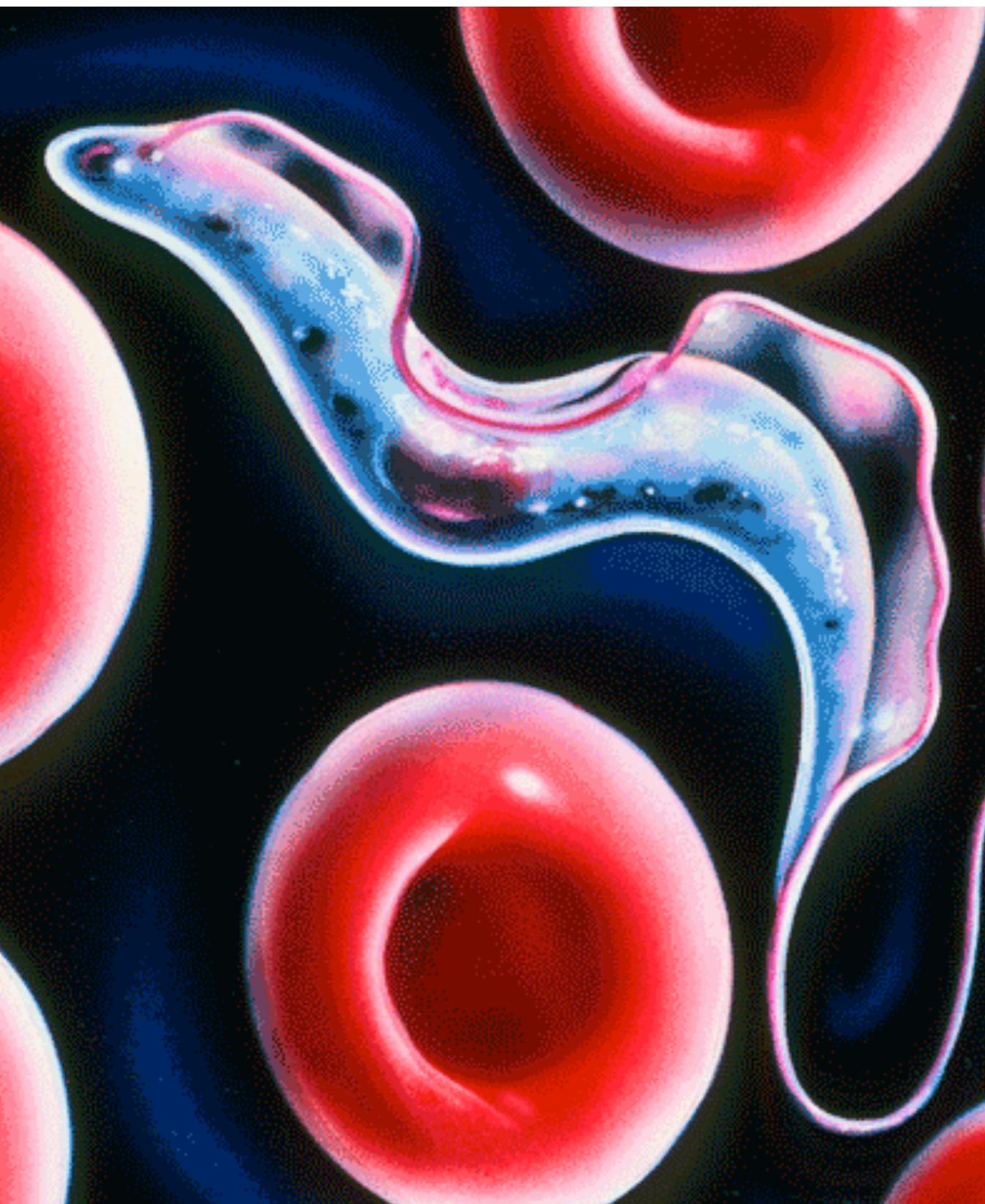


Fixate nitrogen





Cause disease – *Trypanosoma brucei*





Second brain?

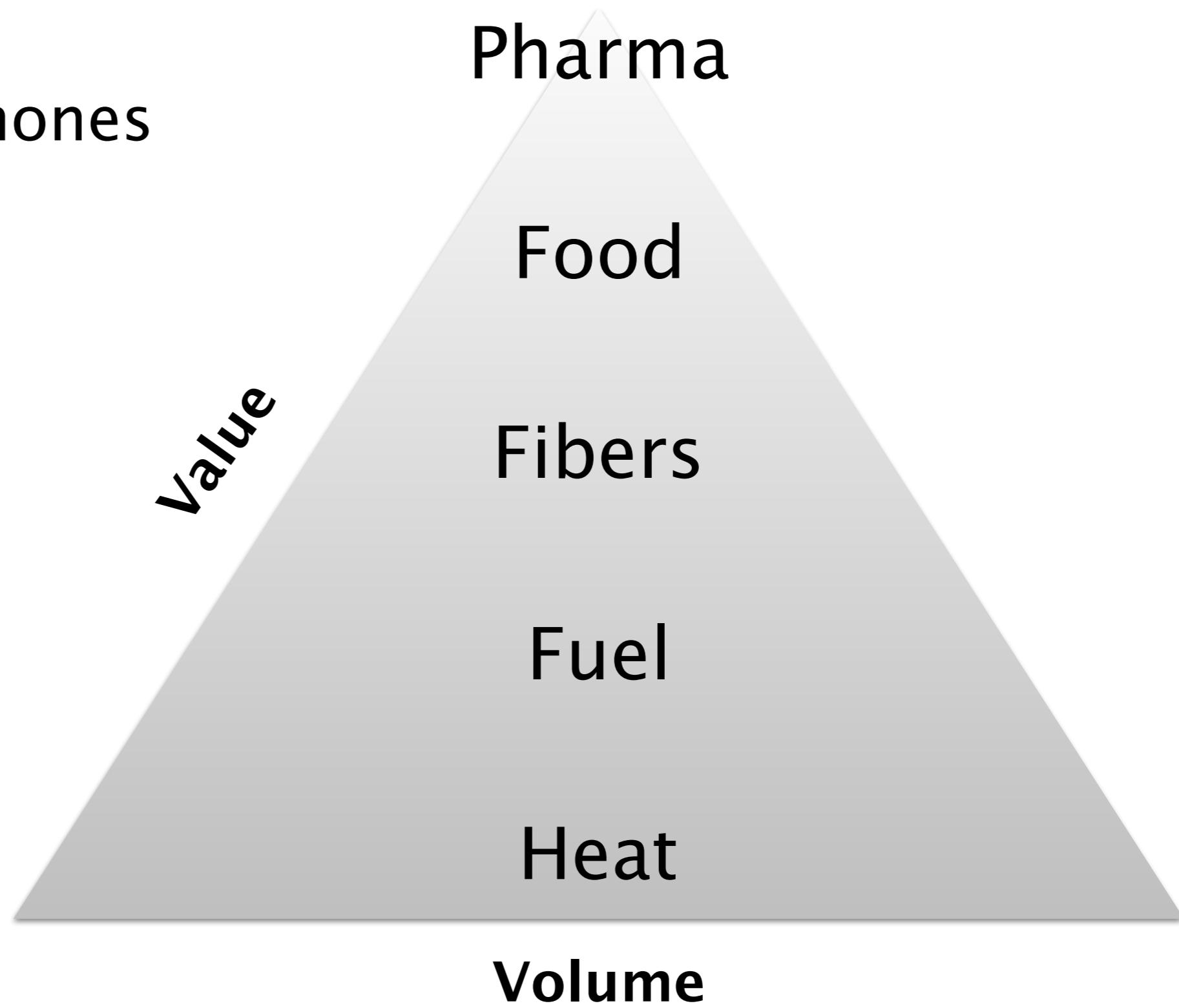
Shaun Moshasha





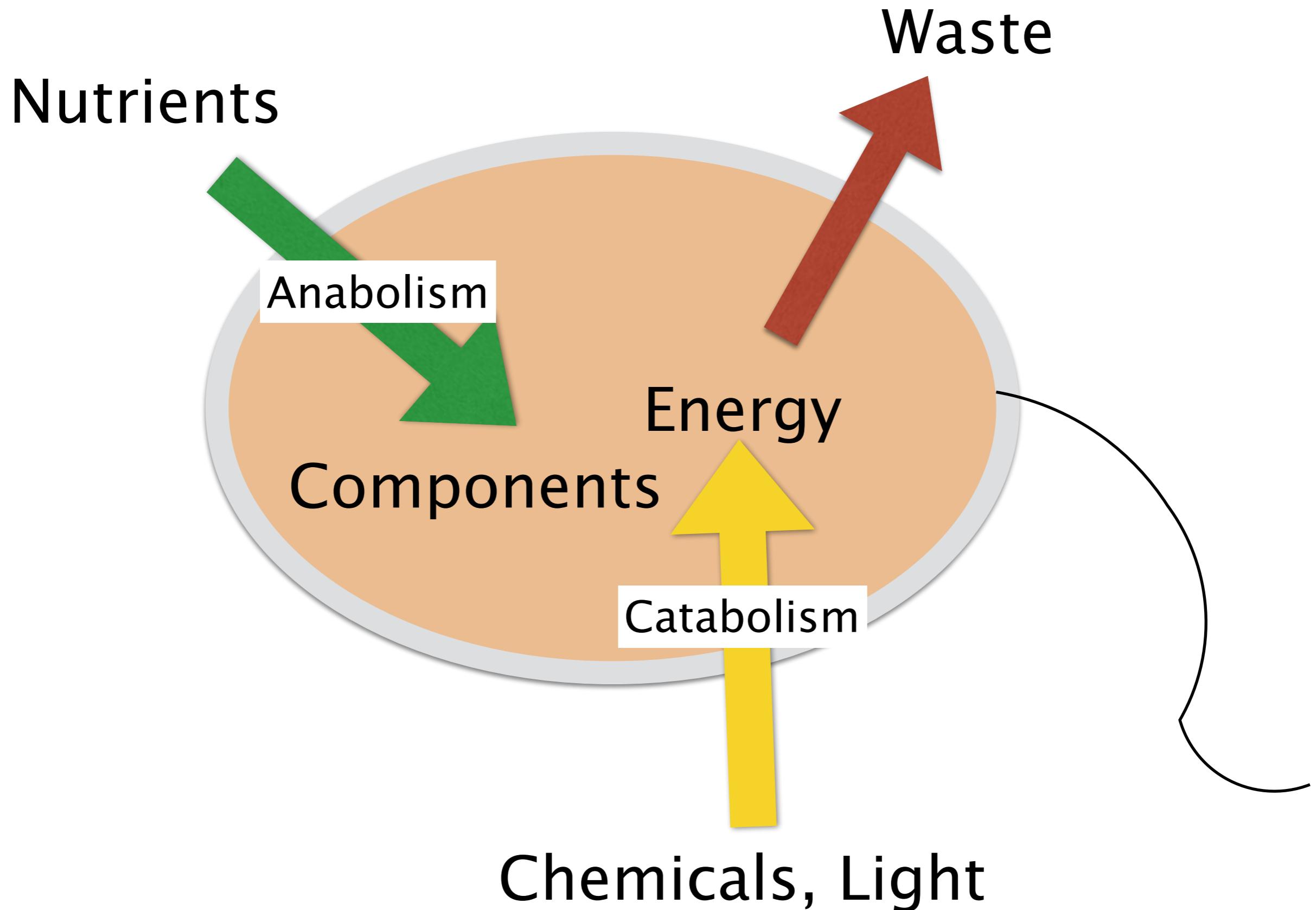
Bioreactor value pyramid

- Antibiotics
- Steroids / hormones
- Vitamins
- Proteins
- Sugars
- Acids





Cellular Metabolism

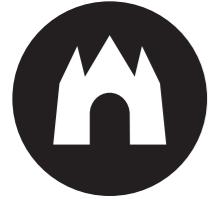




Biomaterials

“All materials that contain or might contain bio agents, or potentially dangerous material from biological origin”

[blood, serum, body fluids, tissues, organs, environmental samples, biological waste, [non- purified] proteins, allergens, [purified] toxins,
]



What's easy to produce?

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



Ivorish - Nina van den Broek





Bacterial Radio - Joe Davis





Fungi products





Maurizio Montalti - Growing Lab





BioSteel fiber





Fragrant Moss

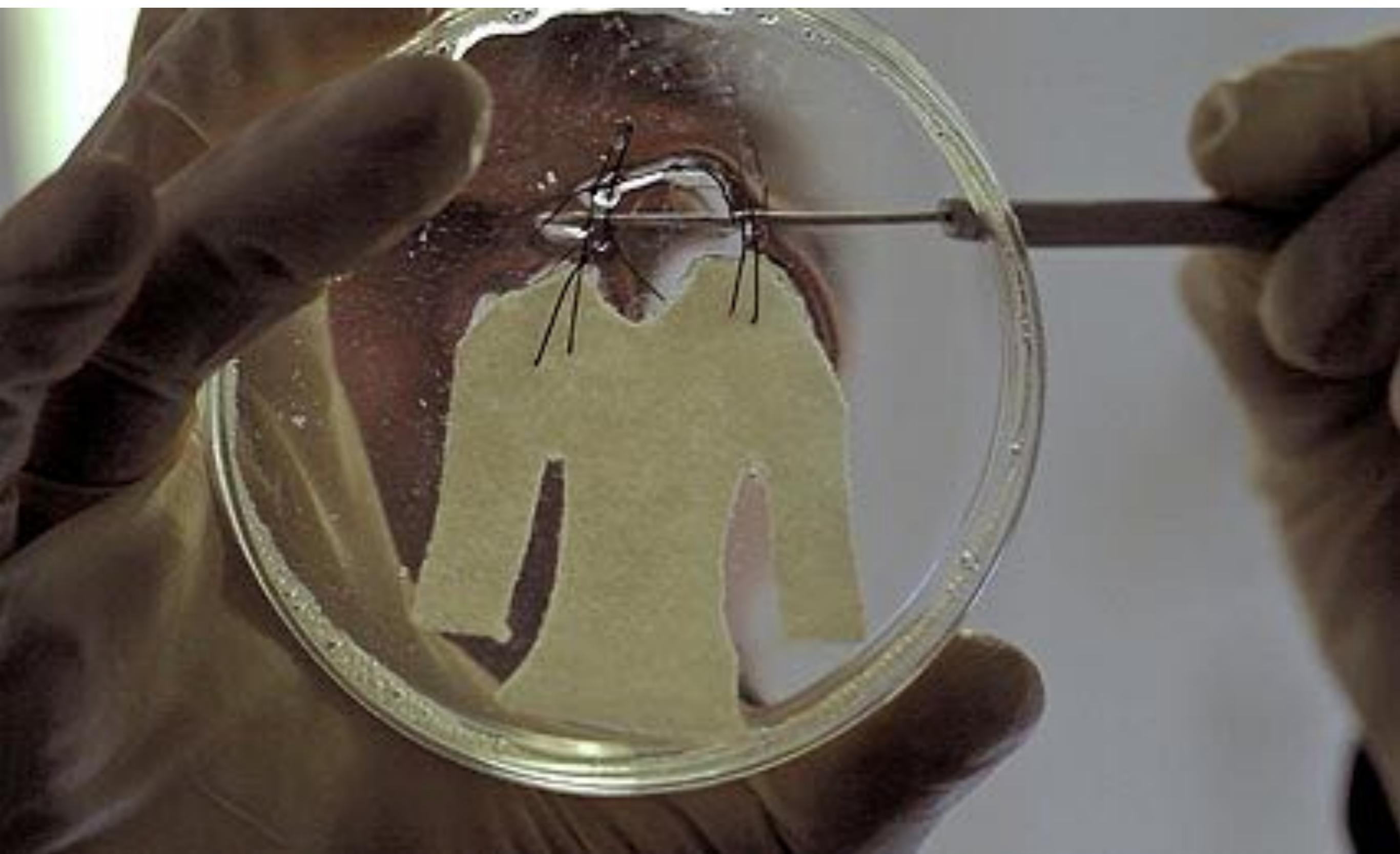
orbella
fragrant moss



Grow Your Own
Aromatic Terrarium



Victimless Leather





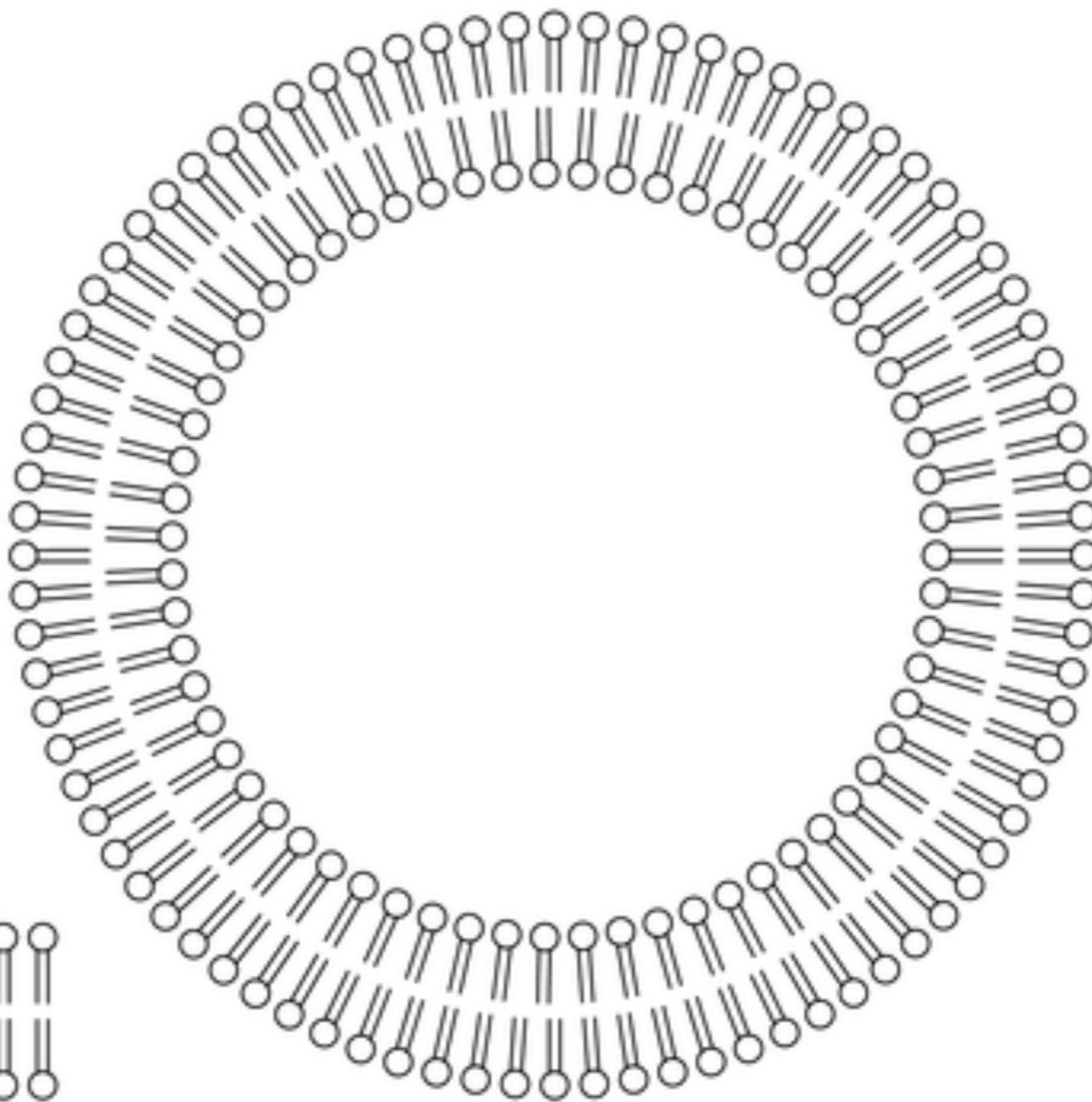
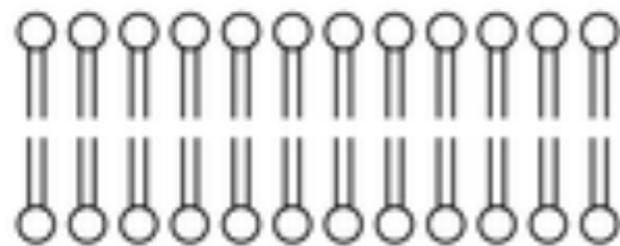
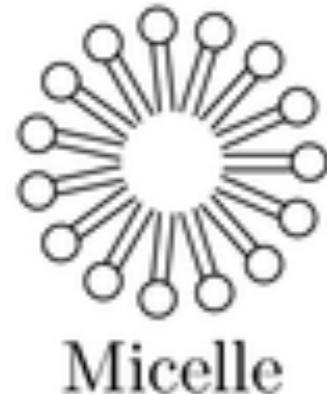
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The Cell

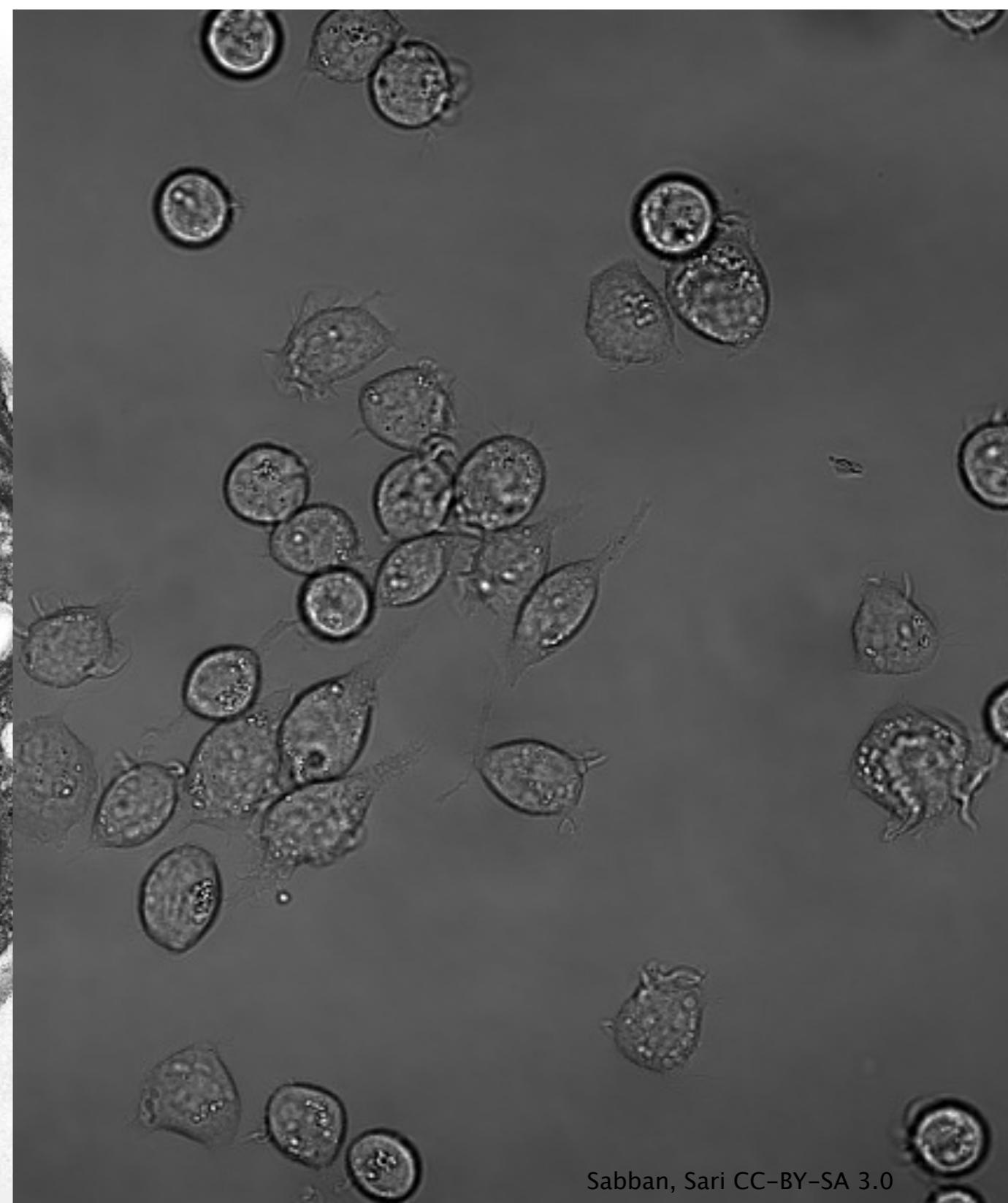
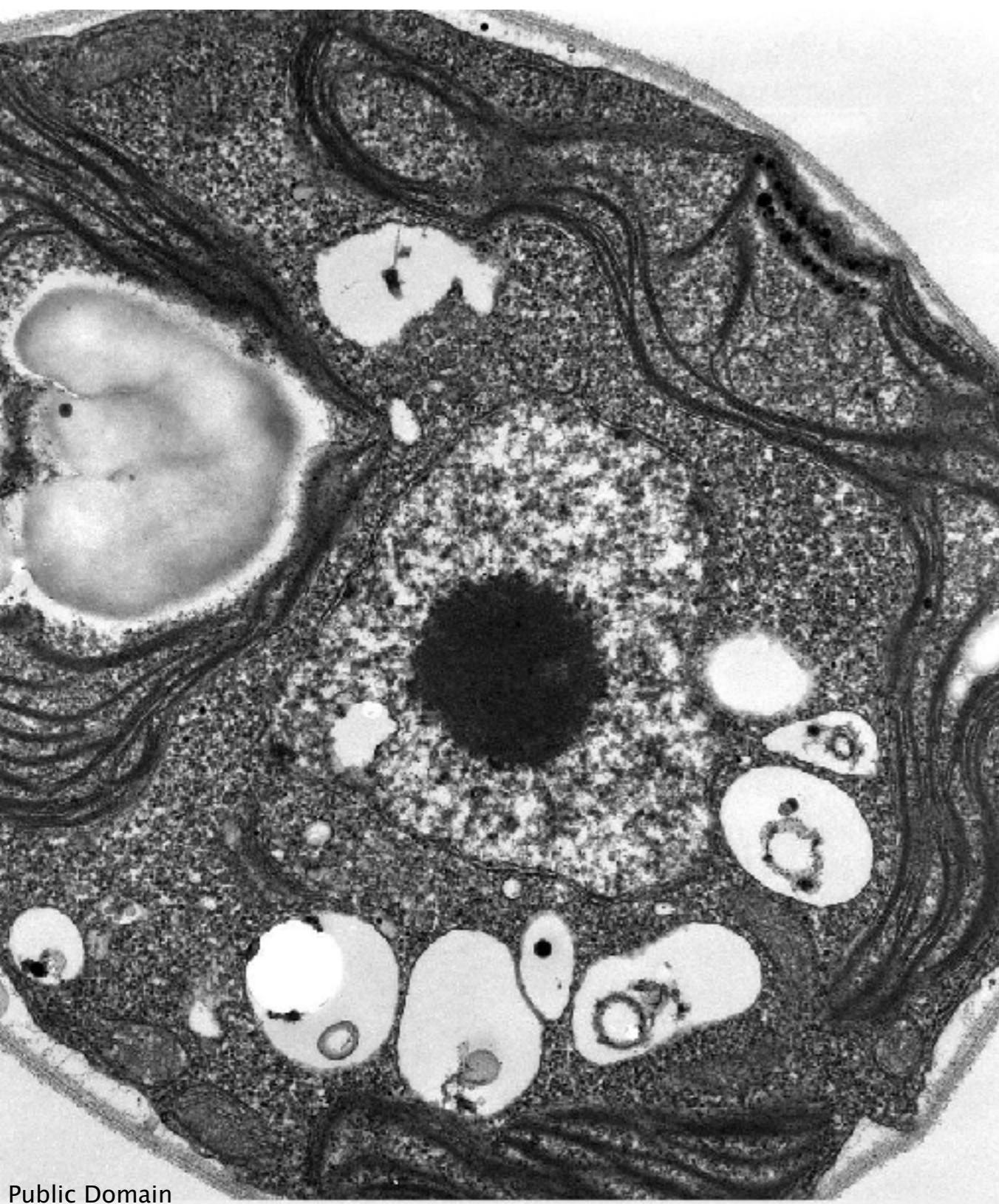


Lipid bilayer cell





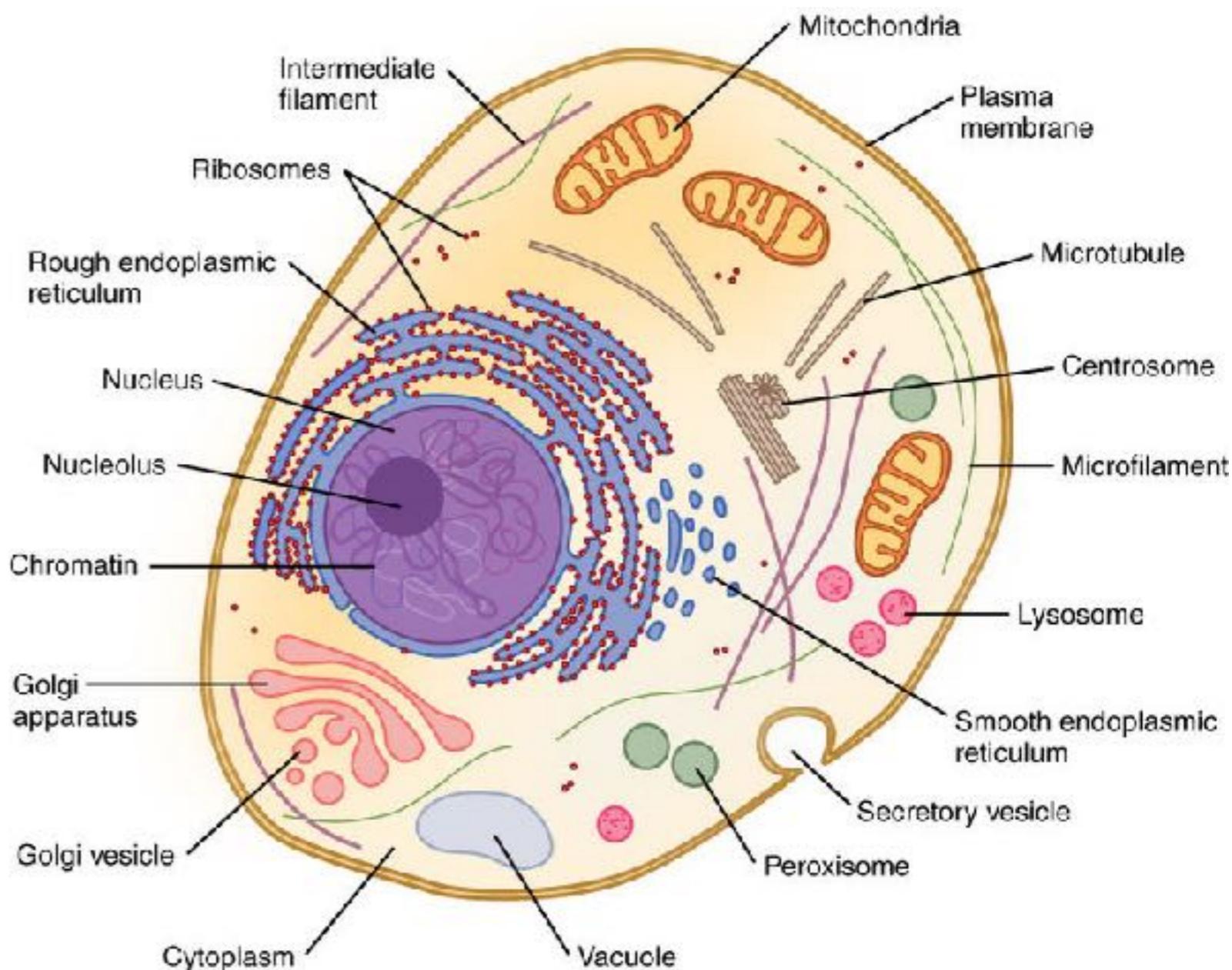
Life is made out of cells





What cells are made of

- Lipids
- Proteins
- DNA
- RNA
- Carbohydrates
- Metabolites
- Ions





IT vs Bio

Digital code (atgc)

Open standards (codons)

Modular code (genes)

Error protection (DNA repair)

Data compression (overlapping ORFs)

Redundant backups (double helix, copy number)

Self-diagnostics (apoptosis)

Firewalls (species)

Operating system (ribosomes)



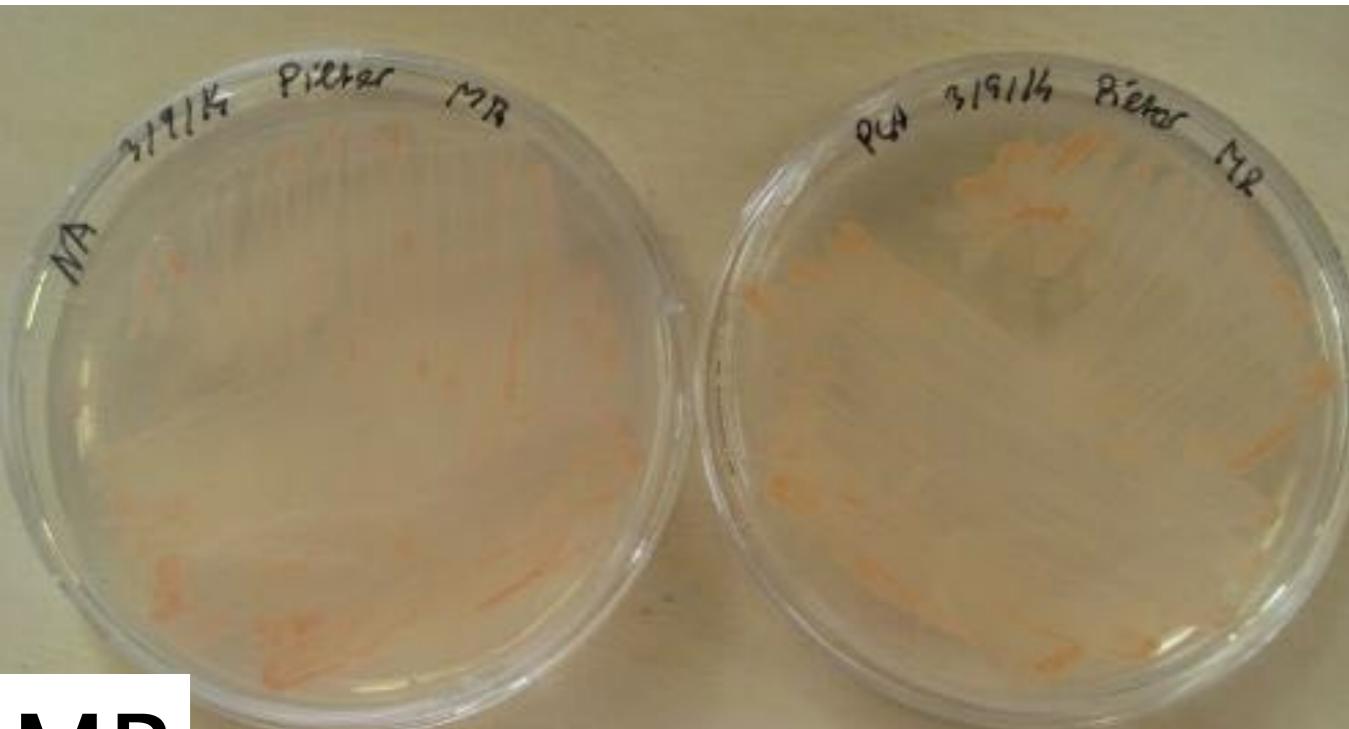
Culture Collection



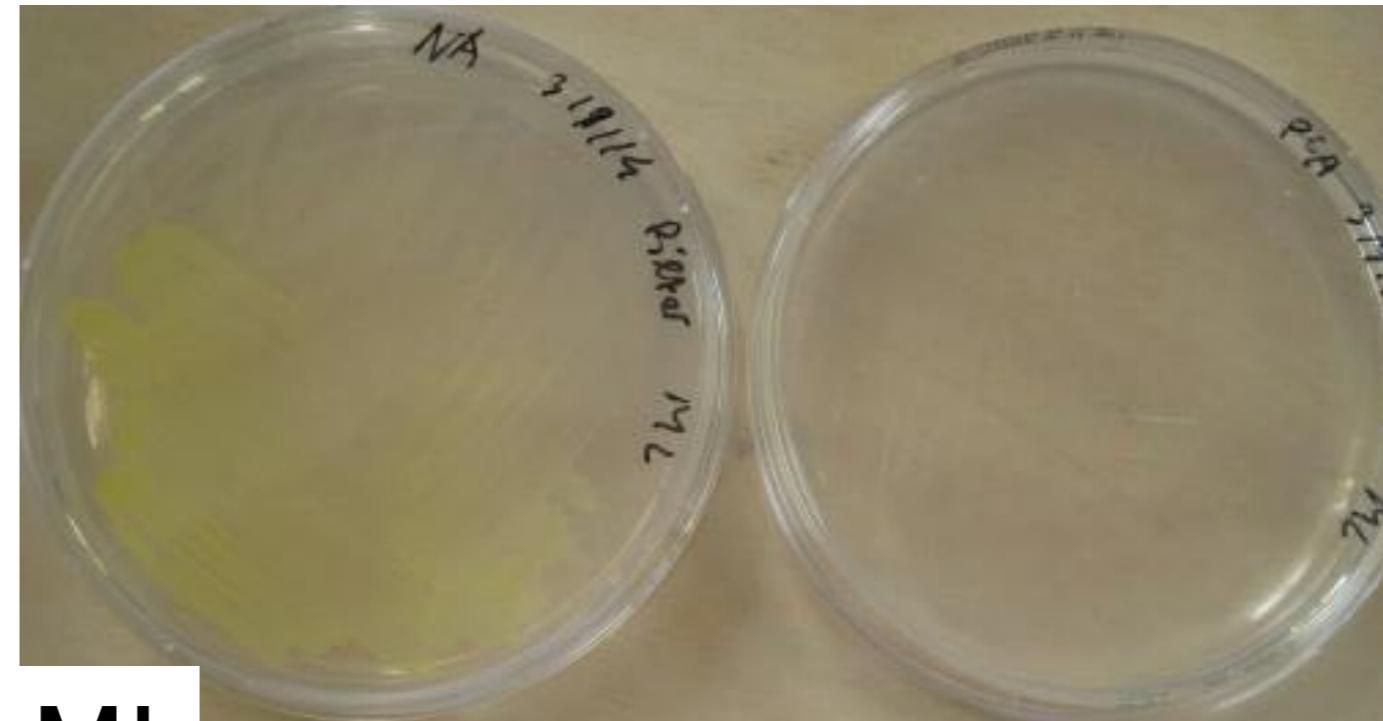
Pigmented bacteria

Pigments
Antibiotics

Janthinobacterium lividum (JL)



MR



ML



JL



SCOBY

Cellulose
Vinegar



Symbiotic Culture of Bacteria and Yeast



Slime mold

Physarum polycephalum

Intelligence





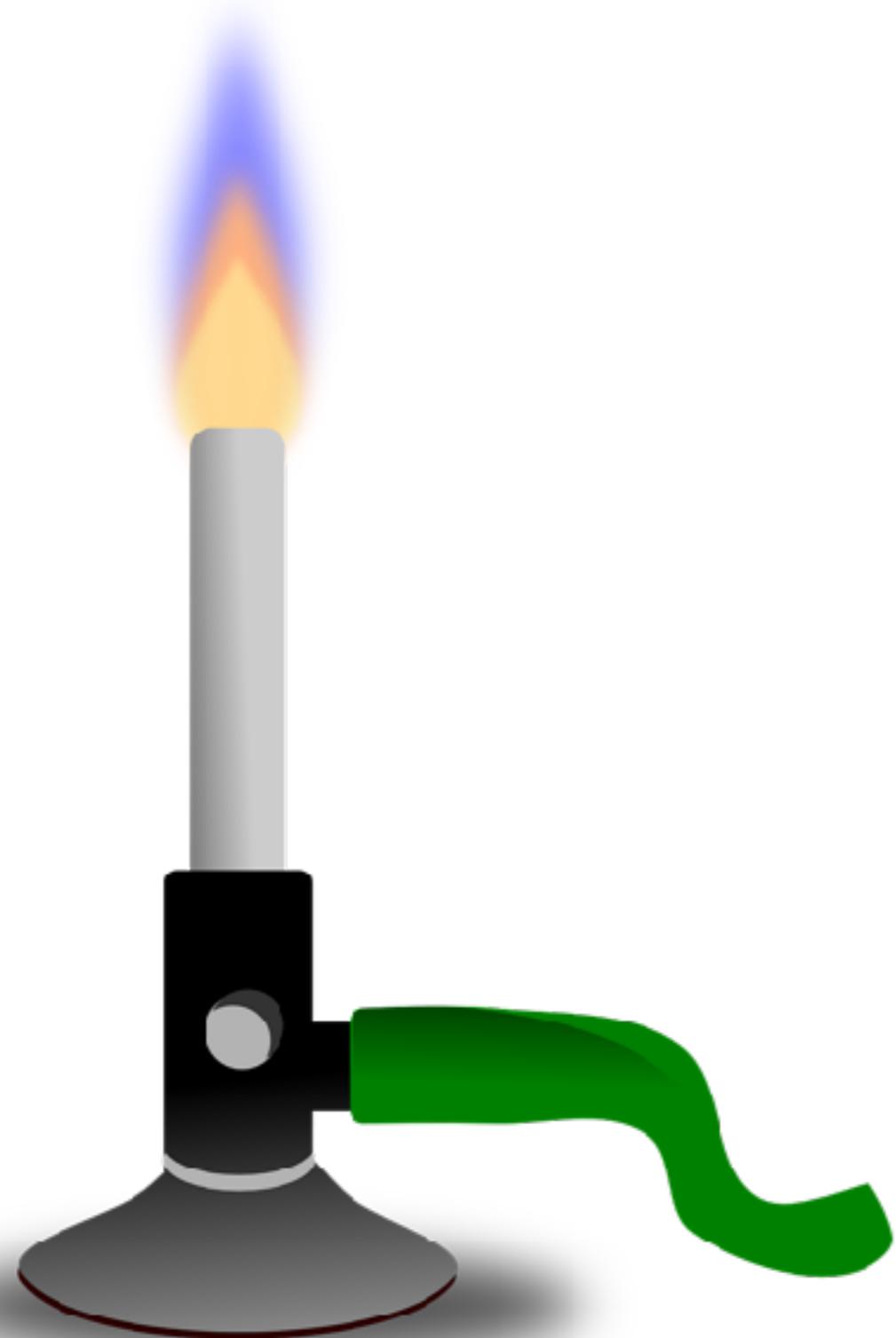
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Working with Microbes



Working sterile with gas burner





Preparing plates

Autoclaving for 20 min

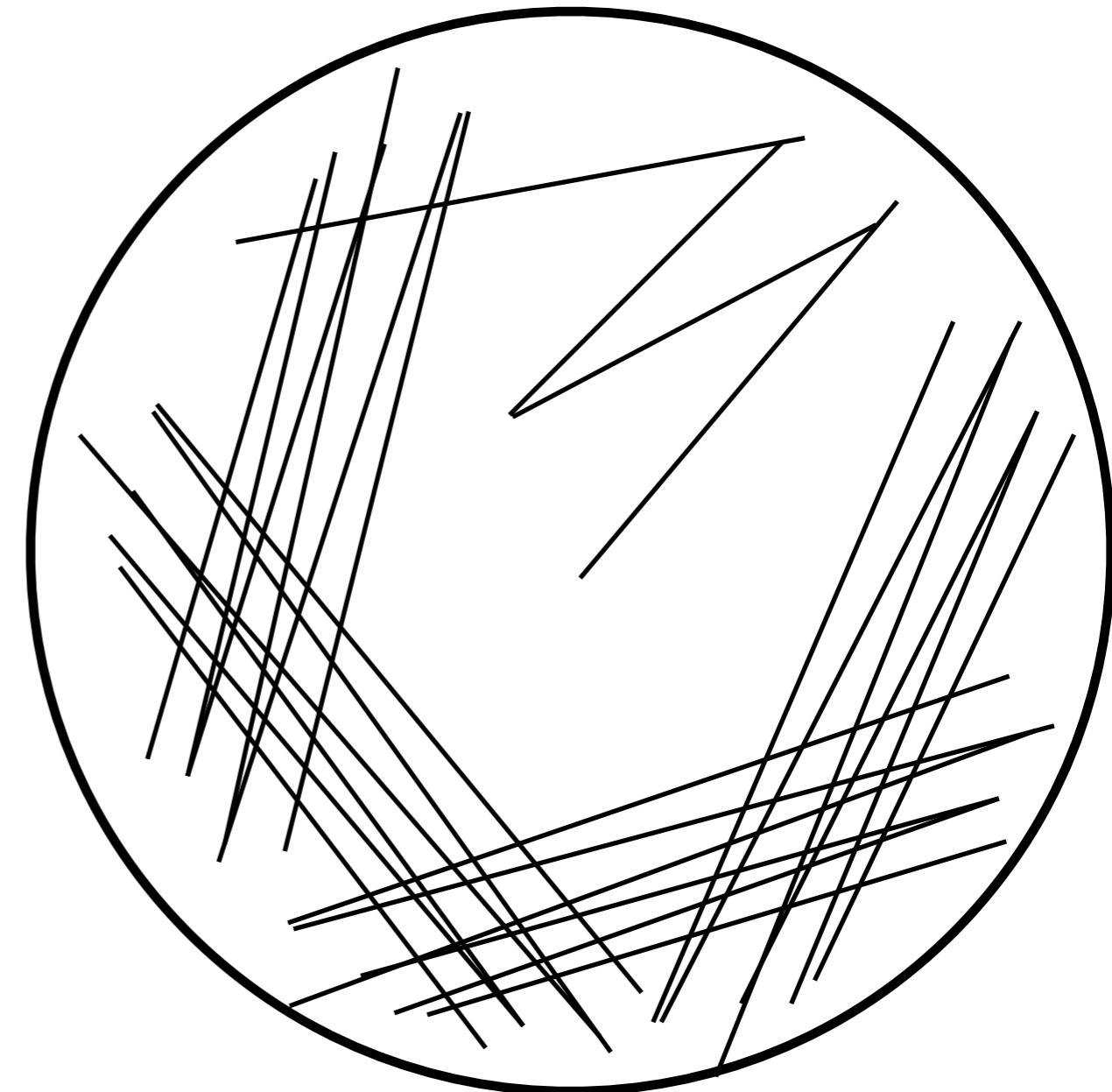
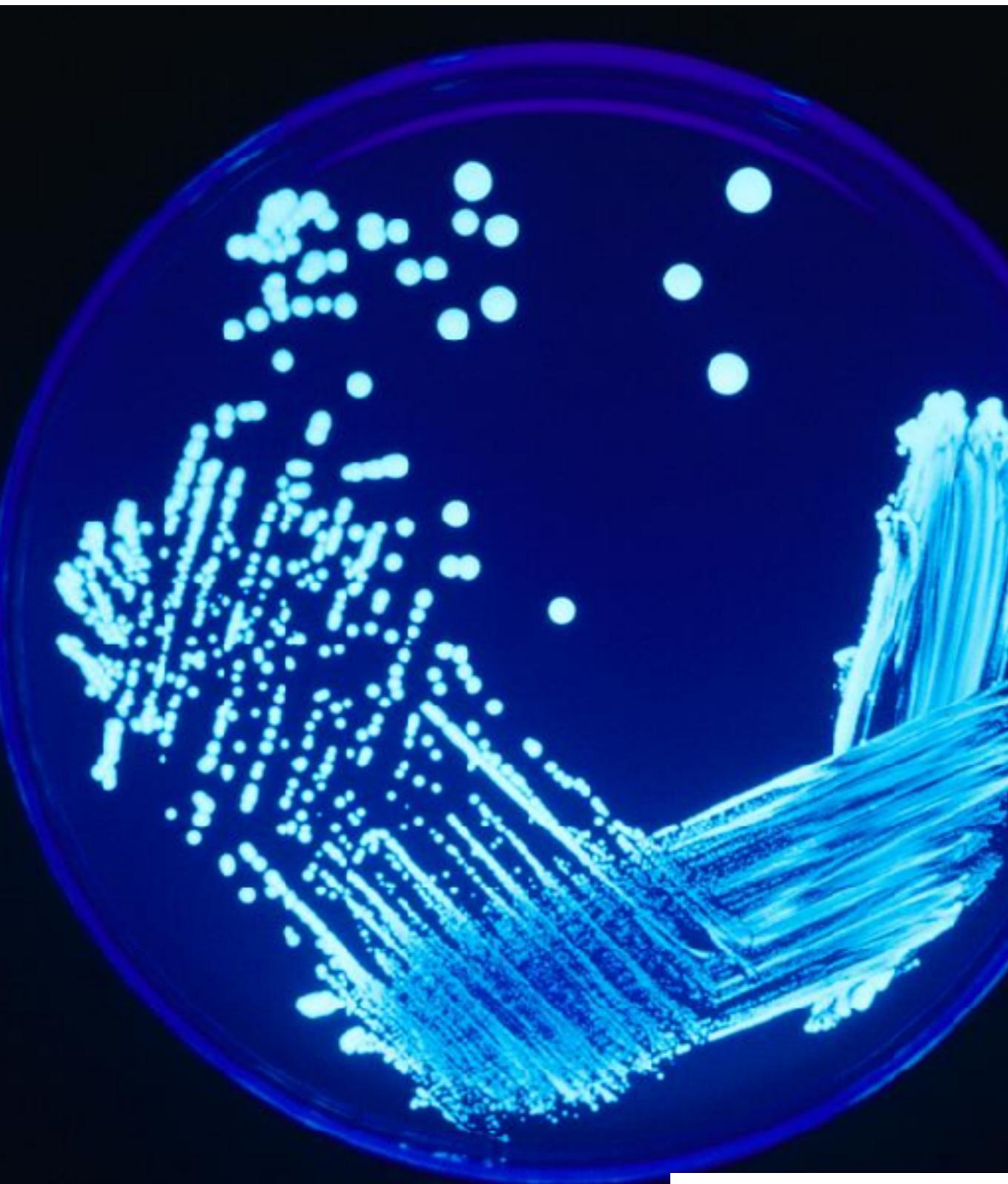


Pouring petri dishes





Inoculation





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Biosafety



Importance of safety

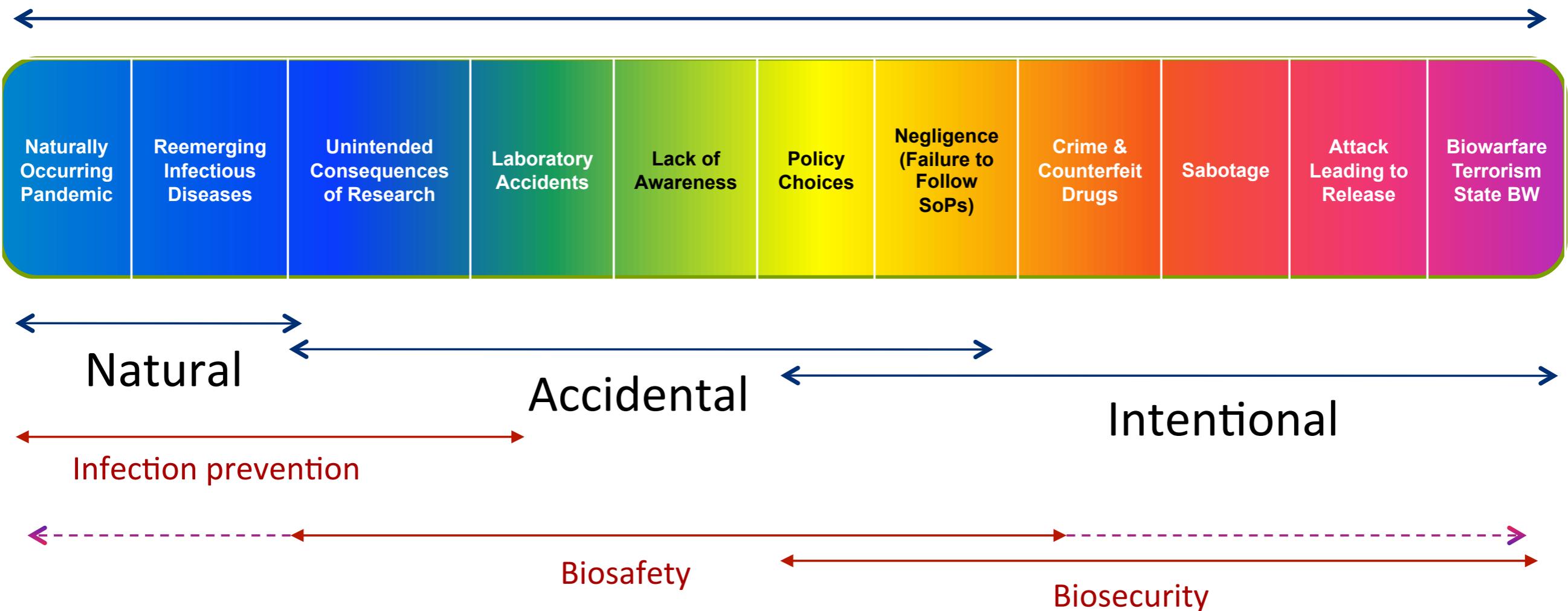
Safe procedures protect:

1. The environment
2. Your colleagues
3. Yourself



Spectrum of Risk

Biological risks can be seen as a spectrum:



By courtesy of Tim Trevan, ICLS



Ways of infection

Exposure, sources and routes of infection 41

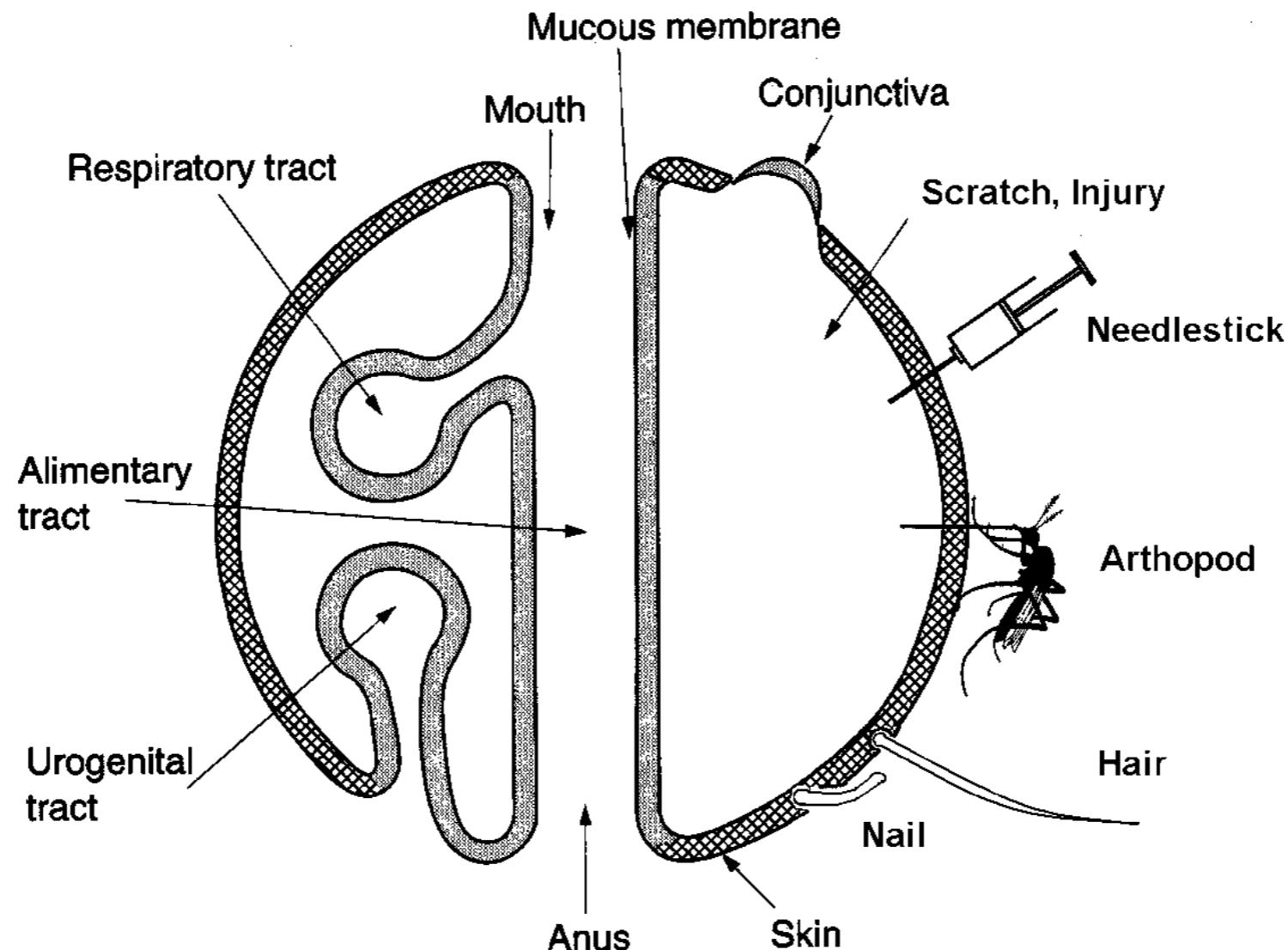


Figure 2.1 Routes of infection: the body's portals of entry of microbes. (From Mims, 1982, by permission of Academic Press)



Aerosols





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





Contamination in the lab

- Bio safety level number indicates the level of regulations that are 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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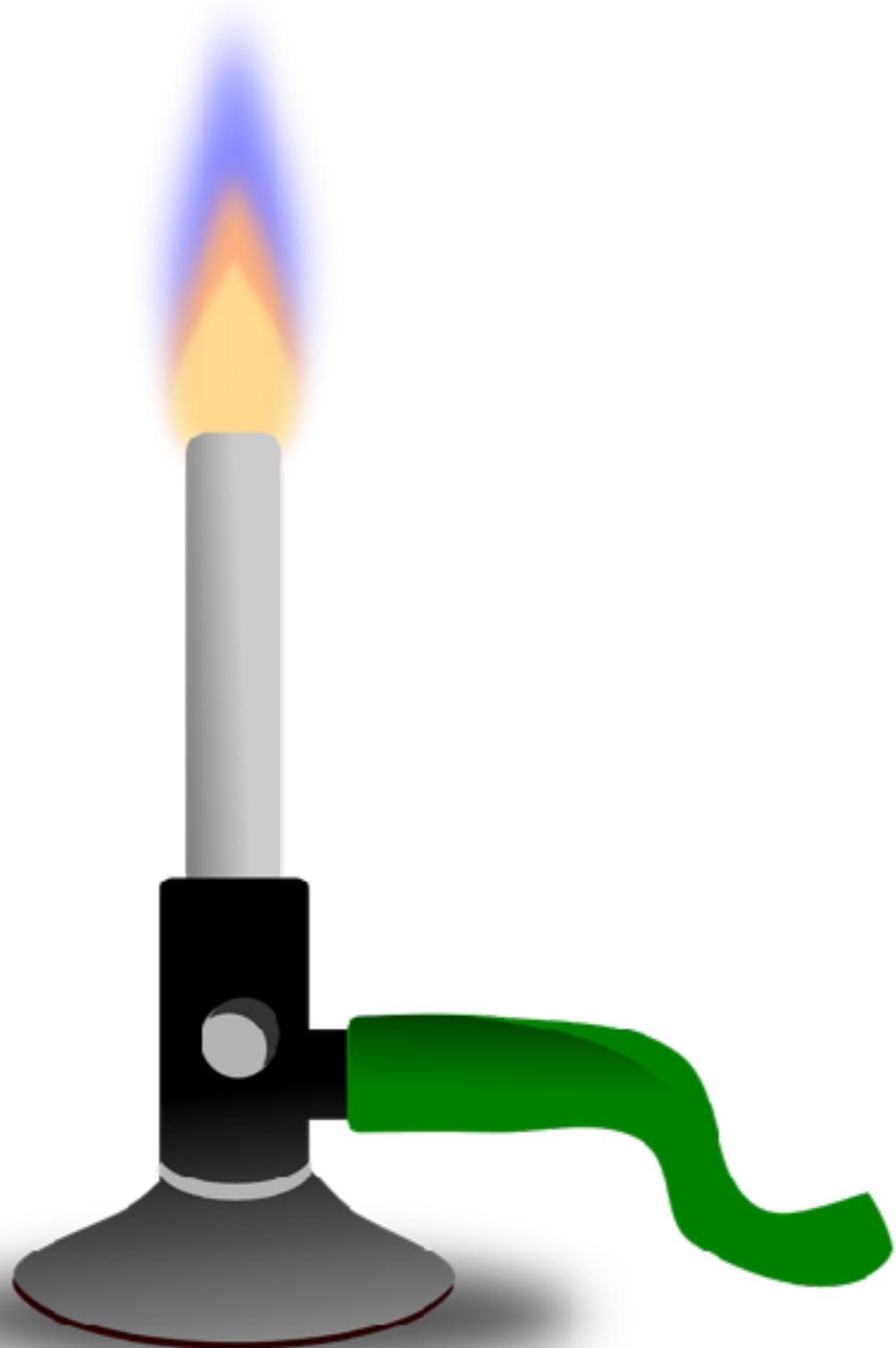
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Personal Protection

Equipment for protection yourself



Working sterile





Personal Protection

These items are recommended in the lab





Wash your hands!

Remember, before and after experiments:

- Wash your hands
- Even after wearing gloves



Arlington County - CC-BY-SA-2.0



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Chemicals



Label everything

- Use labels on everything!!
- You are the only one who knows what is in the container
- Labels must consist of:
 - Content
 - Date
 - Name



Global Harmonized System Labels

Familiarize yourself with the meaning of these symbols:



Explosive



Flammable



Oxidizing



Skin
Irritation



Pollution



Corrosive

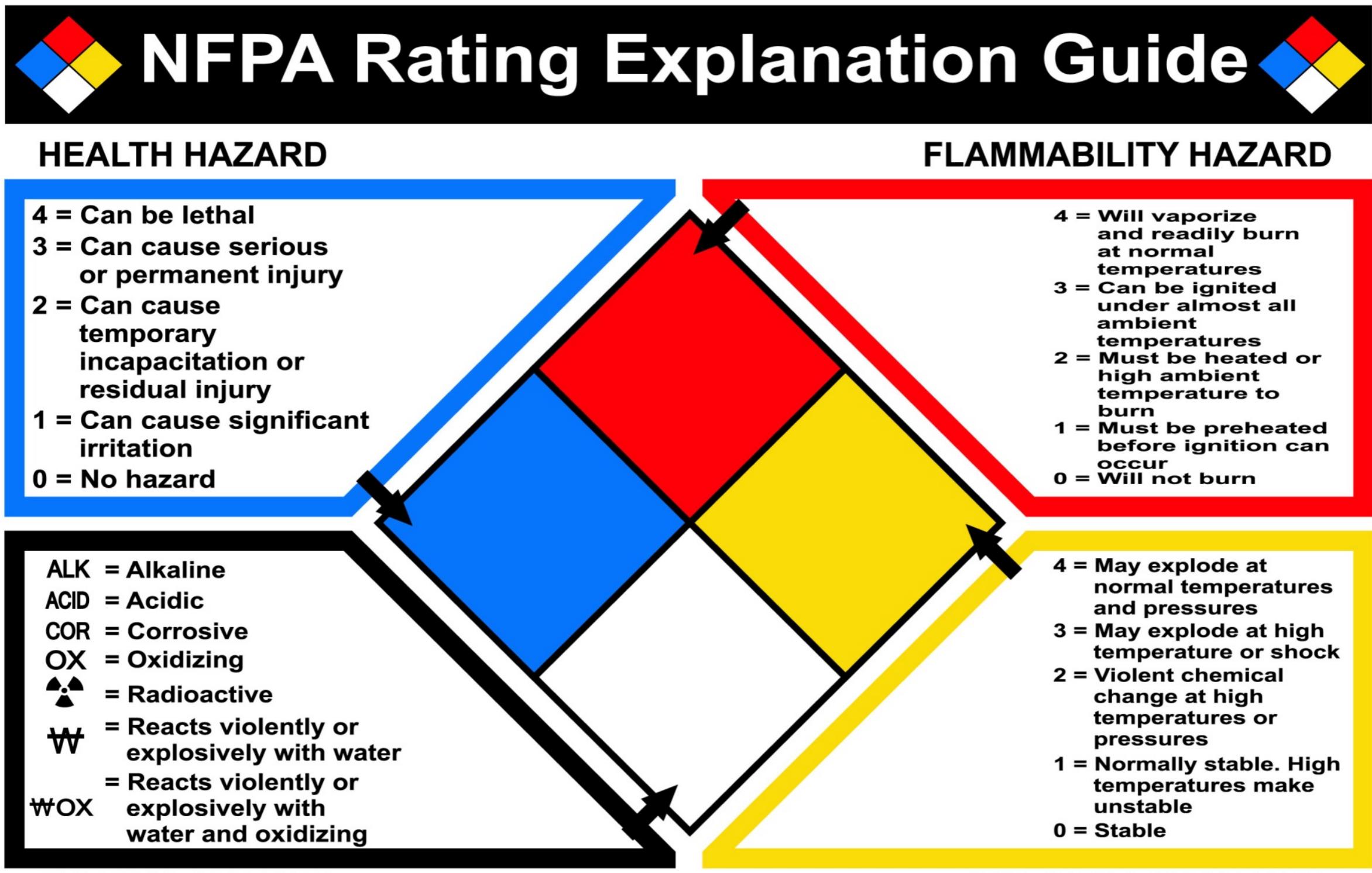


Compressed



NFPA safety diamond

NFPA diamonds are often used as well



This chart for reference only - For complete specifications consult the NFPA 704 Standard



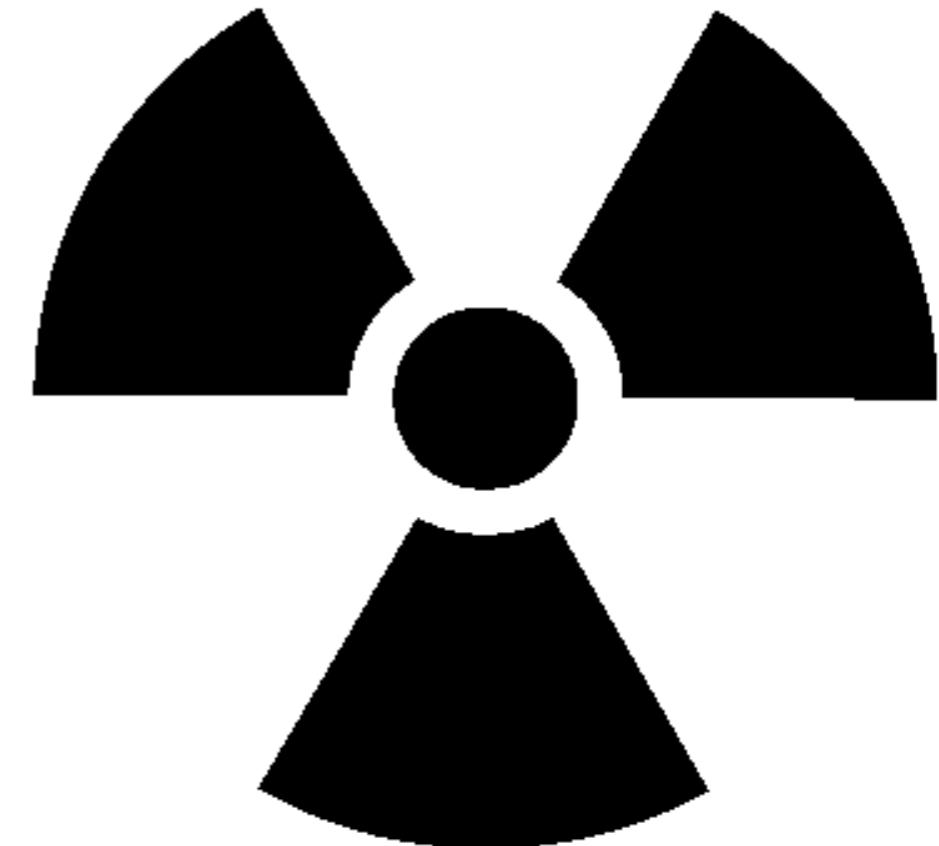
Special labels

Do not bring anything with such label to the lab

BIOHAZARD



DANGER



**RADIOACTIVE
MATERIAL**



MSDS

- Material Safety Data Sheets come with every chemical and contain information about all safety aspects such as:
 - Procedures for safe handling
 - Physical Data
 - Melting point
 - Boiling point
 - Toxicity
 - Reactivity
 - Storage
 - First aid procedure
- Read the MSDS before you use any chemical!





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Waste Disposal



Waste disposal

- Think of how to dispose of things before you bring it into the lab



Biological Waste

You are responsible for killing anything you grow:

- Kill off any culture with 10% hypochlorite bleach
 - Incubate for 24h before disposal
- Clean any used surface and object with 70% ethanol (red capped bottles)
- Autoclave for 20 minutes





Broken glassware

- Do NOT dispose in the normal trash bin
- Special “broken glass” container
- Use broom to clean up, because you can easily cut yourself





Chemical waste

- Check what is allowed to store in the lab with the labmanager
- Check what is allowed to go down the sink with the labmanager
- Do NOT mix / bomb guide:
 - Concentrated Acids and Bases
 - Oxidizers and Flammables
 - Water reactive substances and aqueous solutions
 - Cyanides and acids => cyanide gas
 - Bleach and acids => chloride gas
- Search for reactivity on the internet!
- Read the MSDS before using a chemical!



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