Introduction to Microbiology

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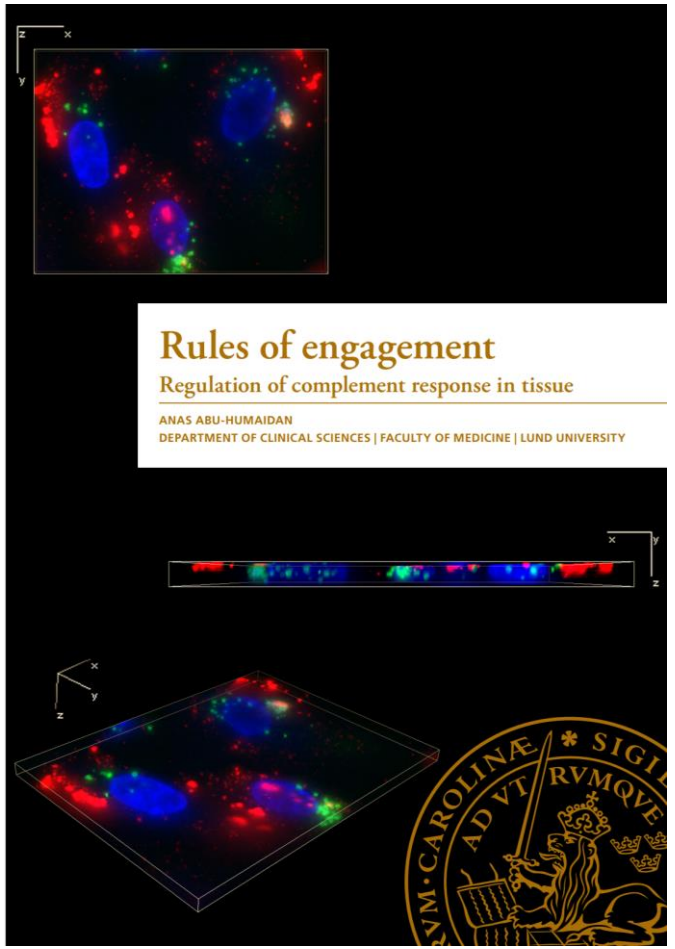
Lecture 1


FACULTY OF MEDICINE


BMC


Rules of engagement
Regulation of complement response in tissue
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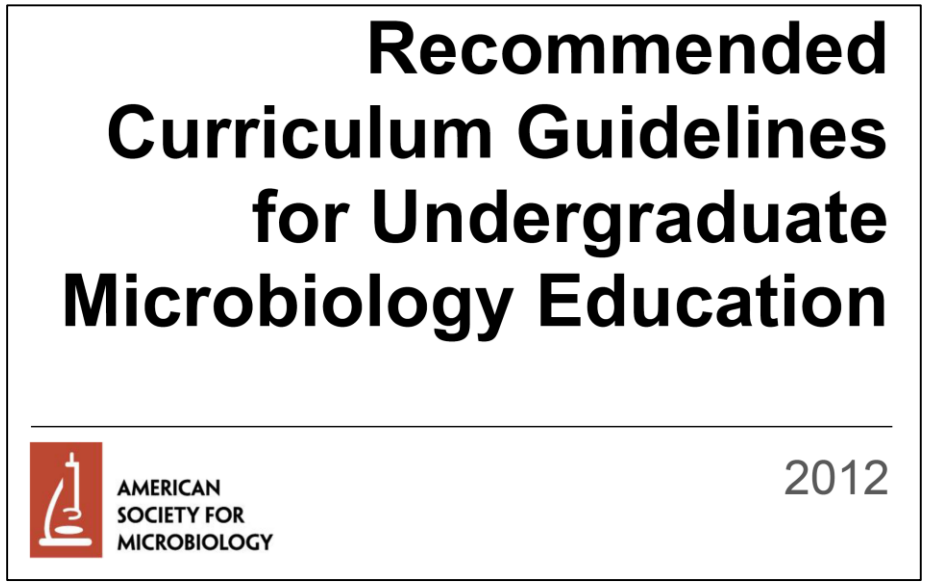
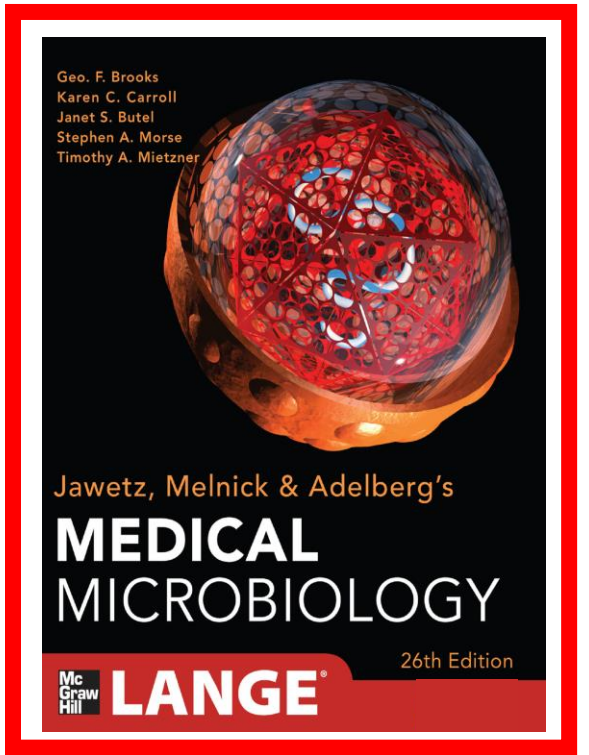
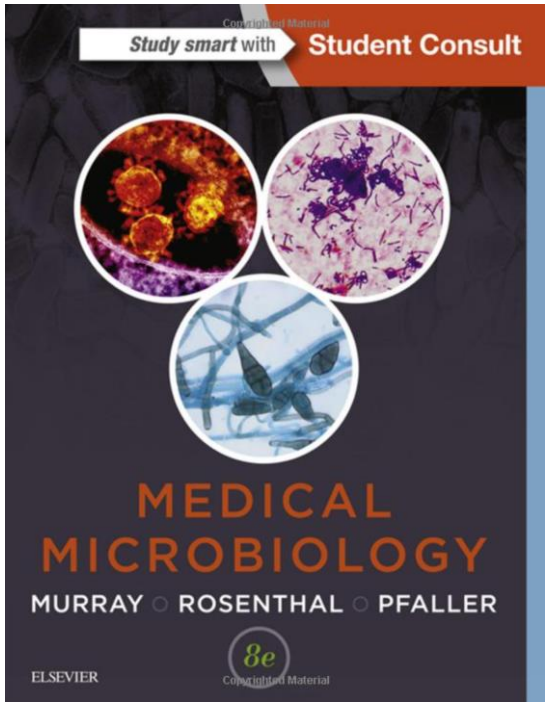
Resources used for this course

- “These reports urge faculty to refrain from presenting science as a sea of facts and work towards ensuring that students have a foundational understanding in biology.”

- Lectures will provide a general outline of main intended learning outcomes, but textbooks are essential for better understanding of the subject.

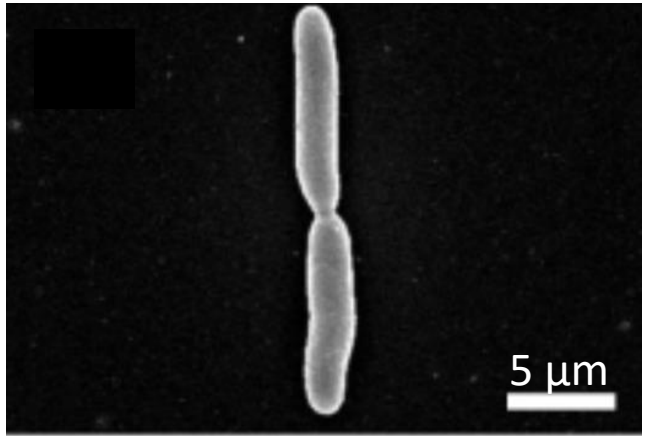




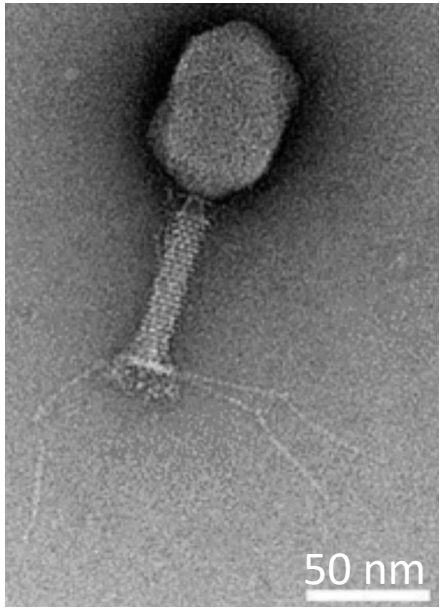


What is Microbiology ?

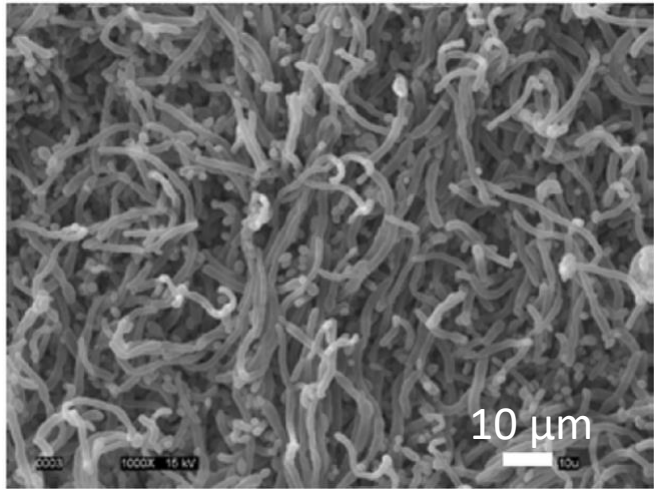
Microbiology is the study of all living organisms that are too small to be visible with the naked eye. This includes bacteria, archaea, viruses, fungi, prions, protozoa and algae, collectively known as 'microbes'.



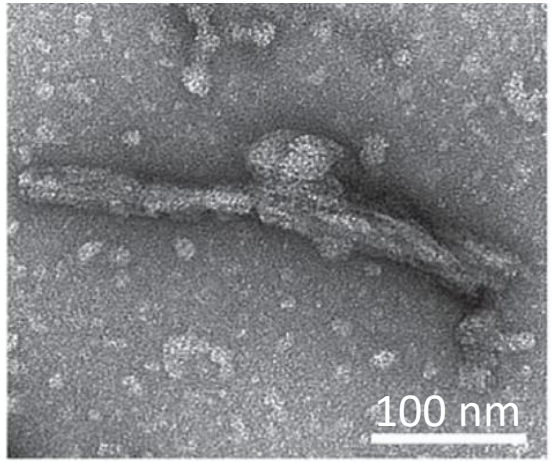
B. Cenocepacia **(Bacteria)**



T4 phage (Virus)



C. lusitaniae **(Fungus)**

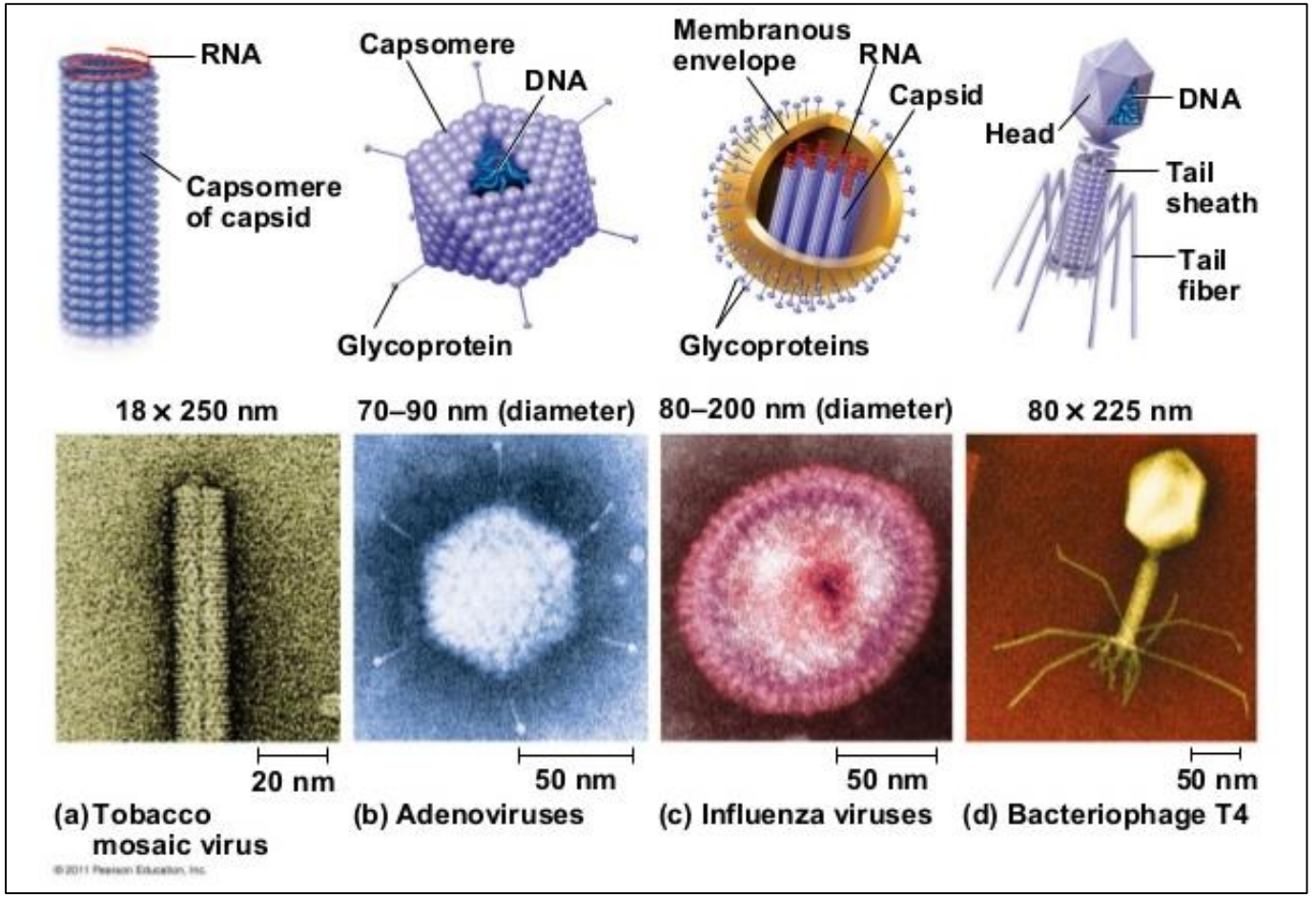


Prion proteins (PrP)

Trypanosoma cruzi **(Protist)**

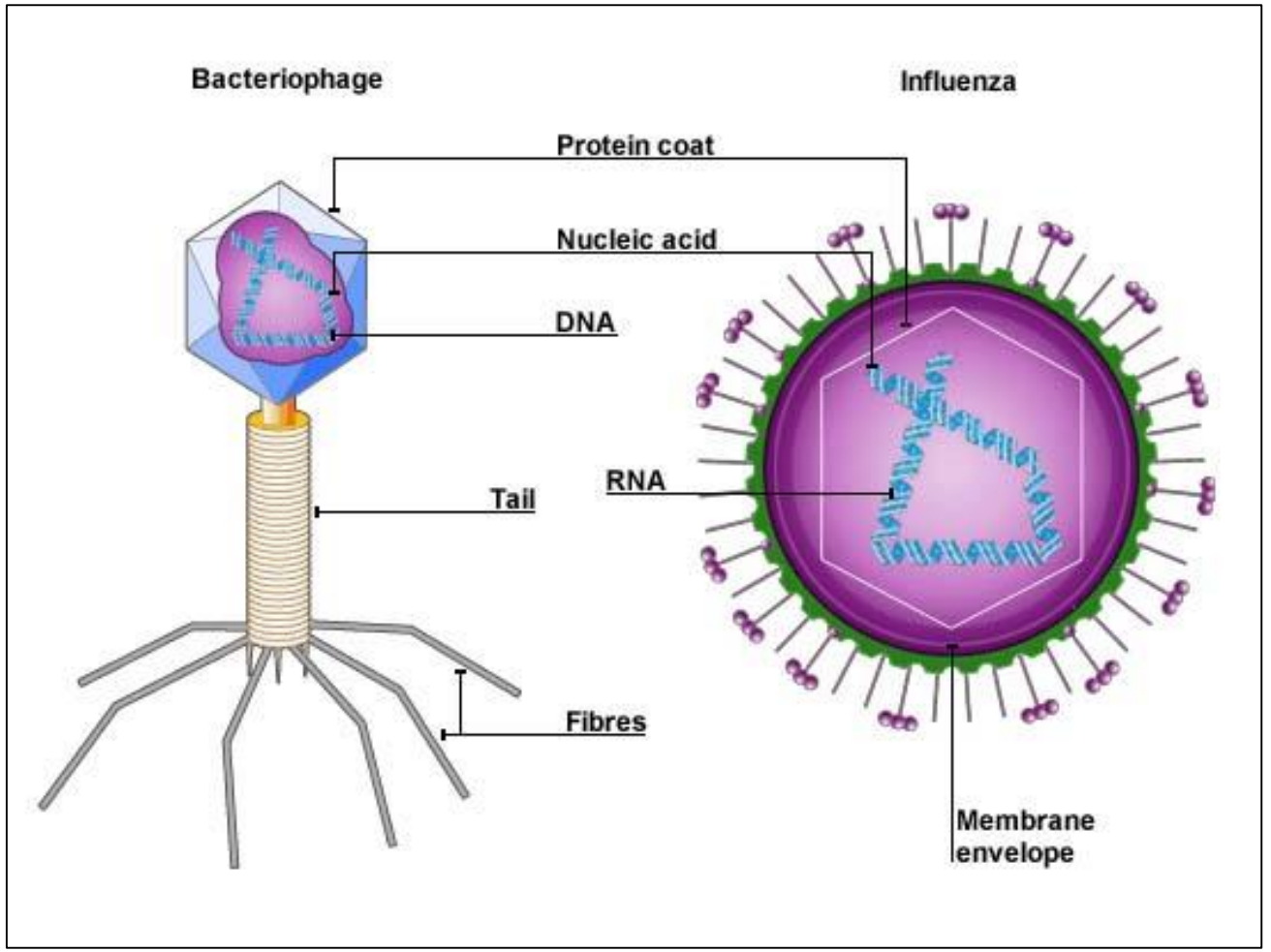
Viruses

- Organisms at the edge of life, lacking metabolism and cell structure, they only “replicate” inside cells.
- Can infect animal, plant and bacterial cells, even other viruses.
- Usually in the nanometre (1×10^{-9} m) size range.



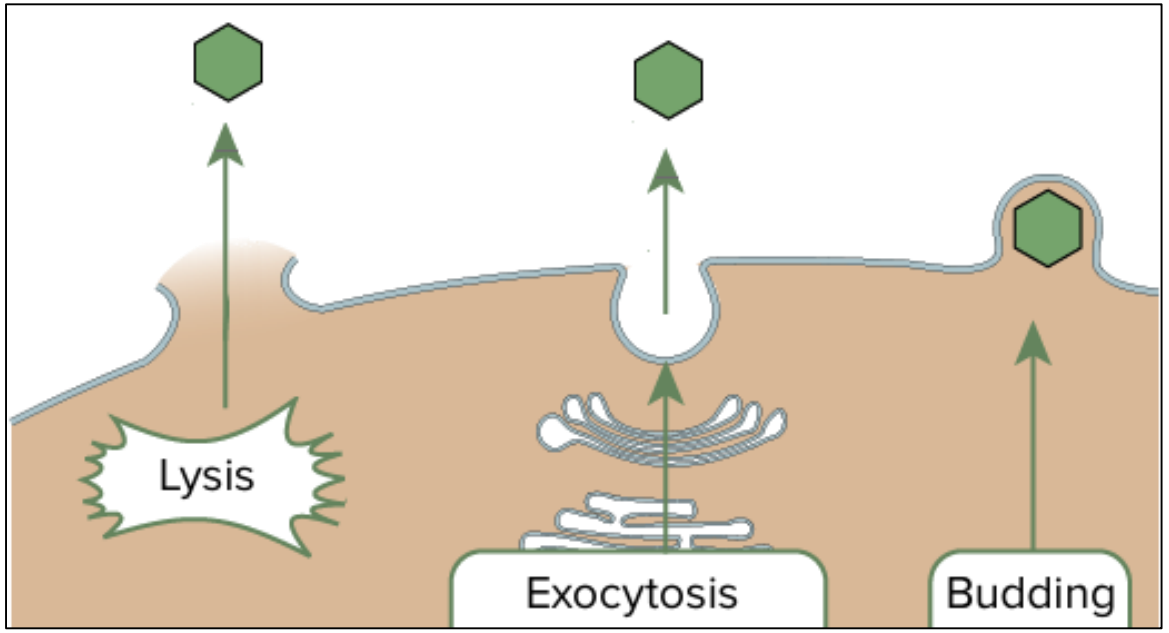
Viruses

- Consist of ss or ds nucleic acids (DNA or RNA), and a protein shell (capsid). Sometimes a lipid membrane is acquired from the host cell.
- Host–virus interactions tend to be highly specific.
- Viral DNA/RNA code for a few proteins that are made using the host cell machinery (Enzymes, ribosomes, amino acids).



Viruses

- The proteins forming the capsid (capsomeres) then assemble to form mature viral particles that exit the cell .



- A number of transmissible plant diseases are caused by viroids—small, single-stranded, covalently closed circular RNA molecules existing as highly base-paired rodlike structures

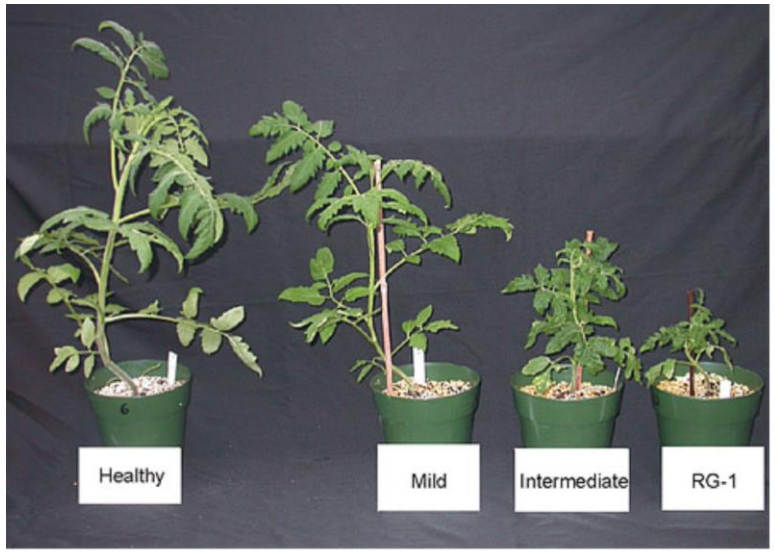
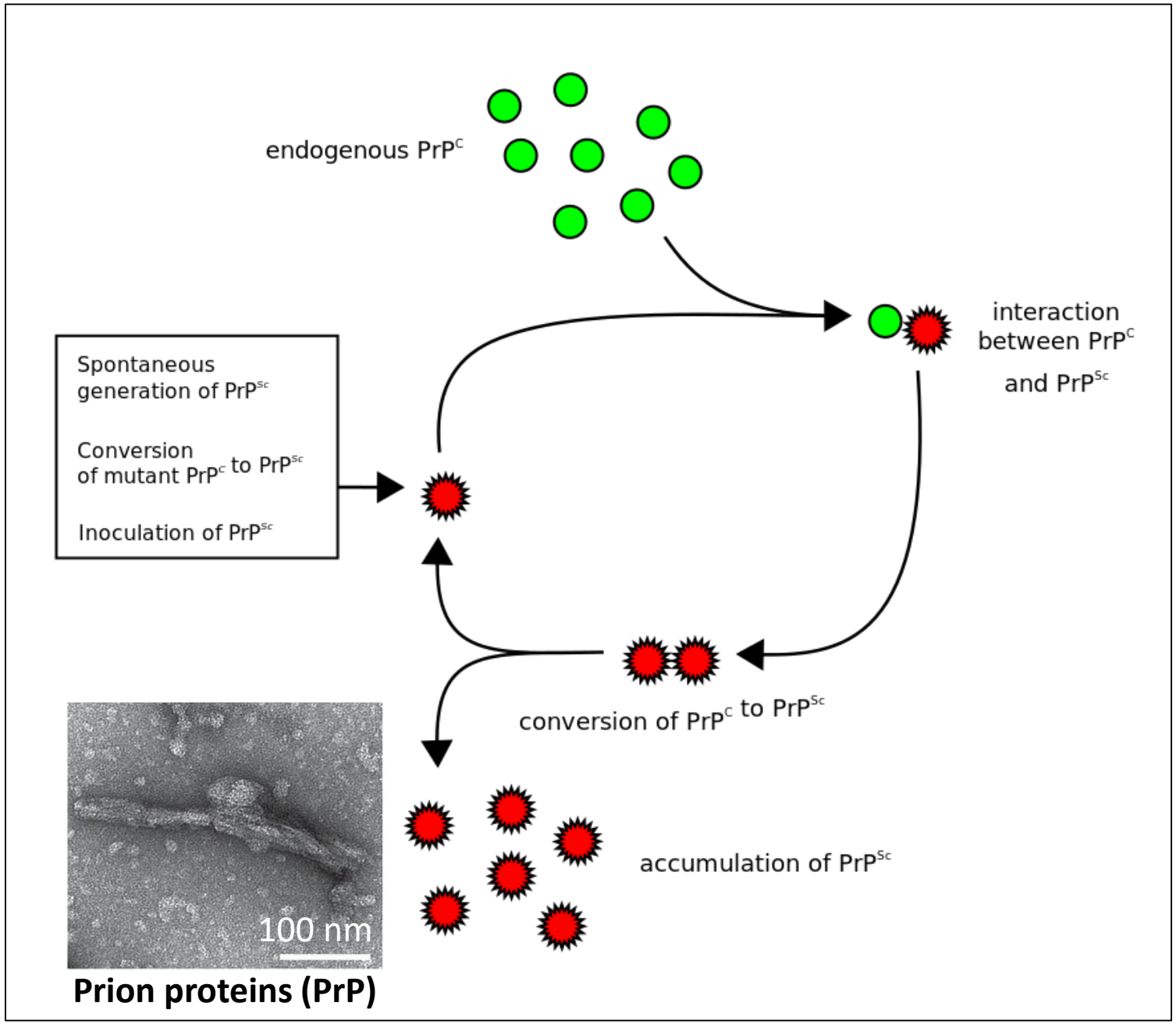


Fig. 3. Rutgers tomato plants infected with naturally occurring strains of Potato spindle tuber viroid exhibit mild to severe symptoms of stunting, epinasty, and leaf rugosity.

Prions

- Described as “proteinaceous infectious particle”.
- Misfolded proteins recovered from infected brains. Normal variants of the protein are found in cell membranes.
- In contrast to other infectious agents, it contains no DNA or RNA.

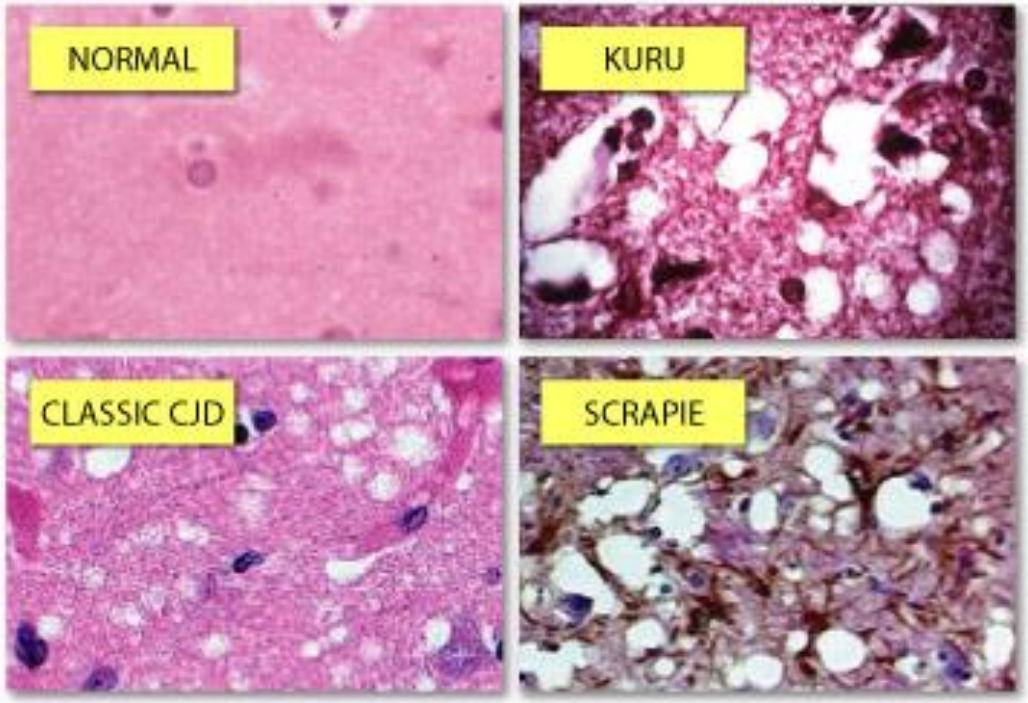


Prions

- Human prion diseases are unique in that they manifest as sporadic (e.g. Creutzfeldt-Jakob disease), genetic (e.g. Fatal familial insomnia), and infectious (e.g. Kuru) diseases.

- Exposure to or ingestion of infected tissue is a source of transmission.

- Effective prion decontamination relies upon destruction of protein tertiary structure

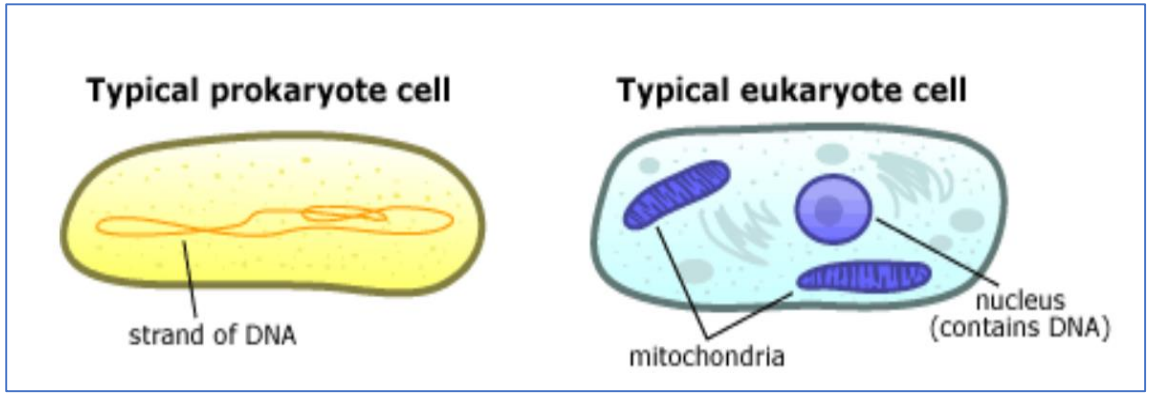


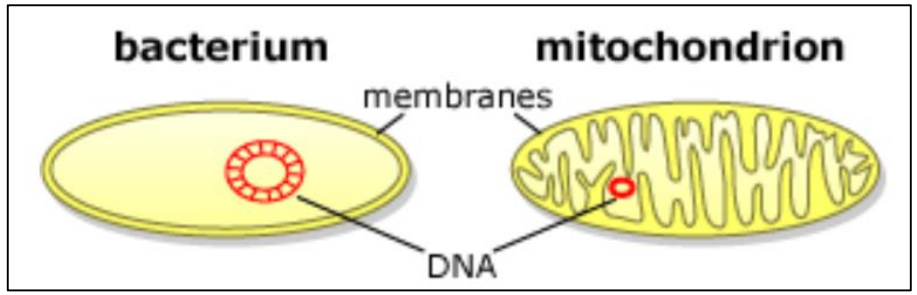
Kuru

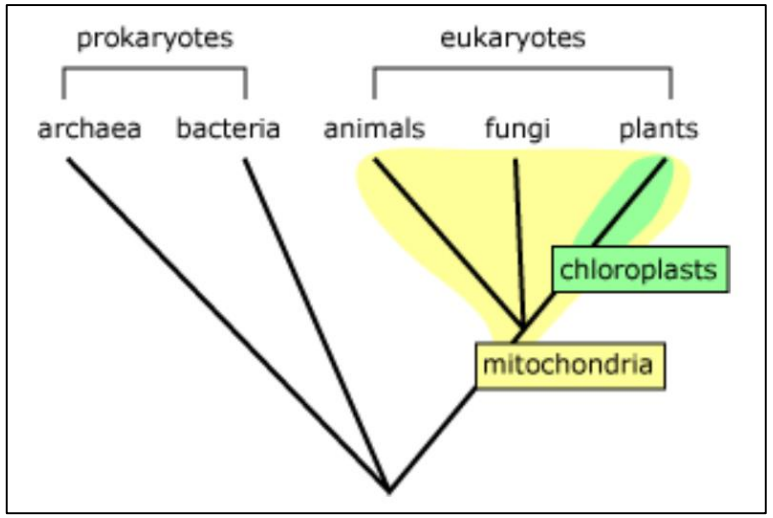
Scrapie

Prokaryotes

- Microscopic organisms (µM range, 1×10^{-6} m) that lack a typical nucleus, and other membranous organells.
- Mitochondria and chloroplasts are examples of Endosymbiosis.
- Major subdivisions of prokaryotes are Bacteria and Archaea.
- Archaea are difficult to study in the lab, and have different biochemical properties.



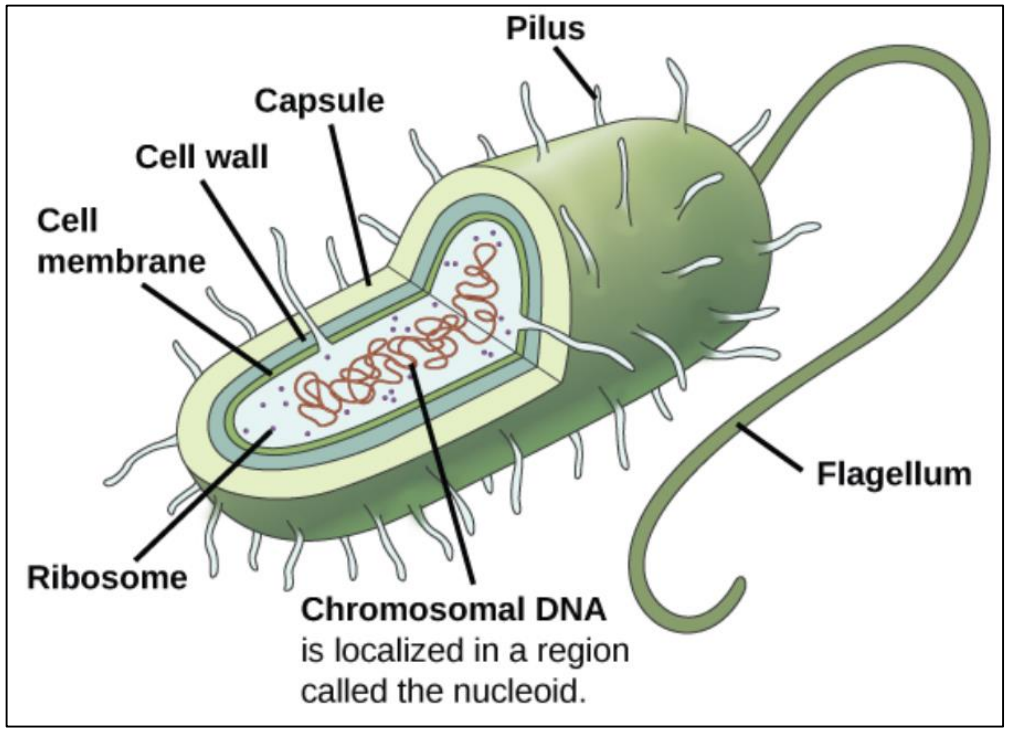


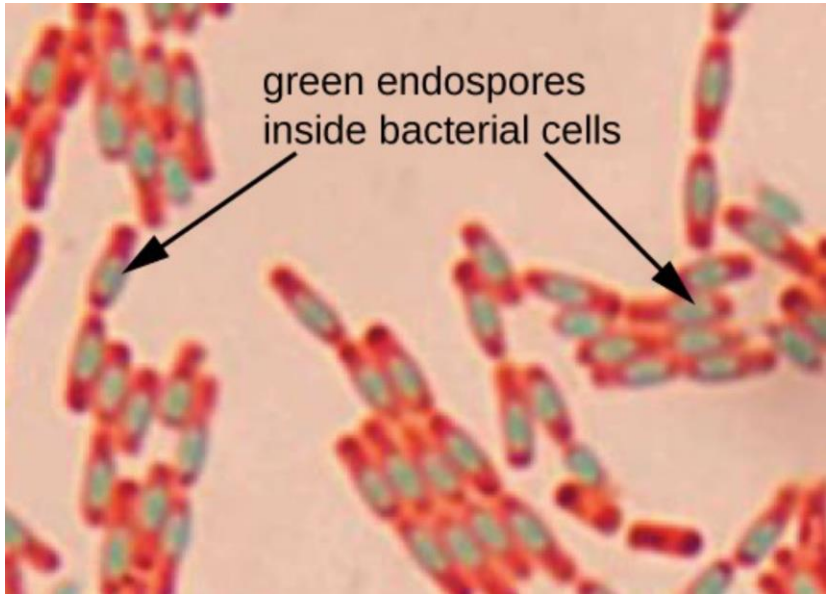


Prokaryotes / Classification

- Prokaryotes share many common features, such as lack of nuclear membrane, unicellularity, division by binary-fission and generally small size.

- Useful criteria may be structural (e.g. Spore formation), biochemical (e.g. gram stain), or genetic (e.g. organisms carrying specified genetic regions with common ancestry / phylogenetic relatedness).

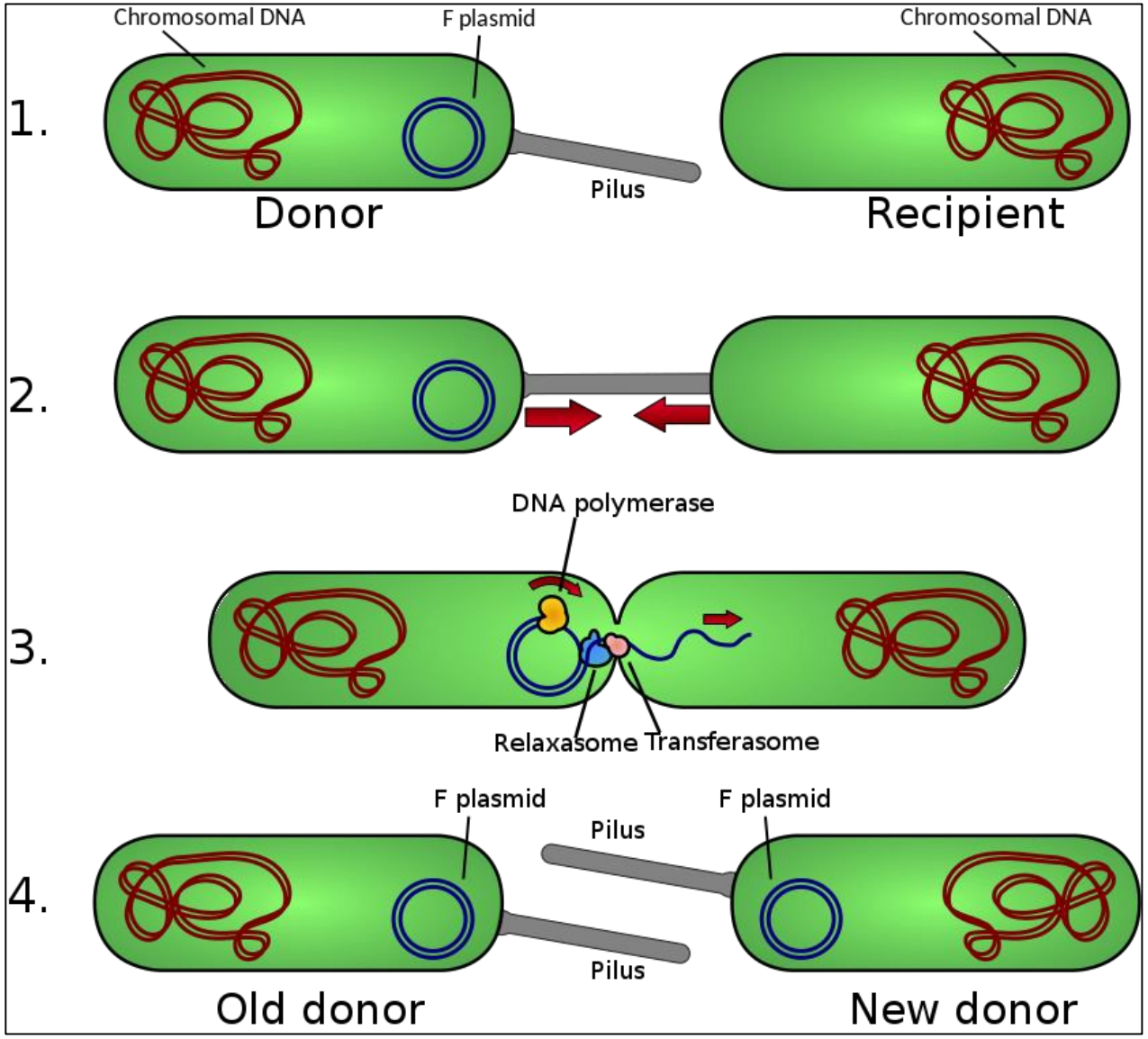




Prokaryotes / Genetics

- Contain a circular DNA with a limited size, thus high genetic diversity among prokaryotes is necessary to occupy diverse niches. This is highlighted by different energy production mechanisms.

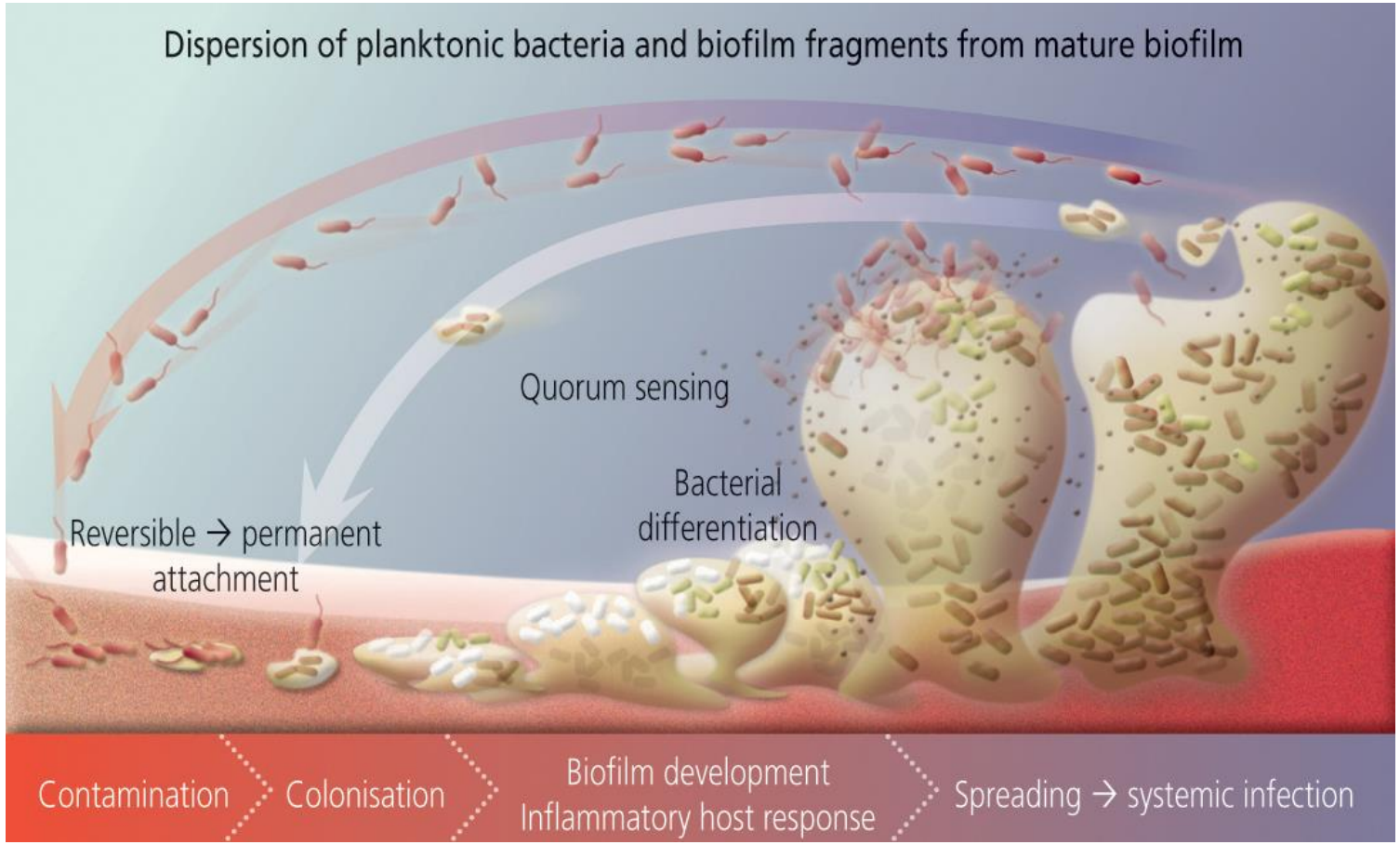
- Plasmids (self replicating small DNA packets) can transmit, through bacterial conjugation, beneficial traits for the survival of the bacterium. (e.g. Antibiotic resistance).



Prokaryotes / Communities

- Bacteria are found in communities that aid the survival of the whole, through providing new characteristics (e.g. biofilm).

- Bacteria communicate with one another using chemical signal molecules (Quorum sensing).



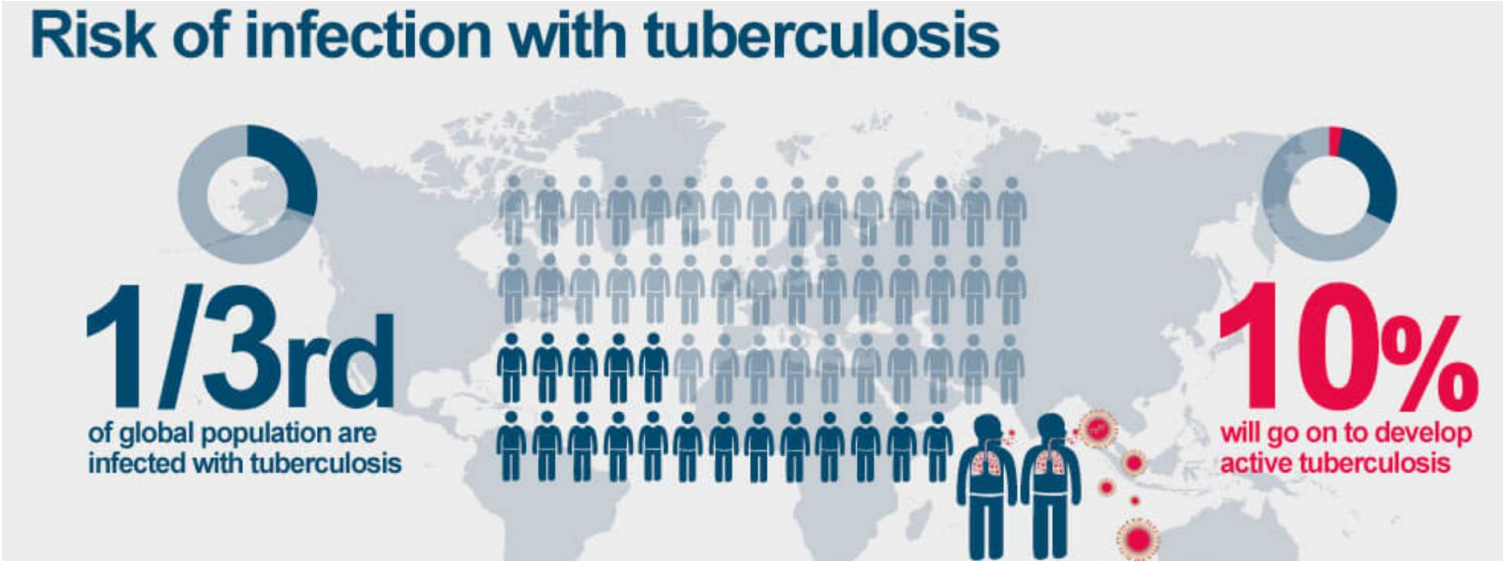
Further reading:

- Jawetz, Melnick & Adelberg's Medical Microbiology, 26th edition-
  Section 1: Fundamentals of Microbiology-
    Chapter 1: The Science of Microbiology

Why Microbiology?

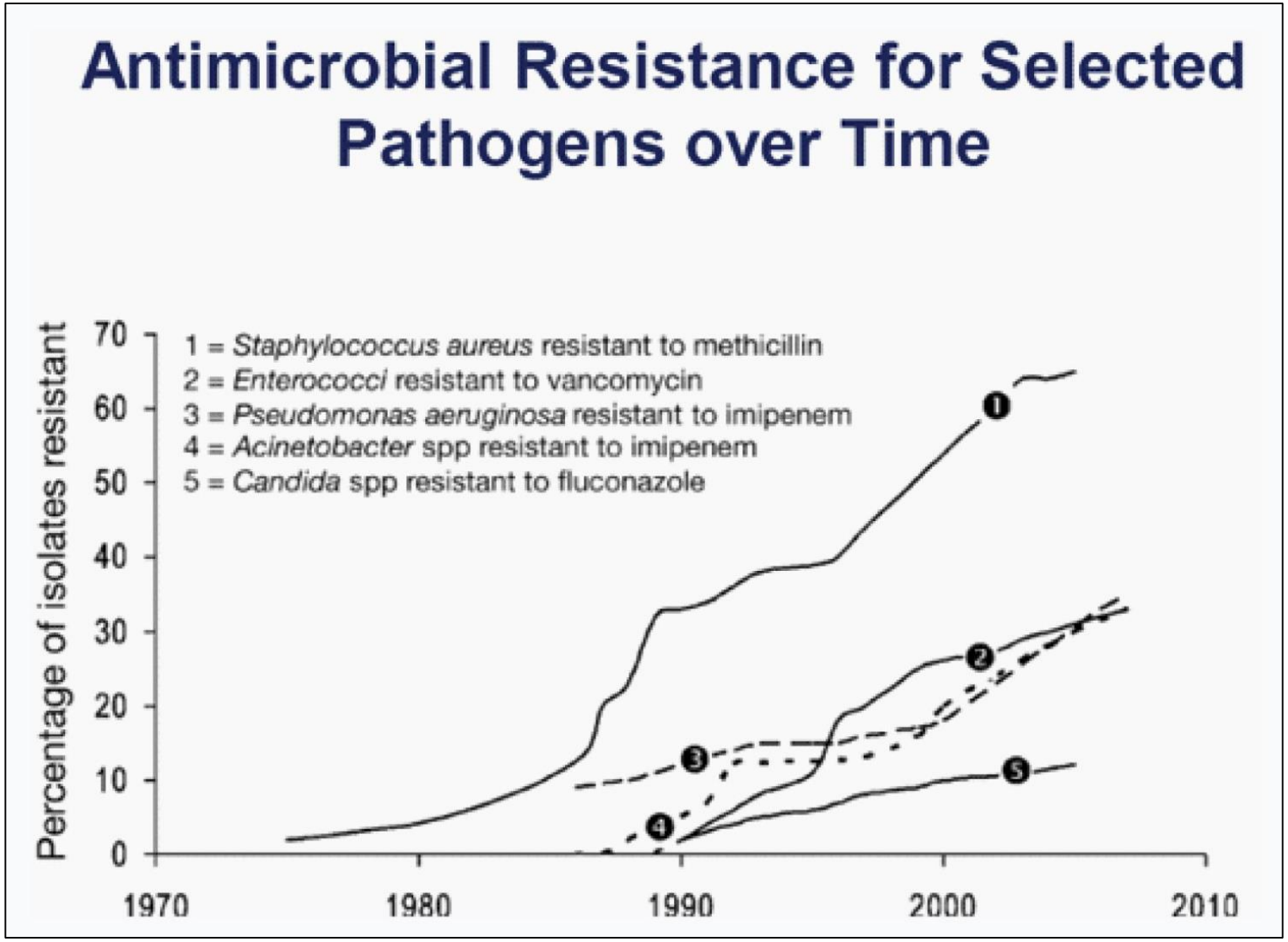
- A topic worthy of headlines.

- Dissemination of scientific knowledge in Microbiology to the community is important in limiting the spread of disease.



Why Microbiology?

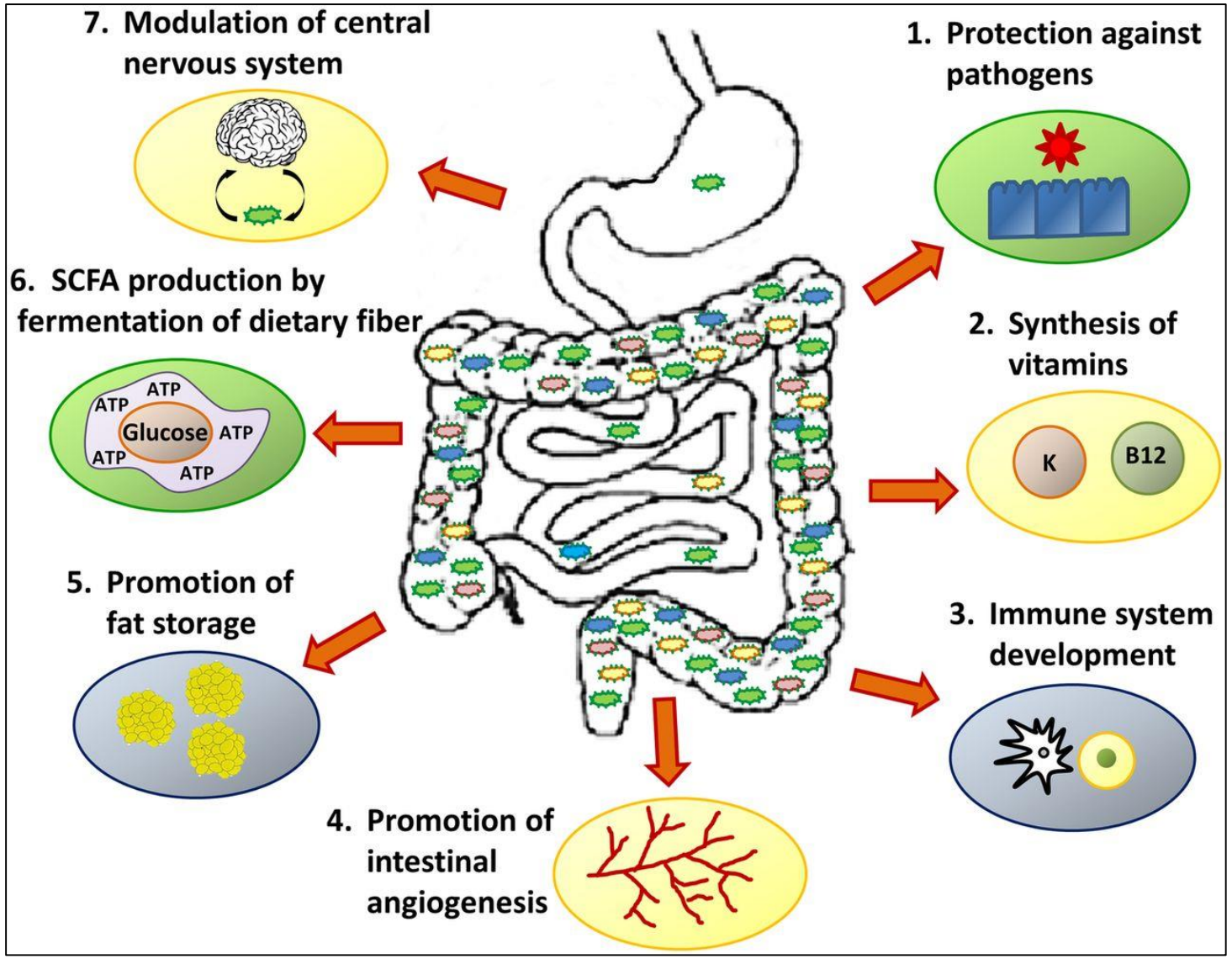
- Antimicrobial resistance is a pressing issue that needs to be addressed.
- Physicians, scientists and governments are at the forefront.



Why Microbiology?

- On average, There's more bacterial cells than human cells living in your body !

- The human microbiome is an organ in its own right.



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Why Microbiology?

- An ever evolving science with consequences on human and animal health, our environment, and is related to issues such as biofuels and bioenergy.

- For the love of science !