

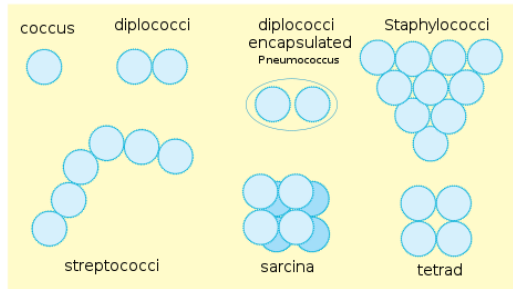
Bacteriology

PharmDr. Jakub Treml, Ph.D.

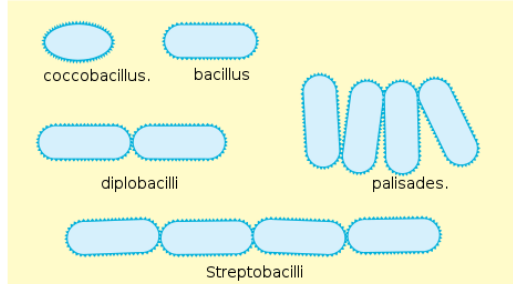


Pro (before) *karyon* (kernel) = bacteria + archea

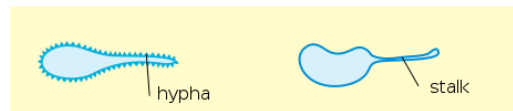
Cocci



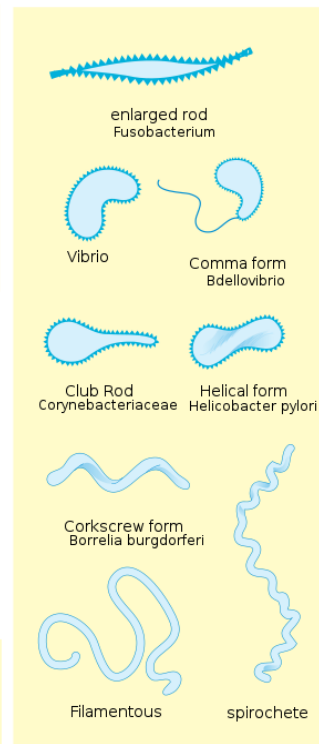
Bacilli



Budding and appended bacteria

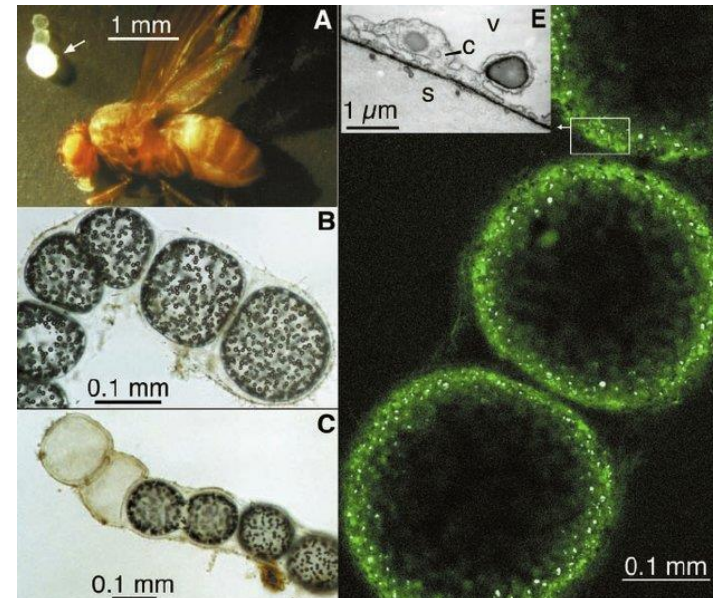


Others

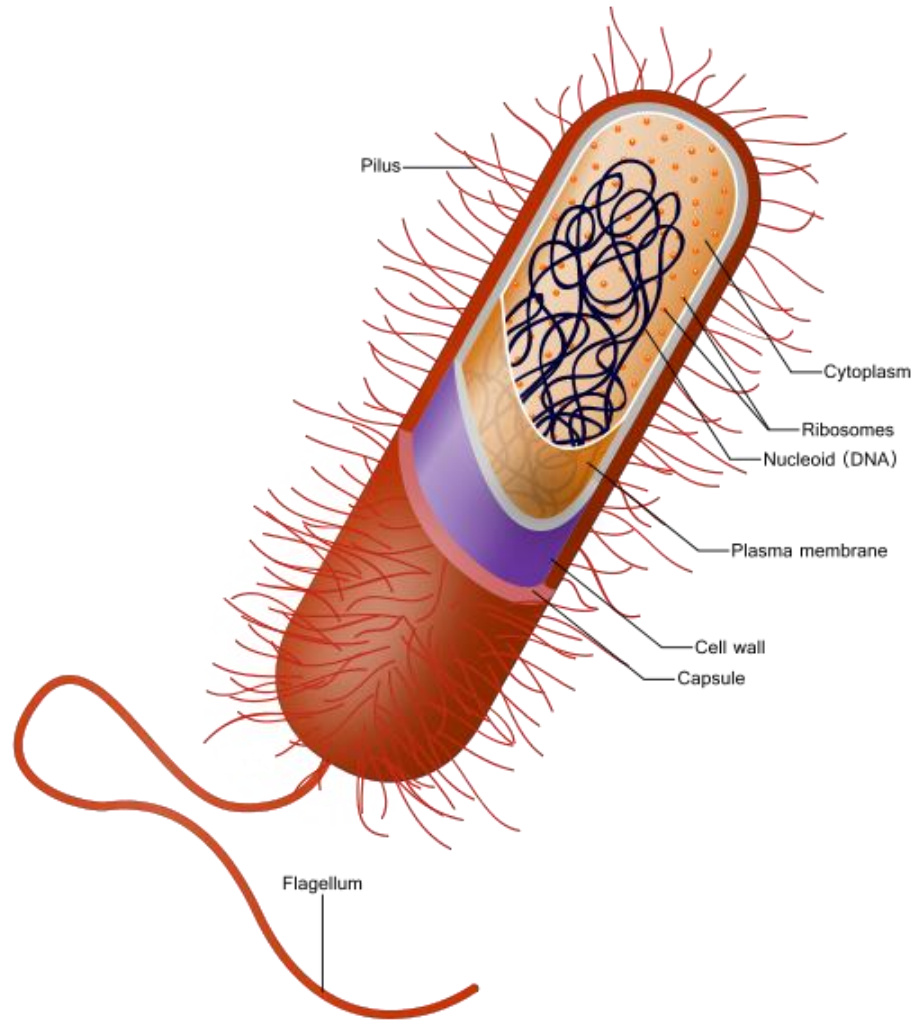


- unicellular org.; clusters at max.
- size: 1 – 5 μm
- exception *Thiomargarita*

namibiensis (750 μm)



Structure of bacterial cell



capsule: protection, attachment

pili: attachment, conjugation

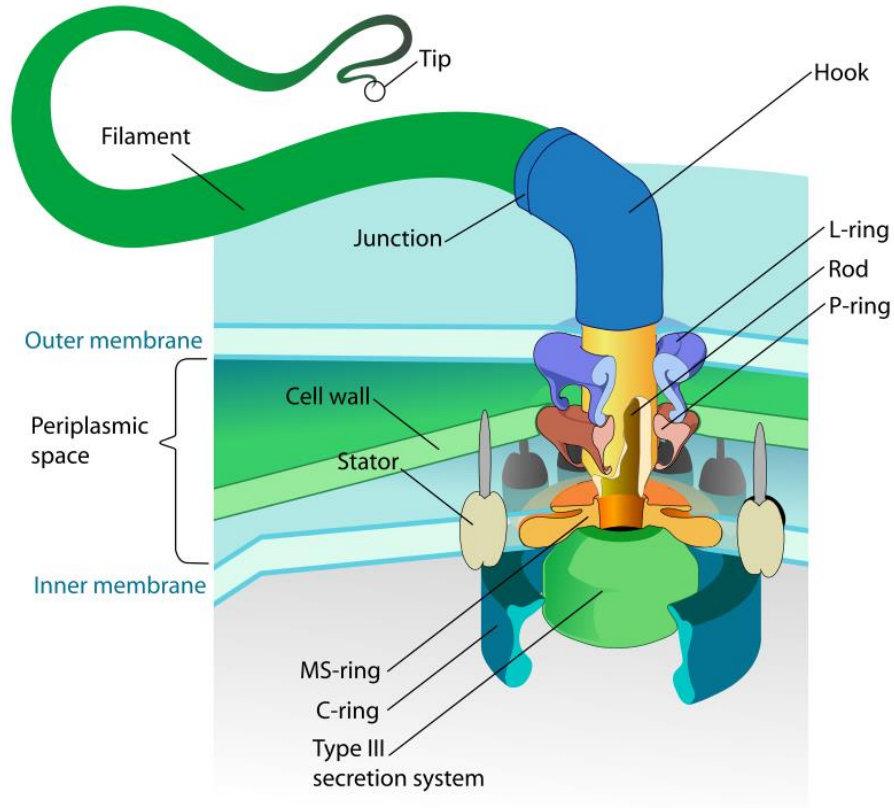
cytoplas. membrane:

semipermeable

ribosome: 70S (small subunit 30S,
velká 50S)

plasmids: circular DNA, genes
of resistance e.g.

Structure of bacterial cell



flagellum: motion ($\frac{1}{2}$ of bacteria) $5 \mu\text{m/s}$ (chemotaxis)

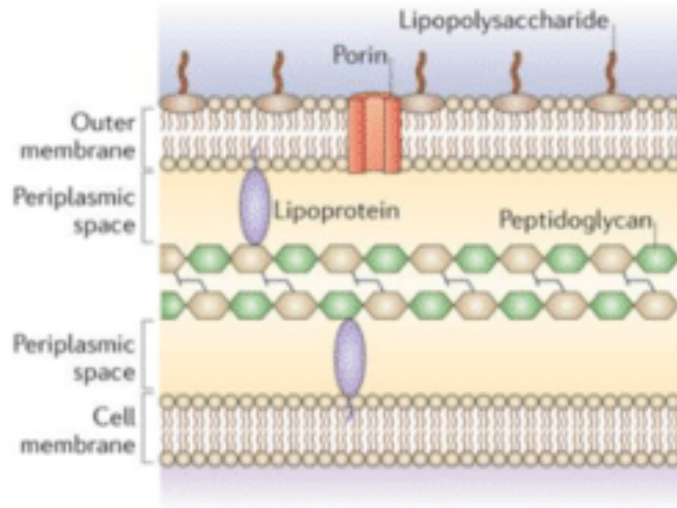
no nucleus, no organelles

nucleoid: circular DNA entangled, without histones = chromosome

bacterial cell wall: peptidoglycan

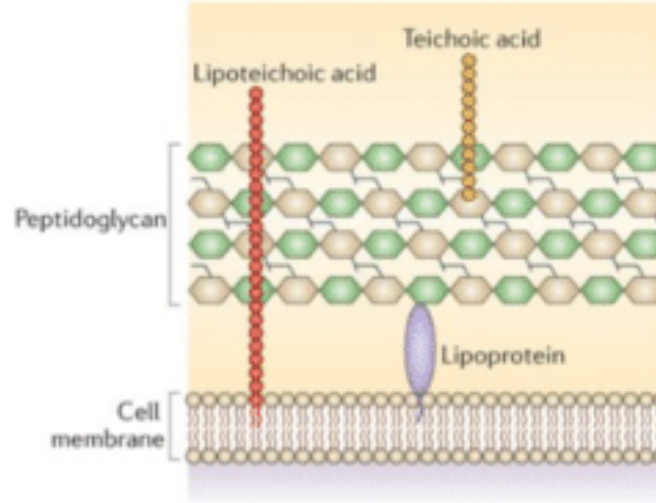
Bacterial cell wall

a Gram-negative bacteria



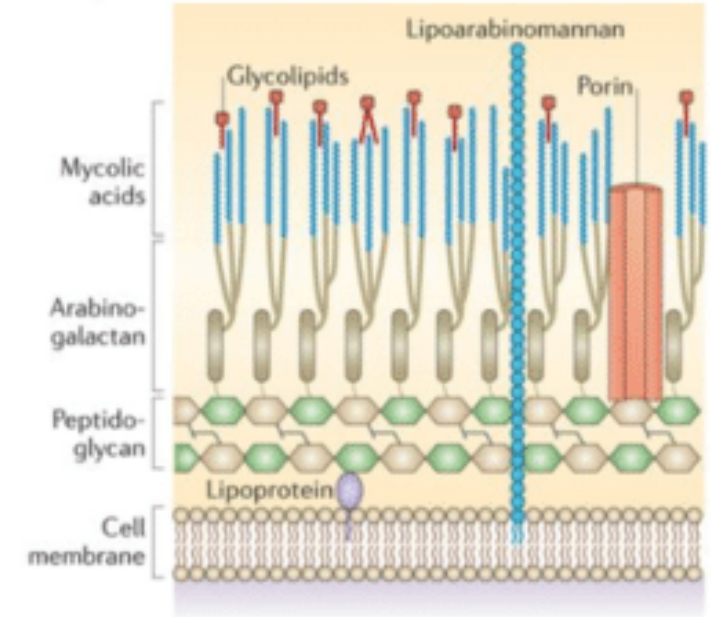
Gram negative

b Gram-positive bacteria



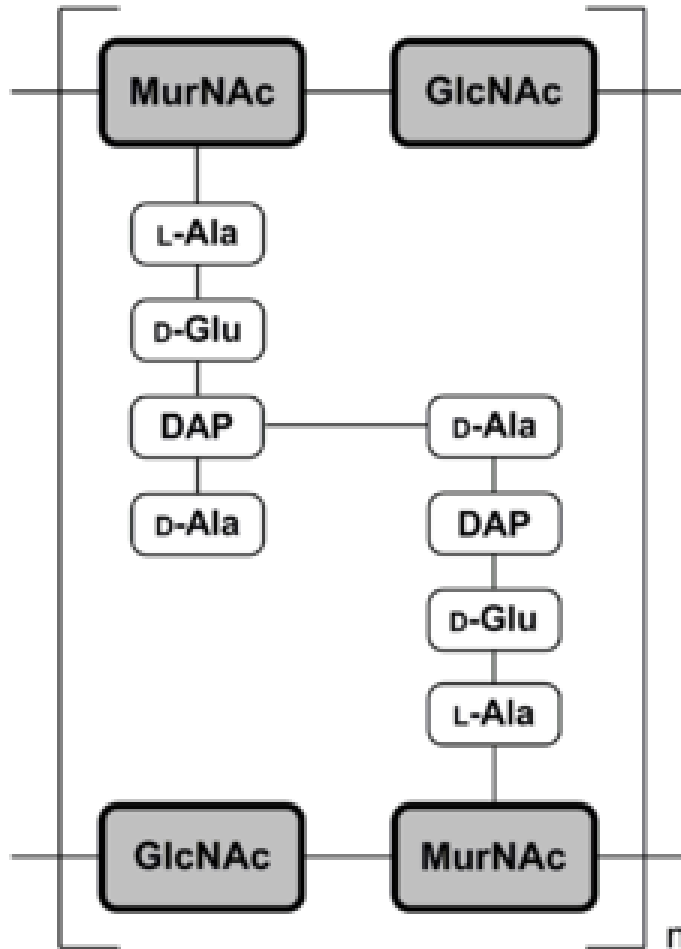
Gram positive

c Mycobacteria



Mycobacteria

Bacterial cell wall - peptidoglycan



N-acetylglucosamine

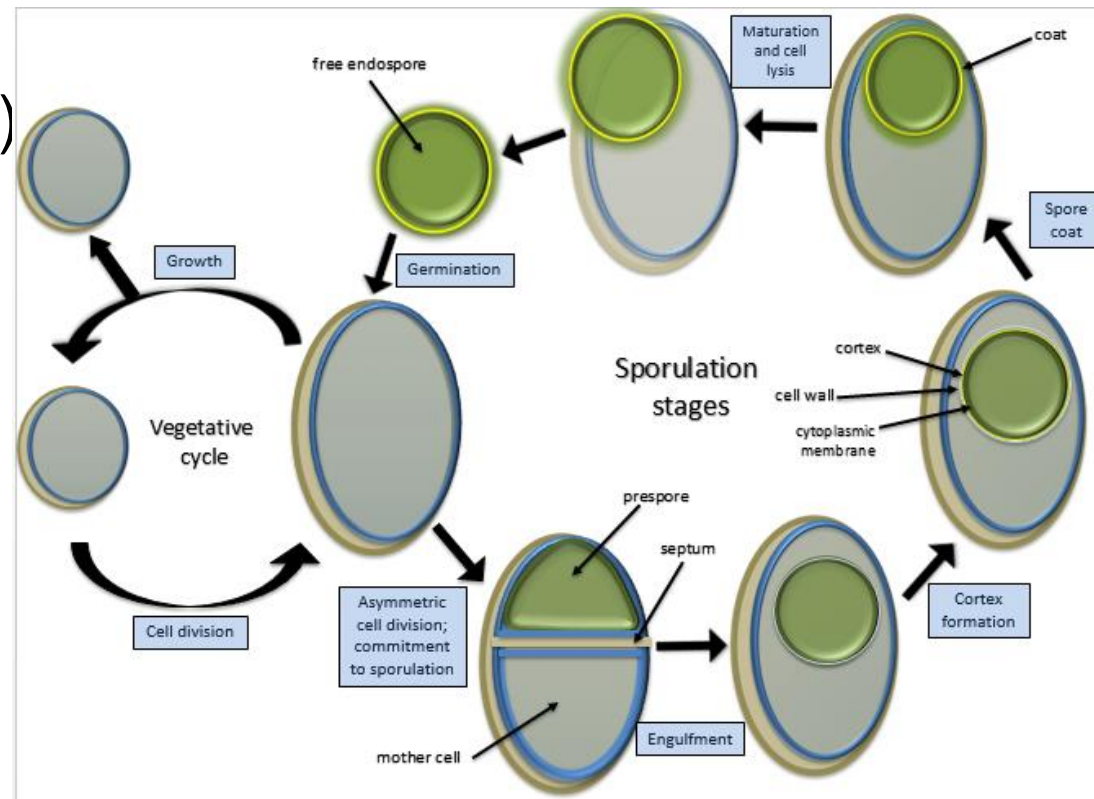
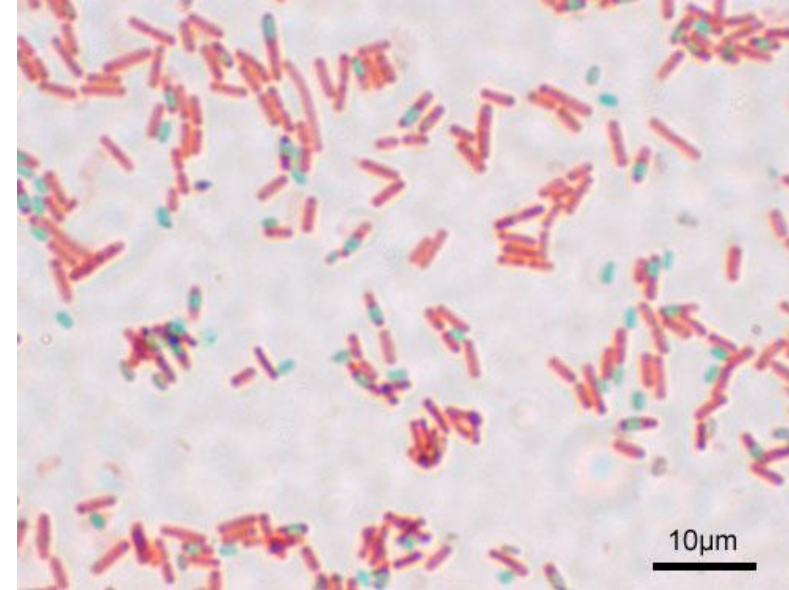
N-acetylmuramic acid

tetrapeptide: L-alanine; D-glutamate;
diaminopimelic acid; D-alanine

Endospores

genuses *Bacillus* and *Clostridium*:

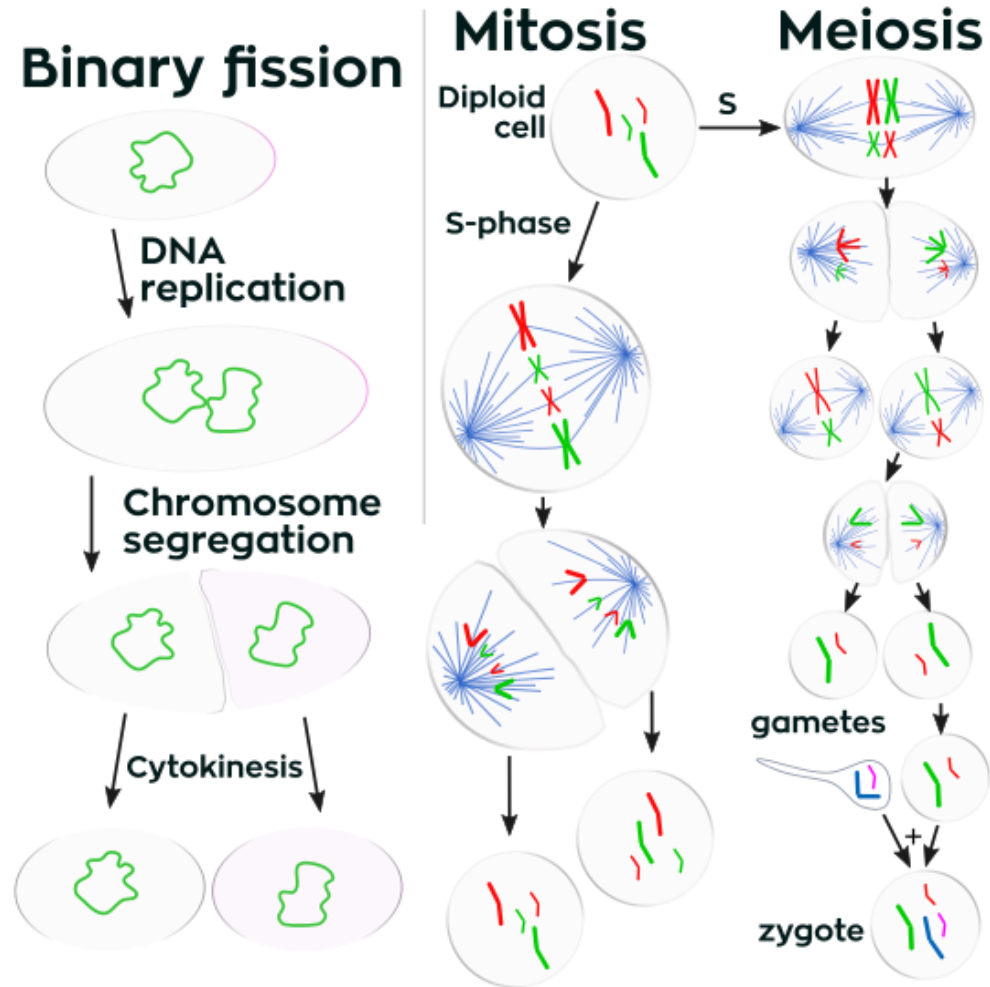
- very very resistant (t; UV; drought, frost)
- dormant phase; without nutrients
- dipicolinic acid (10% of dry matter)
- sporulation
- at convenient time germination starts...



CC Y tambe
CC Alayna5231

MUNI
PHARM

Binary fission

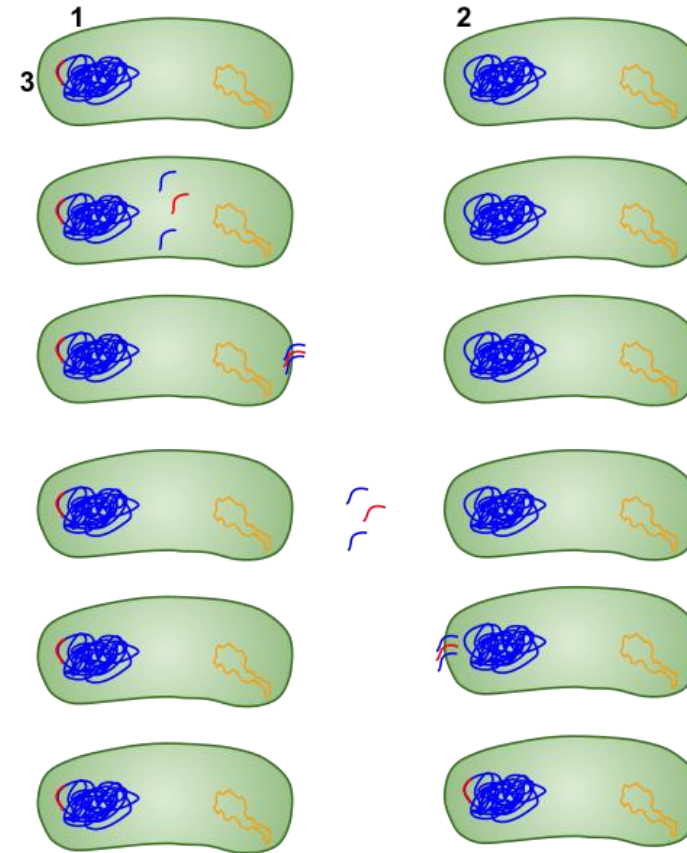


asexual reproduction

generation time of
Escherichia coli = 30 min.

Horizontal gene transfer - transformation

- uptake of extracellular DNA ("naked" or free)
- only by competent cells
- not very usual
- natural competence is because of pilus

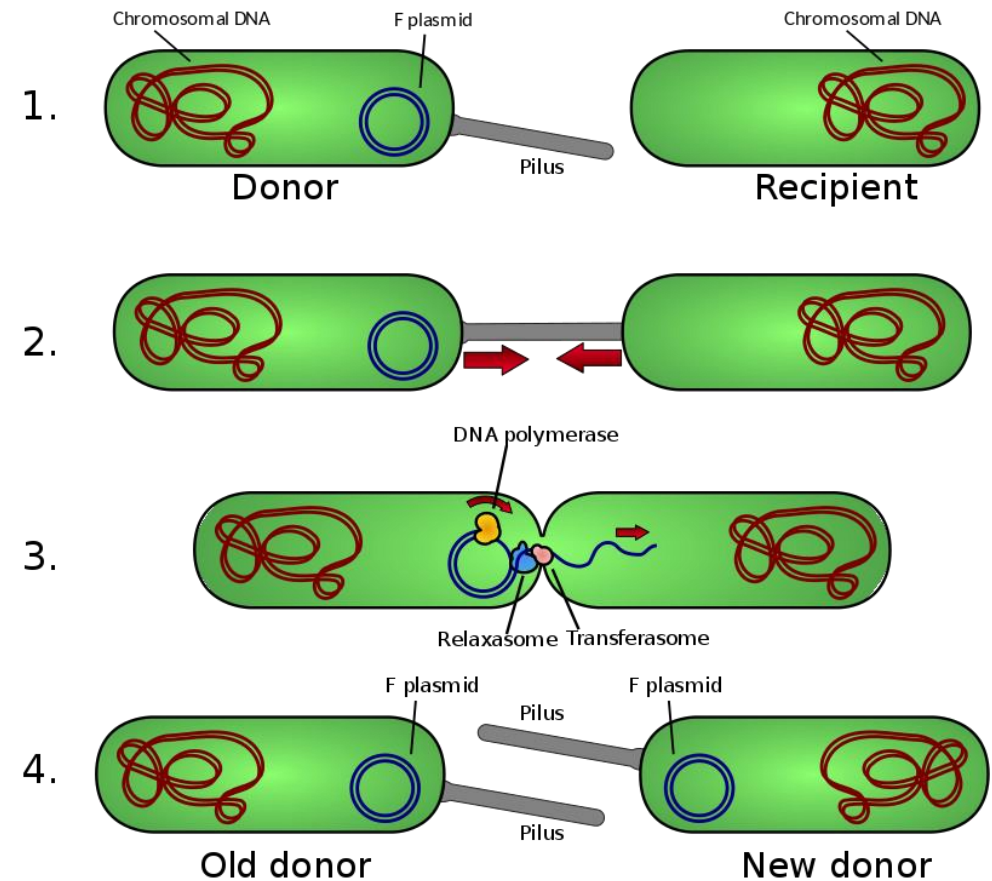


Horizontal gene transfer - conjugation

- bac. F^+ contains F plasmid and also sex-pilus

- e.g. *E. coli*

- ATB resistance, utilization of a new metabolite

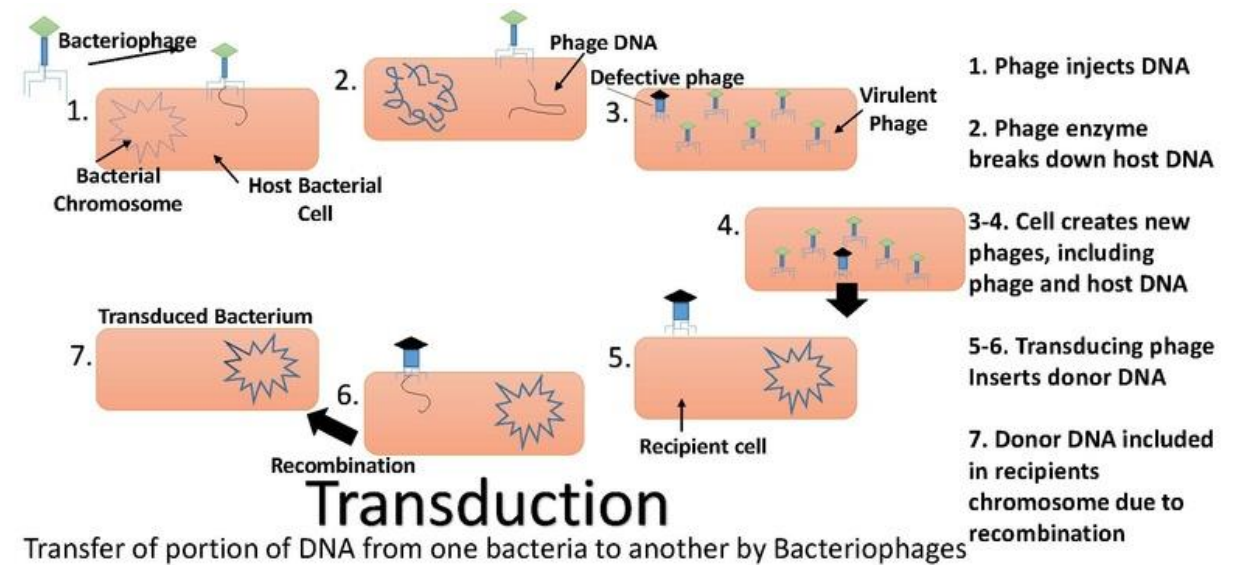


CC Adenosine

Horizontal gene transfer - transduction

- via bacteriophages (bacterial virus) - without physical contact; resistant to DNases

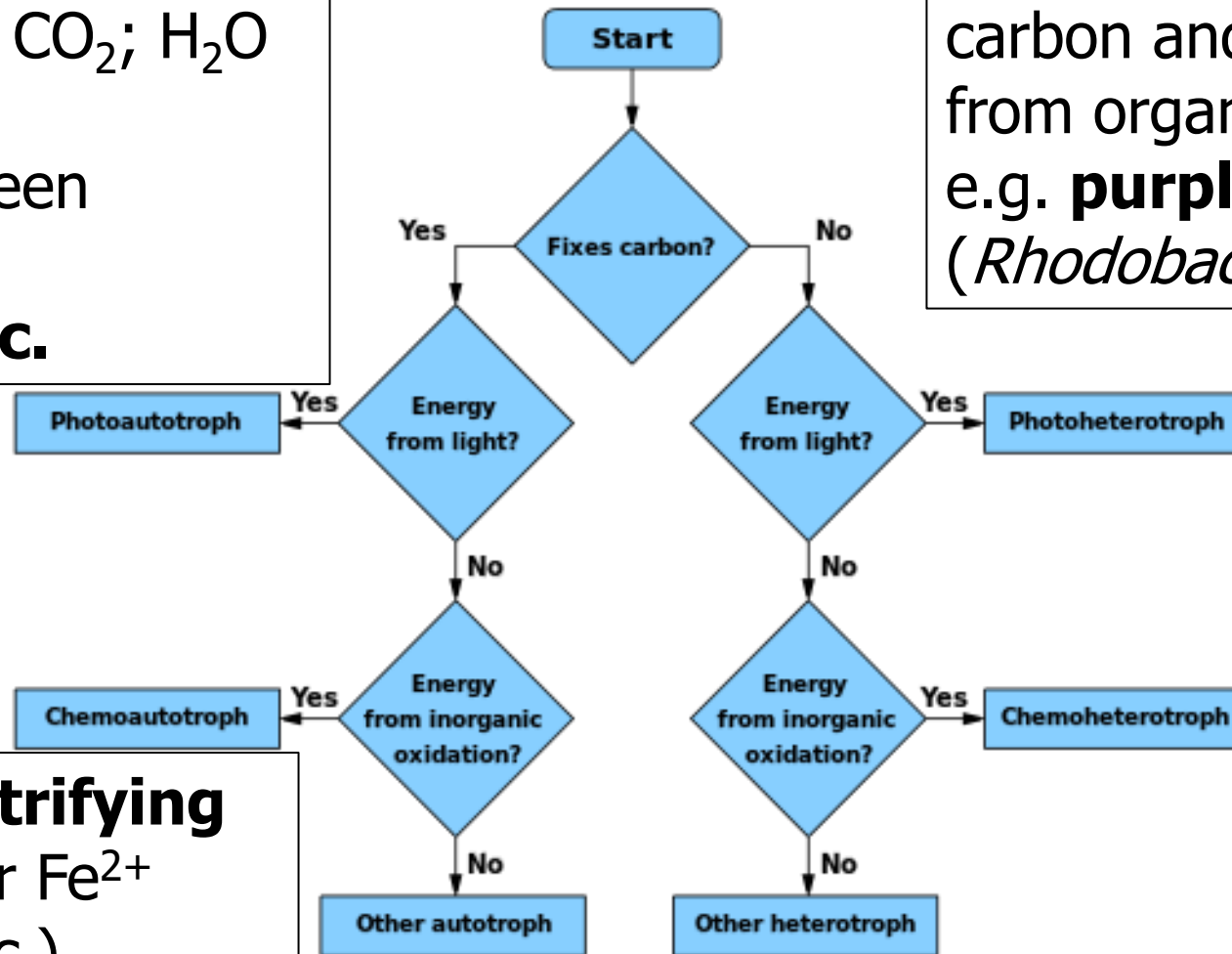
- lytic or lysogenic (prophage) cyclus



Bacterial metabolism

cyanobacteria: fix CO_2 ; H_2O
red. equivalent
Chlorobiaceae: green
sulphur bac.; H_2S
purple sulphur bac.

carbon and red. equivalents
from organic comps.:
e.g. **purple nonsulphur b.**
(*Rhodobacter*)



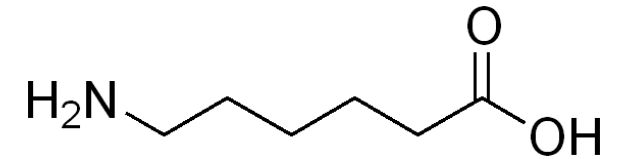
oxidize H_2S ; NH_3 (**nitrifying bac.** - to nitrates) or Fe^{2+} (**iron-oxidizing bac.**)

en., C and H from org.: most b.

Heteroorganotrophic bacteria

- feed on living organisms: **commensals**, **parasites**
- dead organic tissue: **saprophages** (wood - lignin)

- **bioremediation** (nylon-eating bacteria - evolution; linear polymer of 6-aminohexanoic acid - 1932)



- **fermentation**: anaerobic metabolisms (pyruvate to ethanol, lactate, acetone-butanol-ethanol or hydrogen gas)

Archea

domain of procaryotes since '70 – Carl Woese (rRNA seq.)

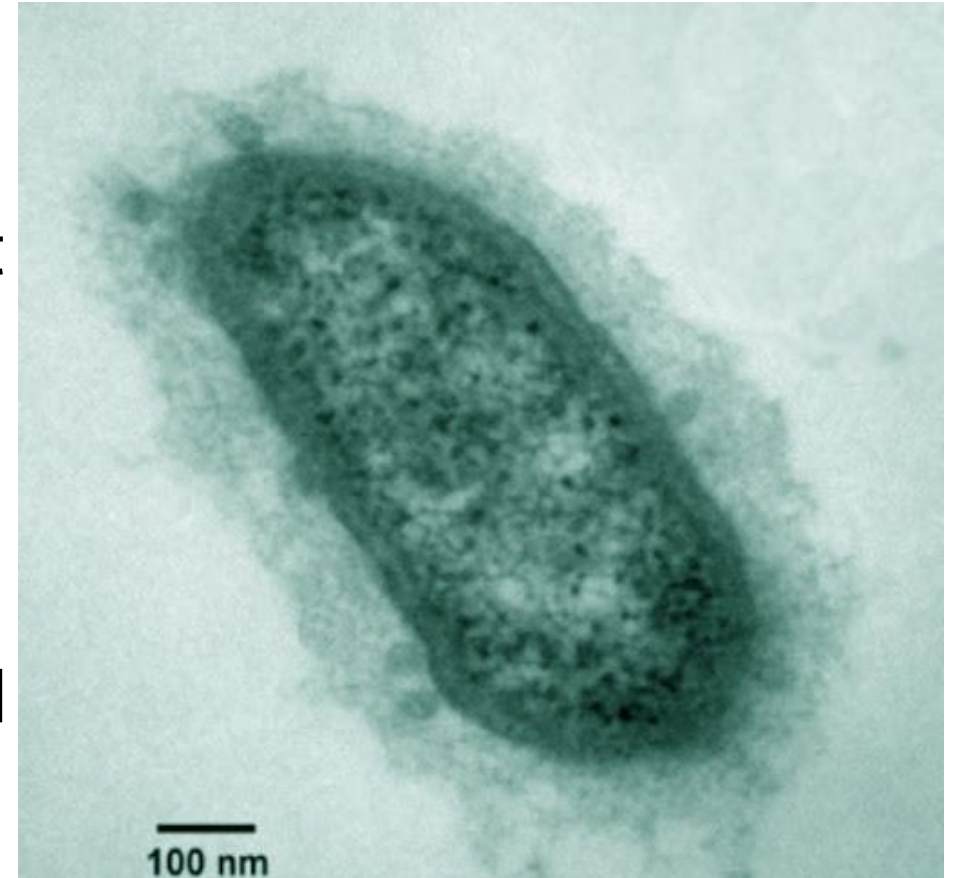
differences:

- **do not have** peptidoglycan
- CPM: glycerol and lipids with **etheric** bond (instead of esters)
- not fatty acids, but branched **izoprene** chains = higher stability(!)
- start kodon AUG is **methionin** (similar for eukaryota; bac.: N-formylmethionin)

Archea – example of human microbiota

Methanobrevibacter smithii:

- most represented archeon in human gut
- turns hydrogen and CO₂ to methane
- it influences processing the final products of bacterial metabolism of polysaccharides (a study proved more *M. smithii* in anorectic patients compared to obese)



Buck S. Samuel et al., 2007