

# Basics of Microbiology

# Basics of microbiology

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- The Cell
- Genetic molecules
- Bacteria

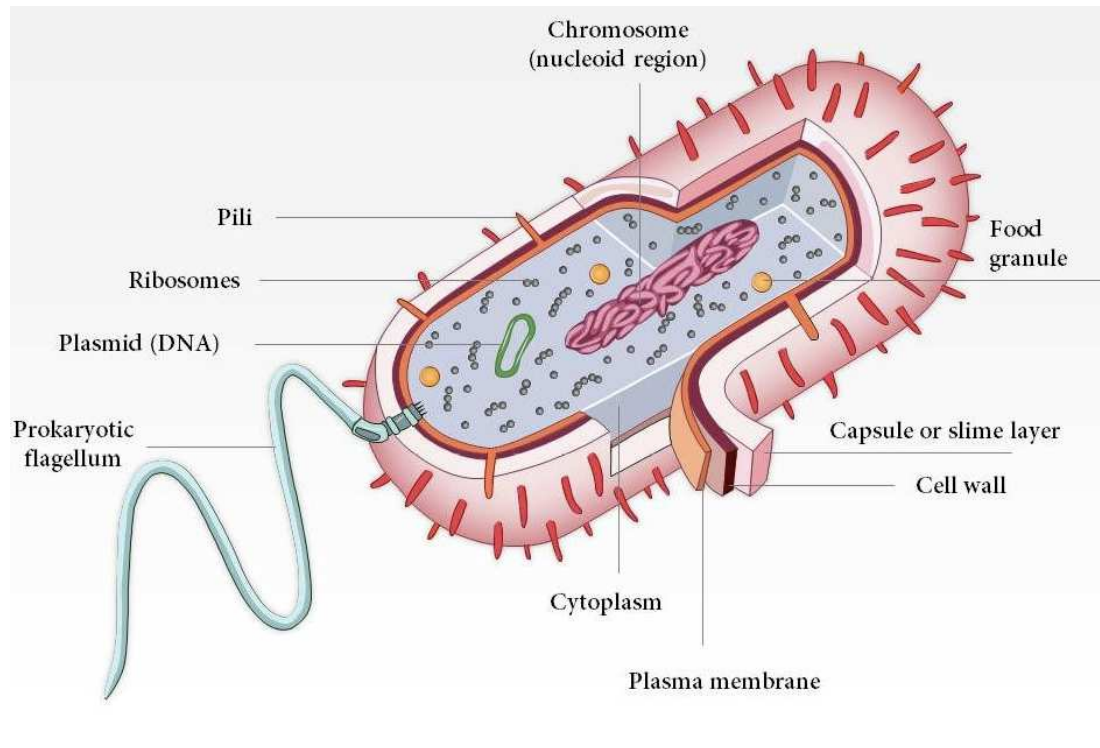
# The cell

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- A building block of life
- Distinct features of a cell
  1. capable of growth and reproduction ✓
  2. highly organized and selectively restrict what crosses their boundaries ✓
  3. composed of major elements (C, N, O, S) that are chemically reduced ✓
  4. self-feeding

# The cell

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- Cell membrane
- Cell wall
- Cytoplasm
- Chromosome
- Ribosome
- Enzyme

#1

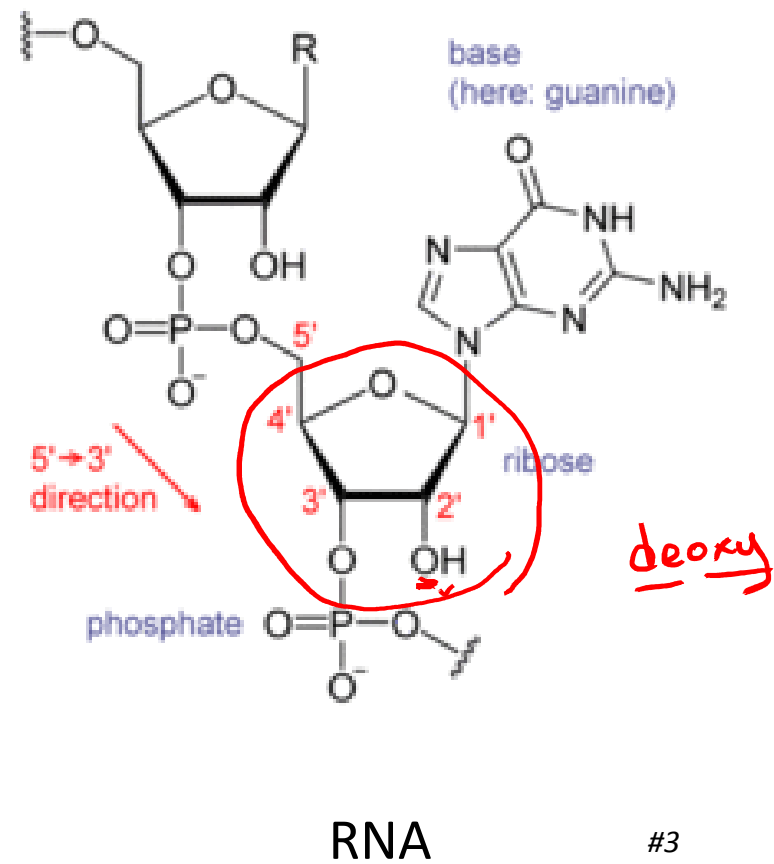
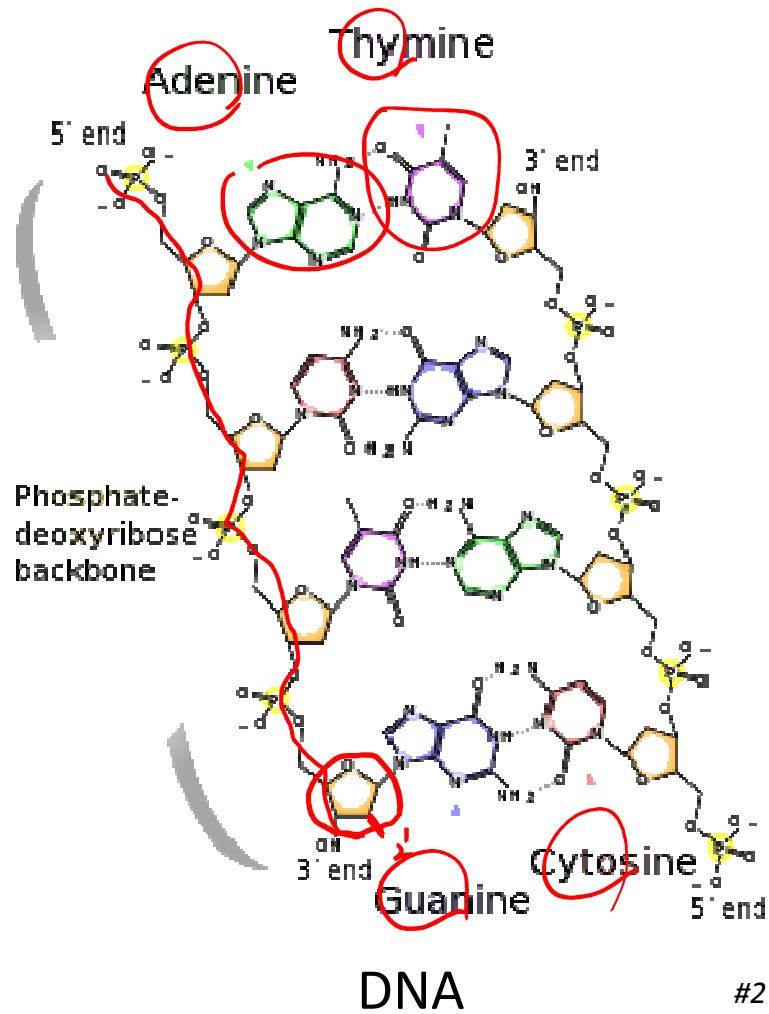
Prokaryotic cell

# Genetic molecules

sugar, base, phosphate  
|  
nucleotide - monomer

	<b>DNA</b> <b>(deoxyribonucleic acid)</b>	<b>RNA</b> <b>(ribonucleic acid)</b>
Sugar	deoxyribose	ribose
Strand	double-stranded	single-stranded
Base	adenine (A), thymine (T), guanine (G), cytosine (C)	adenine (A), <u>uracil (U)</u> , guanine (G), cytosine (C)

# Genetic molecules



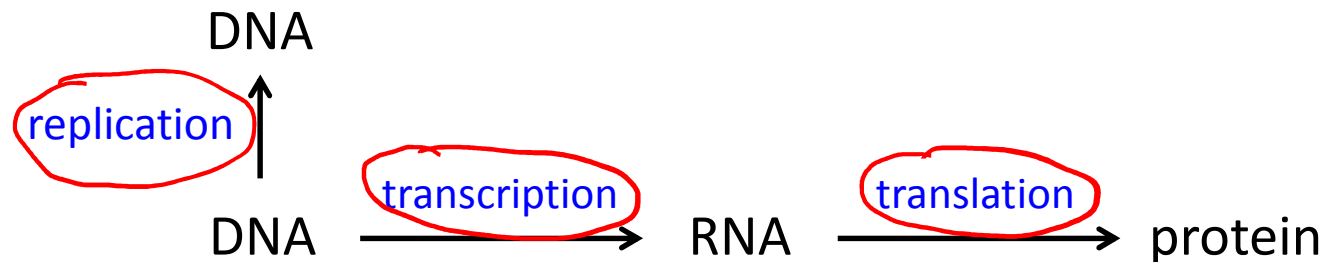
# Genetic molecules

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- DNA: Long-term storage of genetic information; transmission of genetic information to other cells and new organisms
- RNA: Transfer the genetic code from the DNA to ribosomes to make proteins

*potential*

*expression*



# Taxonomy and phylogeny

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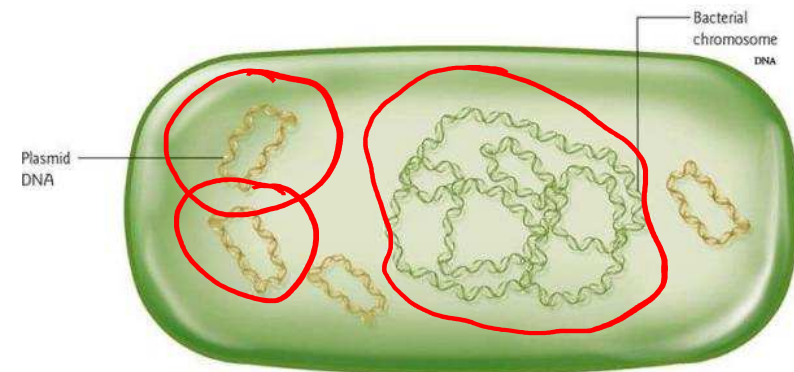
- Taxonomy: classification based on observable physical properties of organisms (phenotype)  
ex) appearance, dye or strain characteristics, ability of chemical transformation
- Phylogeny: classification based on genetic characteristics (16S rRNA) 18S rRNA



# Bacteria

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- Ubiquitous
- Can transform a great variety of inorganic and organic pollutants
- Plasmids – horizontal gene transfer
- 0.5 – 2  $\mu\text{m}$  size  
→  $\sim 10^{12}$  cells/g



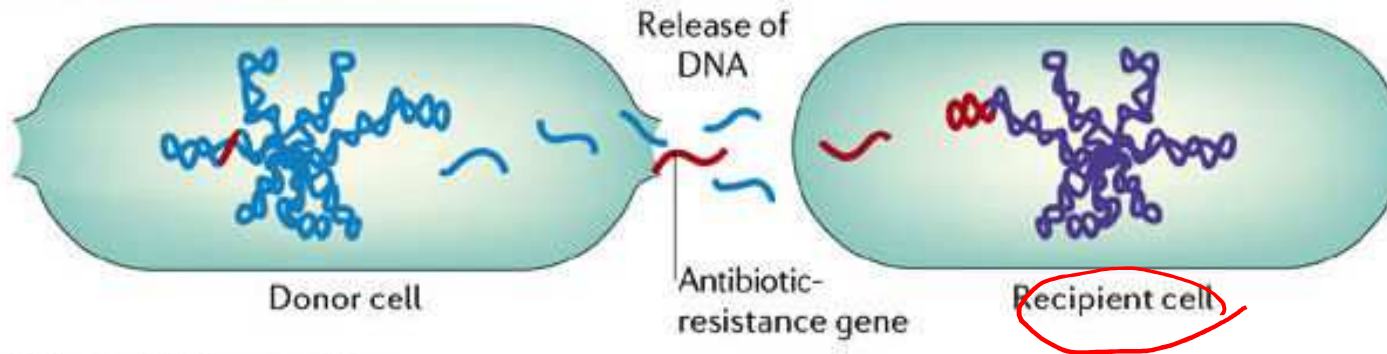
#4

# Horizontal gene transfer

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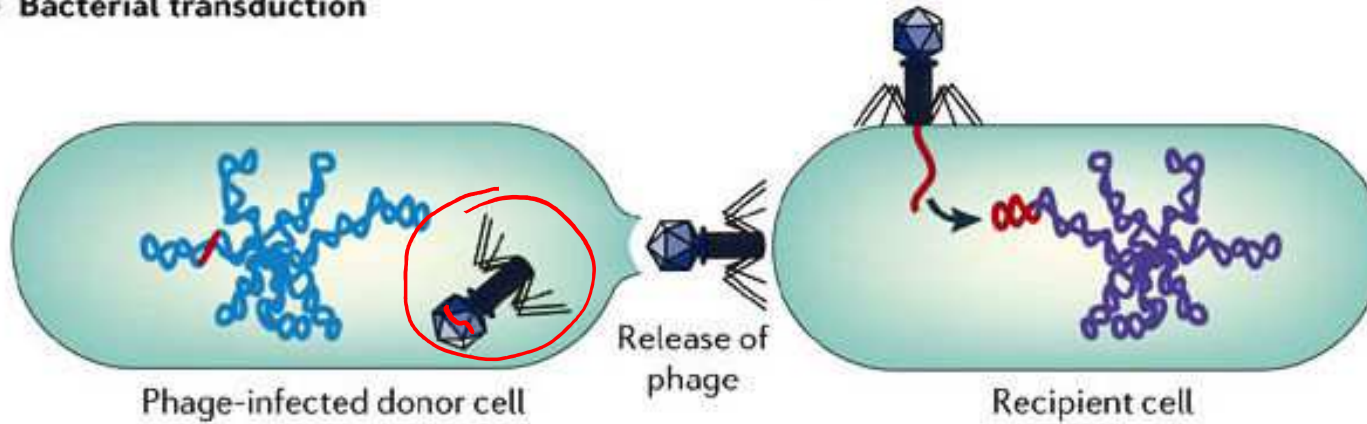
- Movement of genetic material between organisms other than by vertical transmission of DNA
  - cf) Vertical gene transfer: from parent to offspring
- Mechanisms
  - Transformation: direct uptake and incorporation of exogenous genetic material
  - Transduction: introduction of foreign DNA into a cell by a virus
  - Conjugation: transfer of genetic material between bacterial cells by direct cell-to-cell contact or by a bridge-like connection

**a Bacterial transformation**

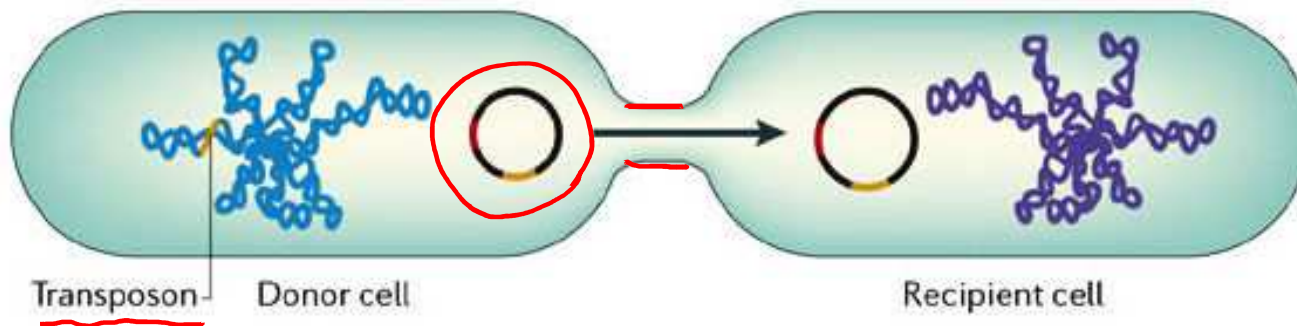


*antibiotic  
resistance*

**b Bacterial transduction**



**c Bacterial conjugation**



*pili*

#5

# Classification of bacteria

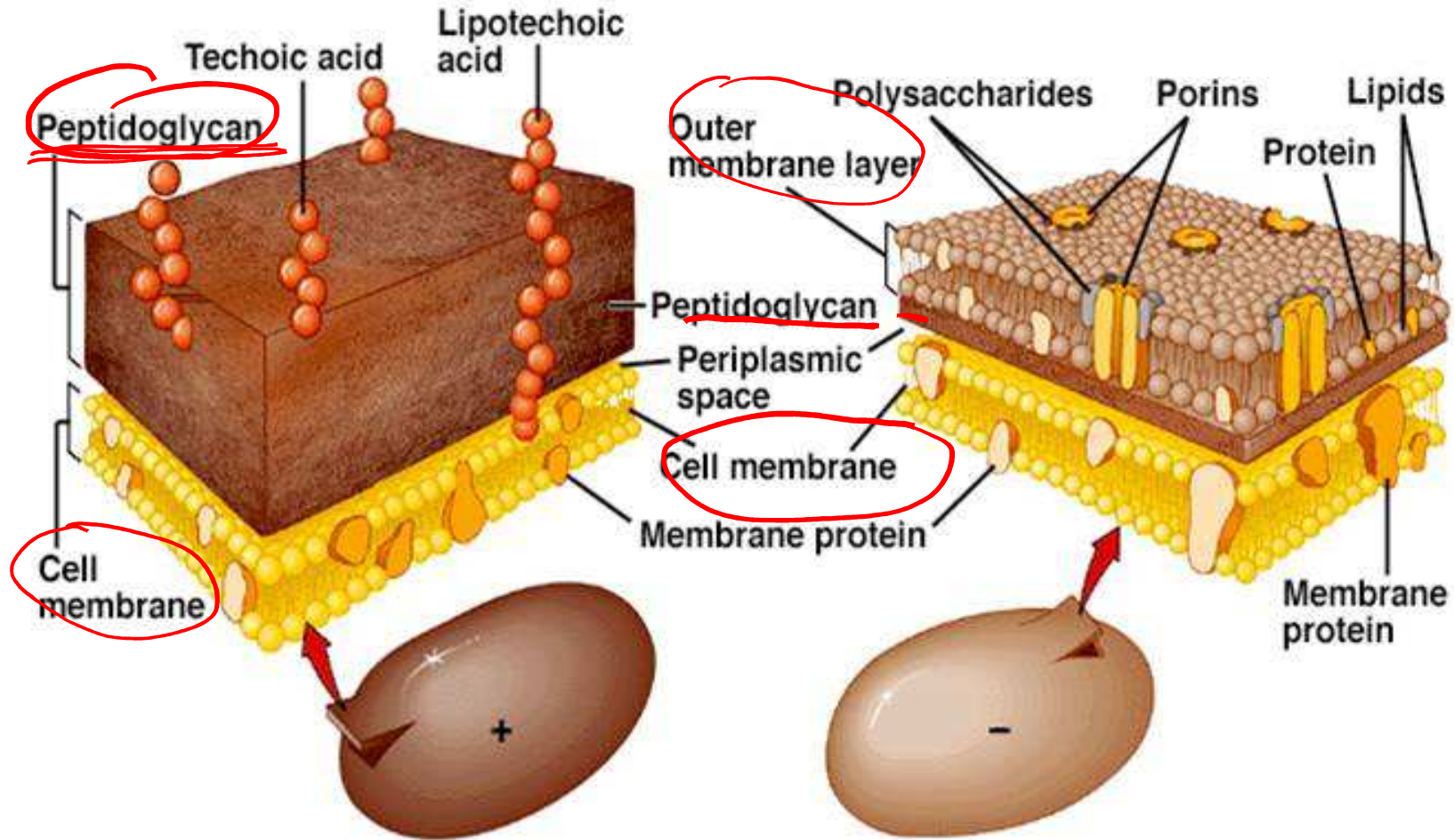
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- By staining:
  - Gram positive & negative
  - Discovered by H. C. Gram in 1884
  - Gram(+): blue-purple / Gram(-): red
  - Based on cell wall characteristics

# Classification of bacteria

Gram Positive

Gram Negative



# Classification of bacteria

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- By energy source: phototrophs & chemotrophs (organotrophs/lithotrophs)
- By carbon source: autotrophs & heterotrophs
- By growth in the presence/absence of O<sub>2</sub>: aerobes & anaerobes
  - obligate anaerobes
  - aerotolerant anaerobes
  - obligate aerobes
  - facultative aerobes

# References

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- #1) <https://www.slideteam.net/0614-prokaryotic-cell-structure-medical-images-for-powerpoint.html>
- #2) <https://en.wikipedia.org/wiki/DNA>
- #3) <https://en.wikipedia.org/wiki/RNA>
- #4) <http://nepad-abne.net/biotechnology/process-of-developing-genetically-modified-gm-crops/commonly-used-plasmidsvectors/>
- #5) Furuya, E. Y., Lowy, F. D. (2006) Antimicrobial-resistant bacteria in the community setting. *Nature Reviews Microbiology*, 4:36-45.
- #6) <https://medimoon.com/2013/04/why-is-it-more-difficult-to-treat-gram-negative-bacteria/>