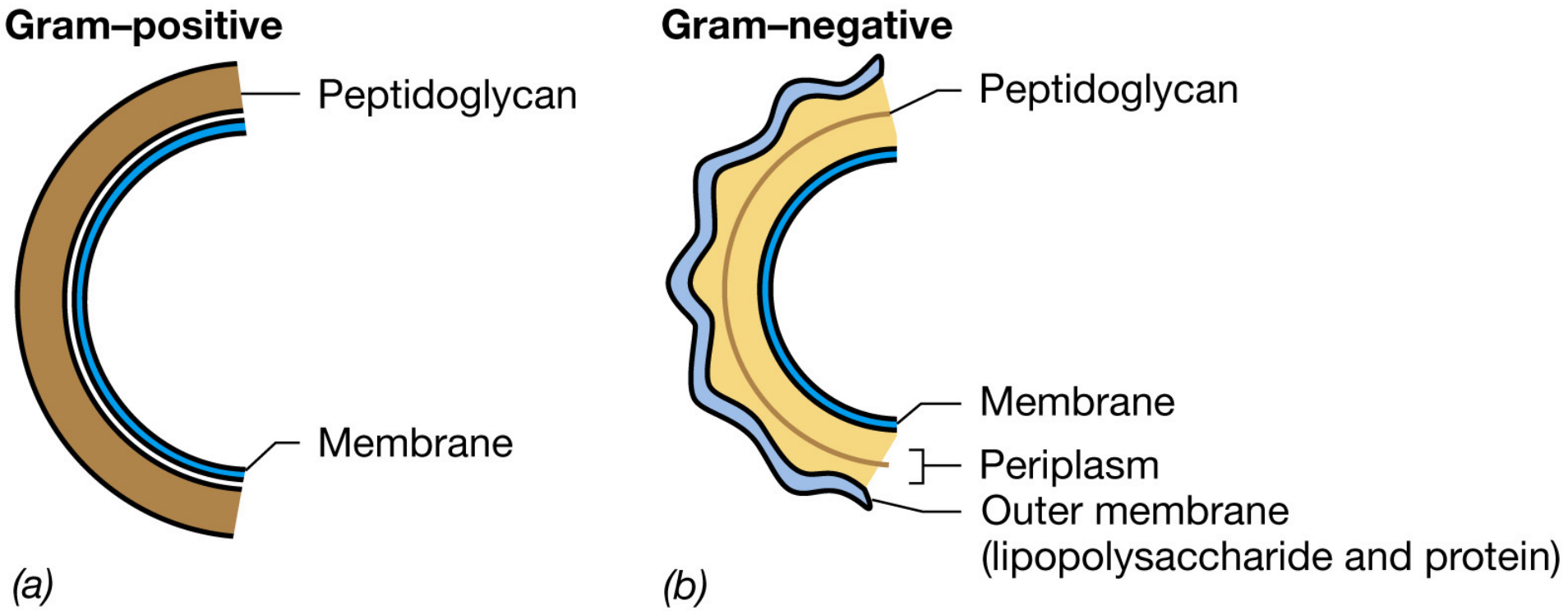
Comparing Prokaryotic and Eukaryotic Cells

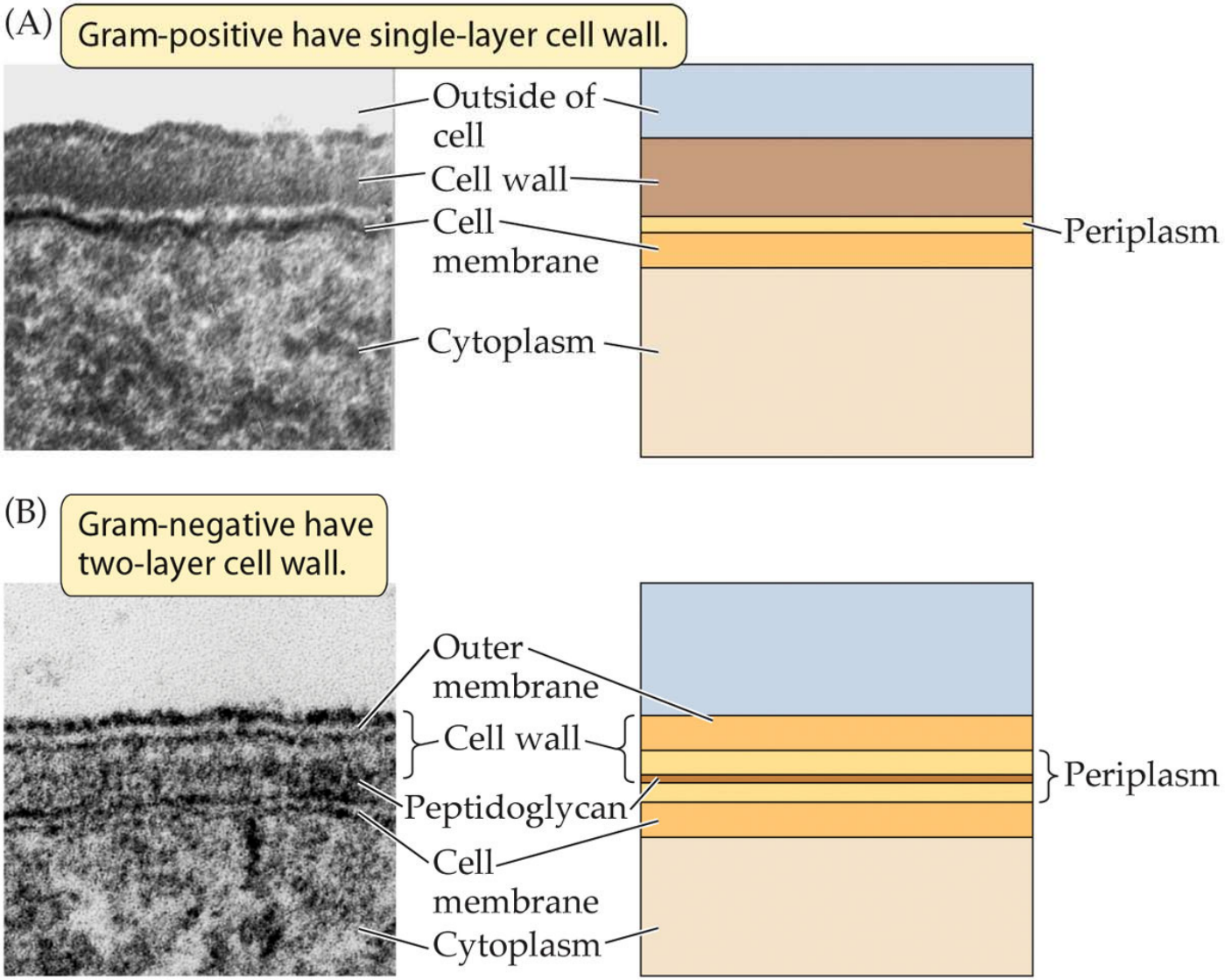
Classification of prokaryotic cellular features: Variant (or NOT common to all)

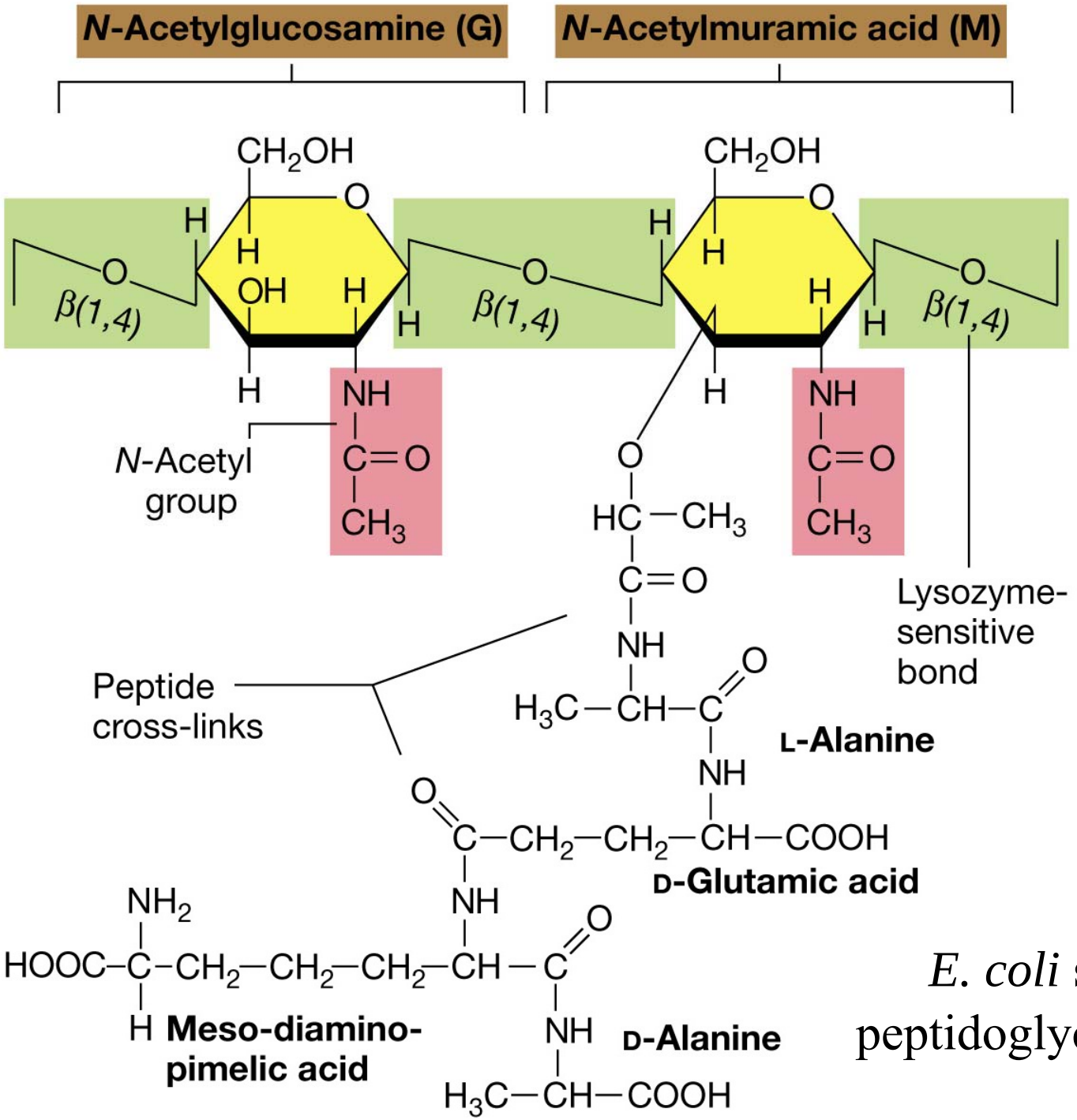
- Cell Wall (multiple barrier support themes)
- Endospores (heavy-duty life support strategy)
- Bacterial Flagella (appendages for movement)
- Gas Vesicles (buoyancy compensation devices)
- Capsules/Slime Layer (exterior to cell wall)
- Inclusion Bodies (granules for storage)
- Pili (conduit for genetic exchange)

Cell walls of *Bacteria*



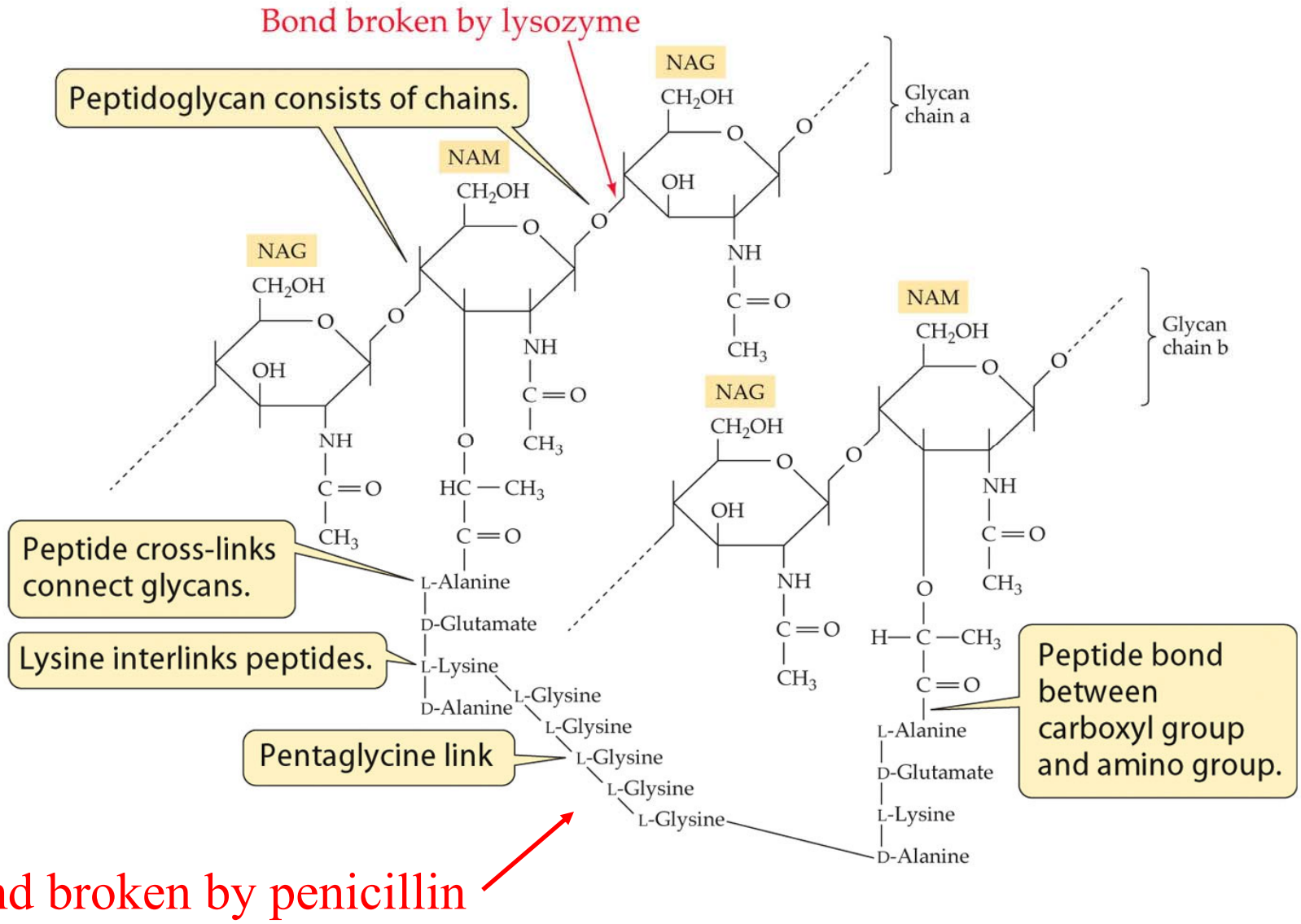
Cell envelope structure

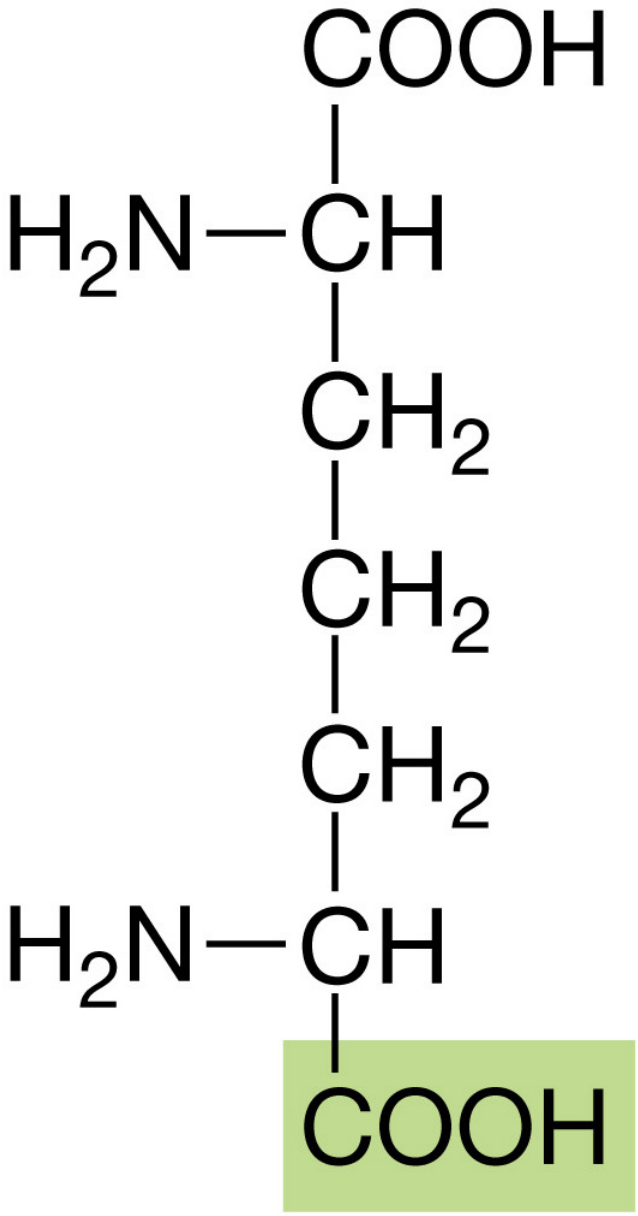




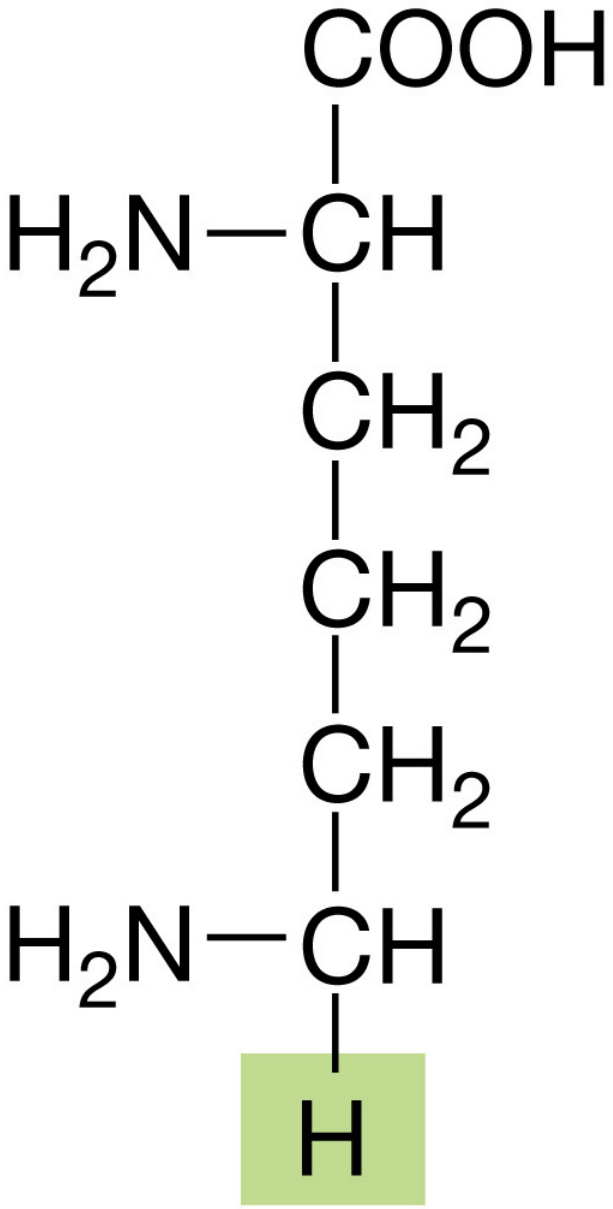
E. coli structure of peptidoglycan aka murein

Peptidoglycan of a gram-positive bacterium

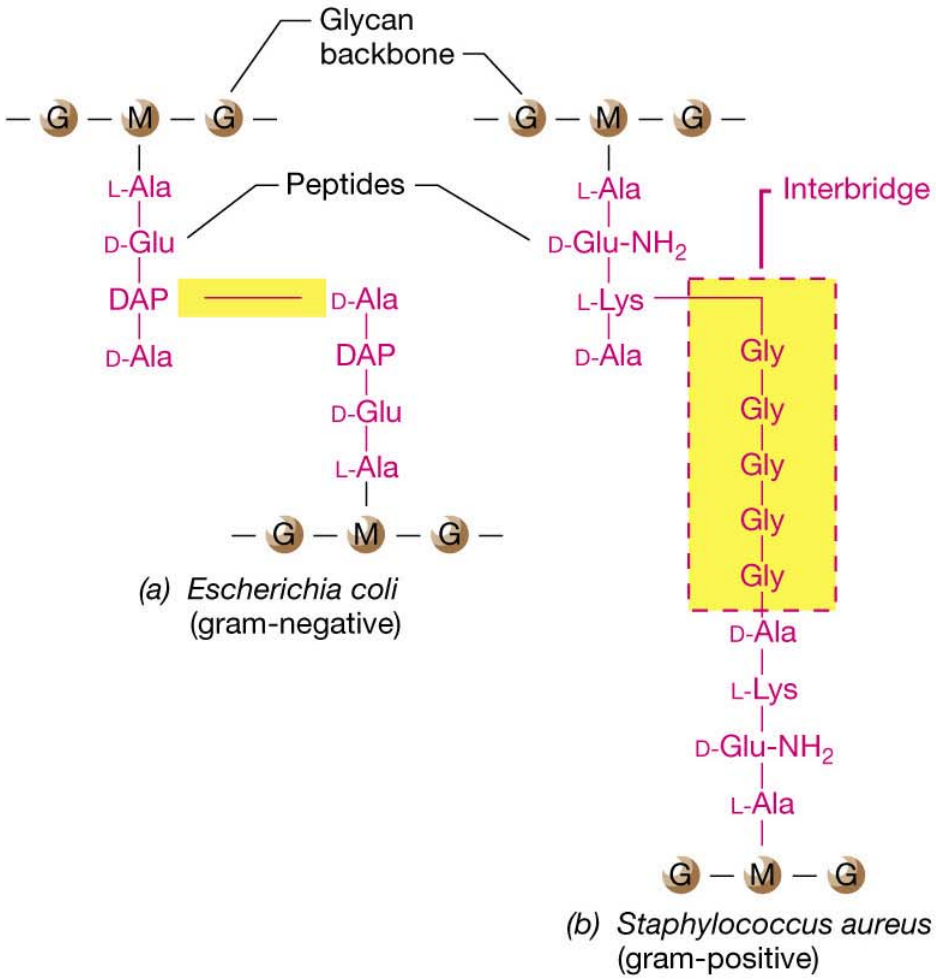


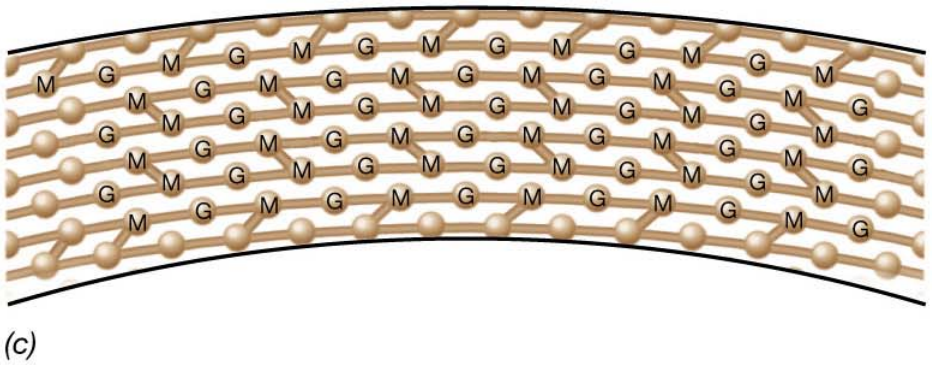


(a) DAP or Diaminopimelic acid



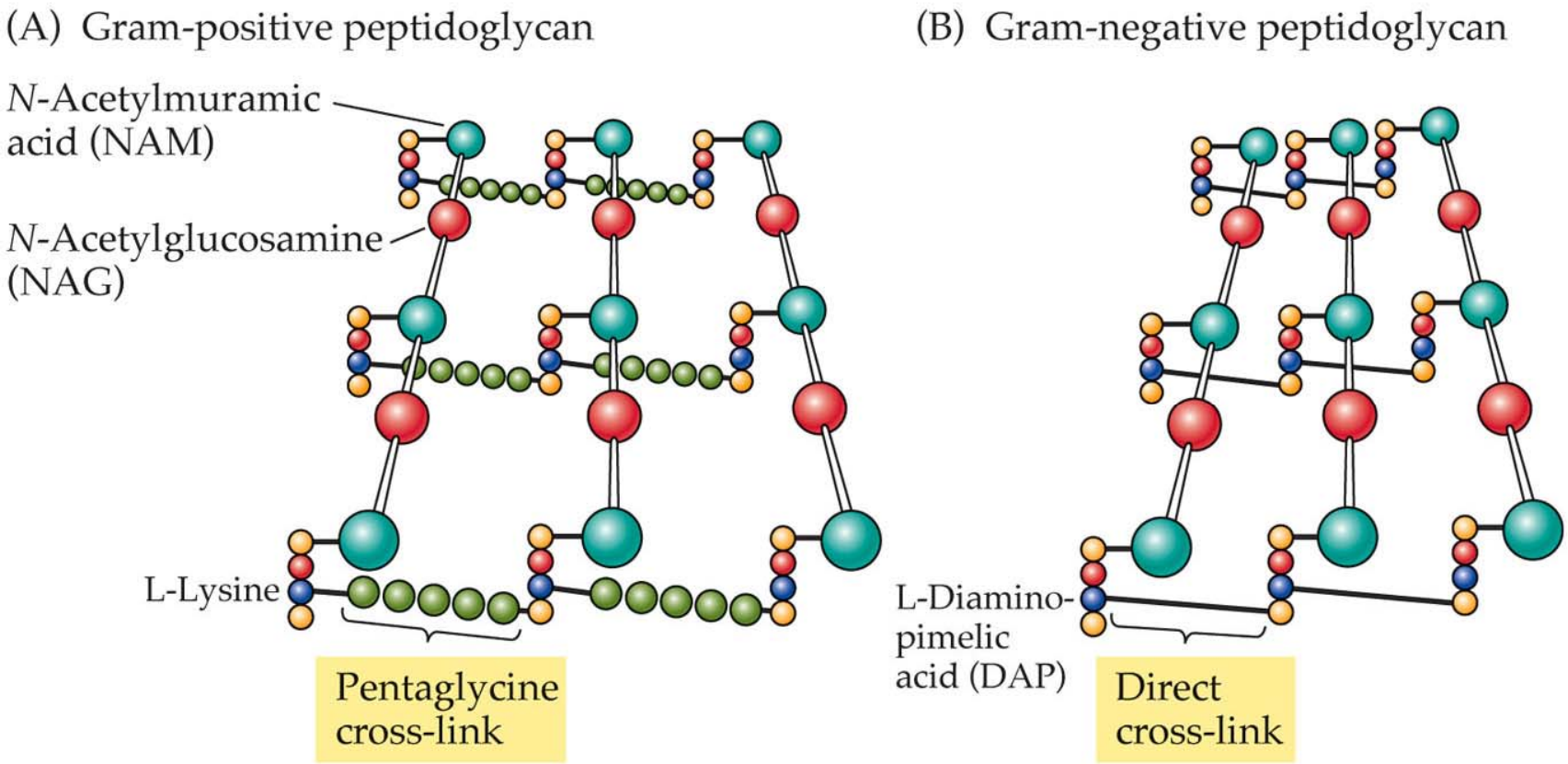
(b) Lysine

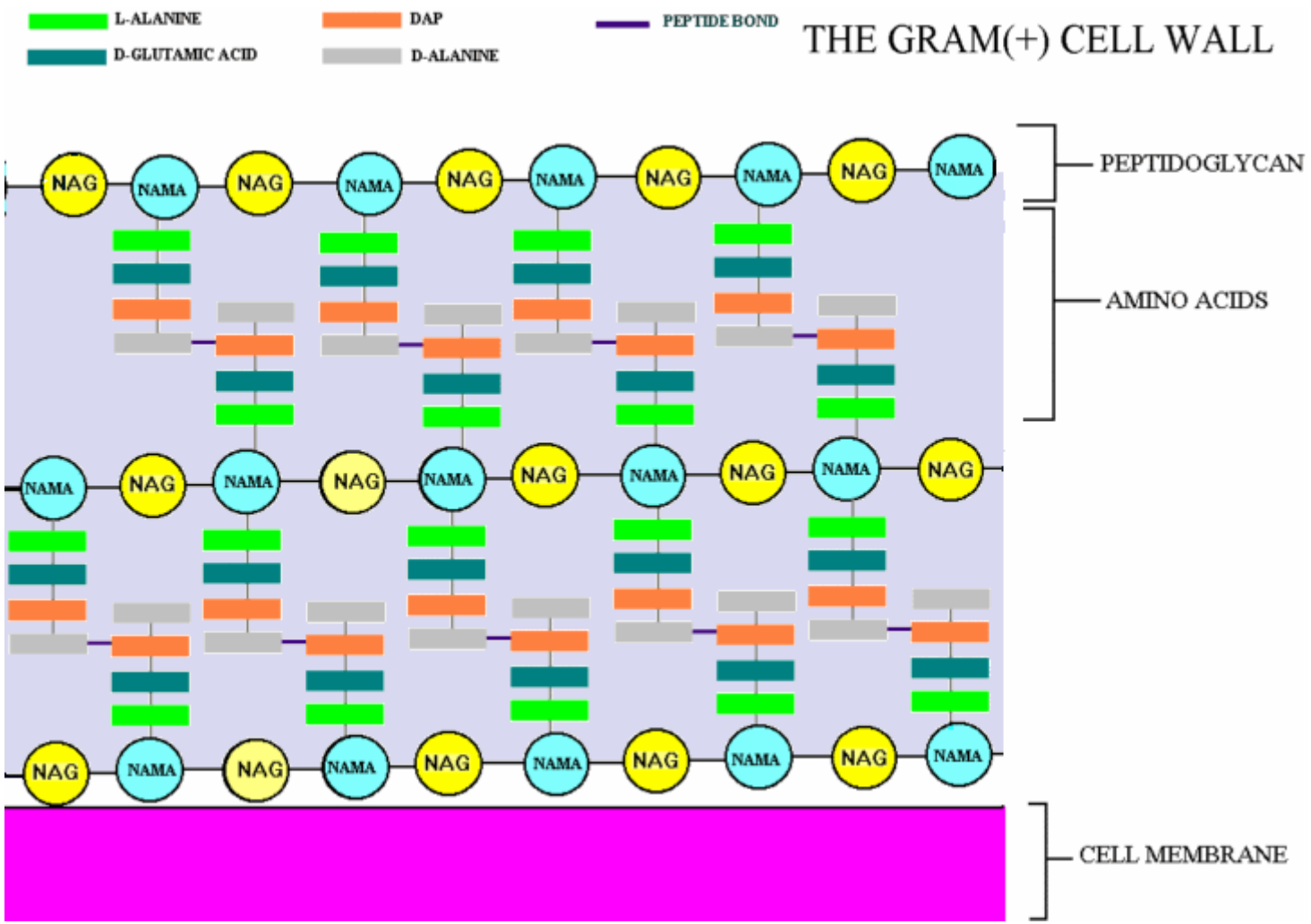


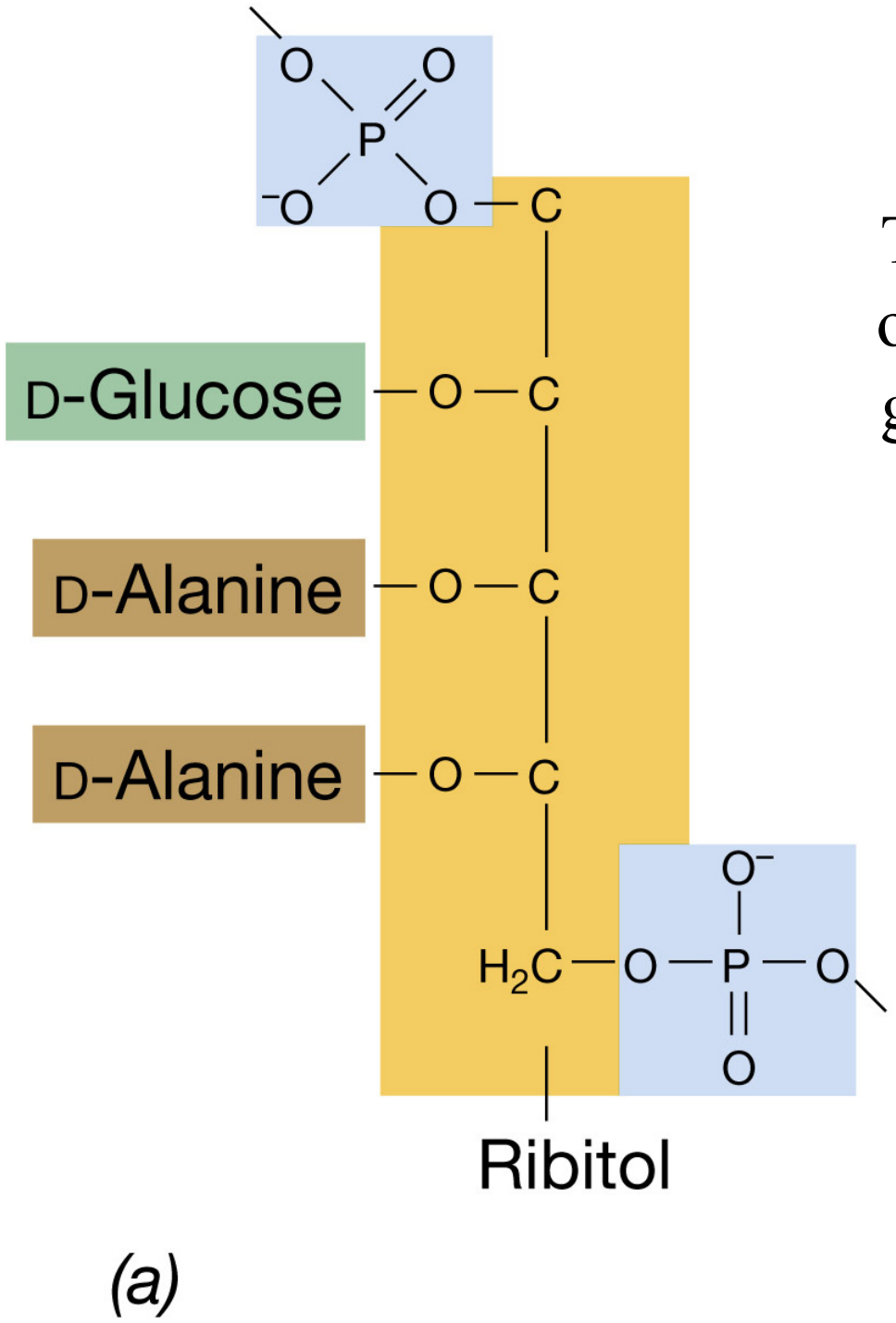


Overall structure of peptidoglycan

Cell walls of gram-positive and gram-negative bacteria

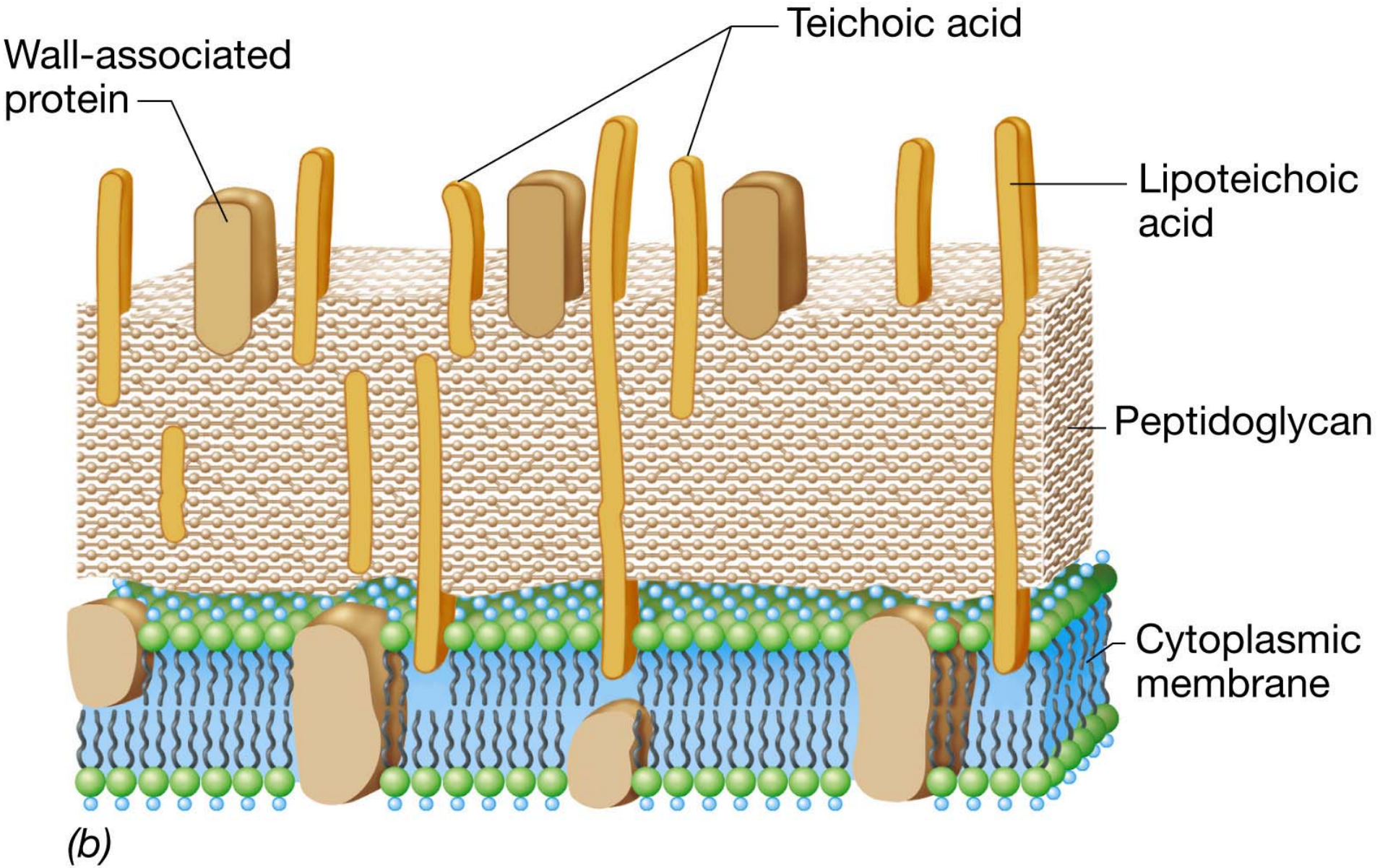



L-ALANINE
D-GLUTAMIC ACID
DAP
D-ALANINE
PEPTIDE BOND
THE GRAM(+) CELL WALL
NAG
NAMA
PEPTIDOGLYCAN
AMINO ACIDS
CELL MEMBRANE



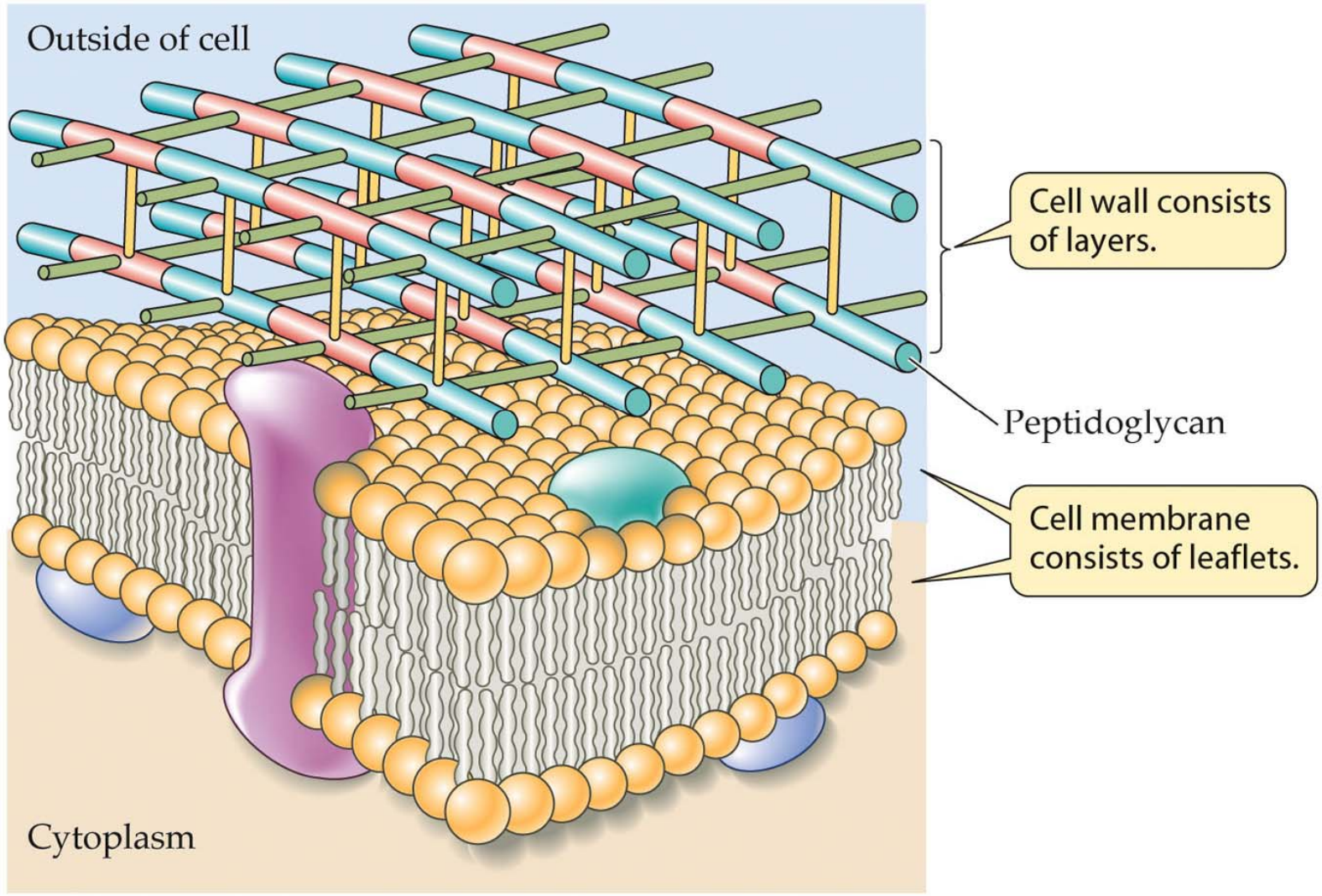
Teichoic acids and the overall structure of the gram-positive cell wall

Summary diagram of the gram-positive cell wall

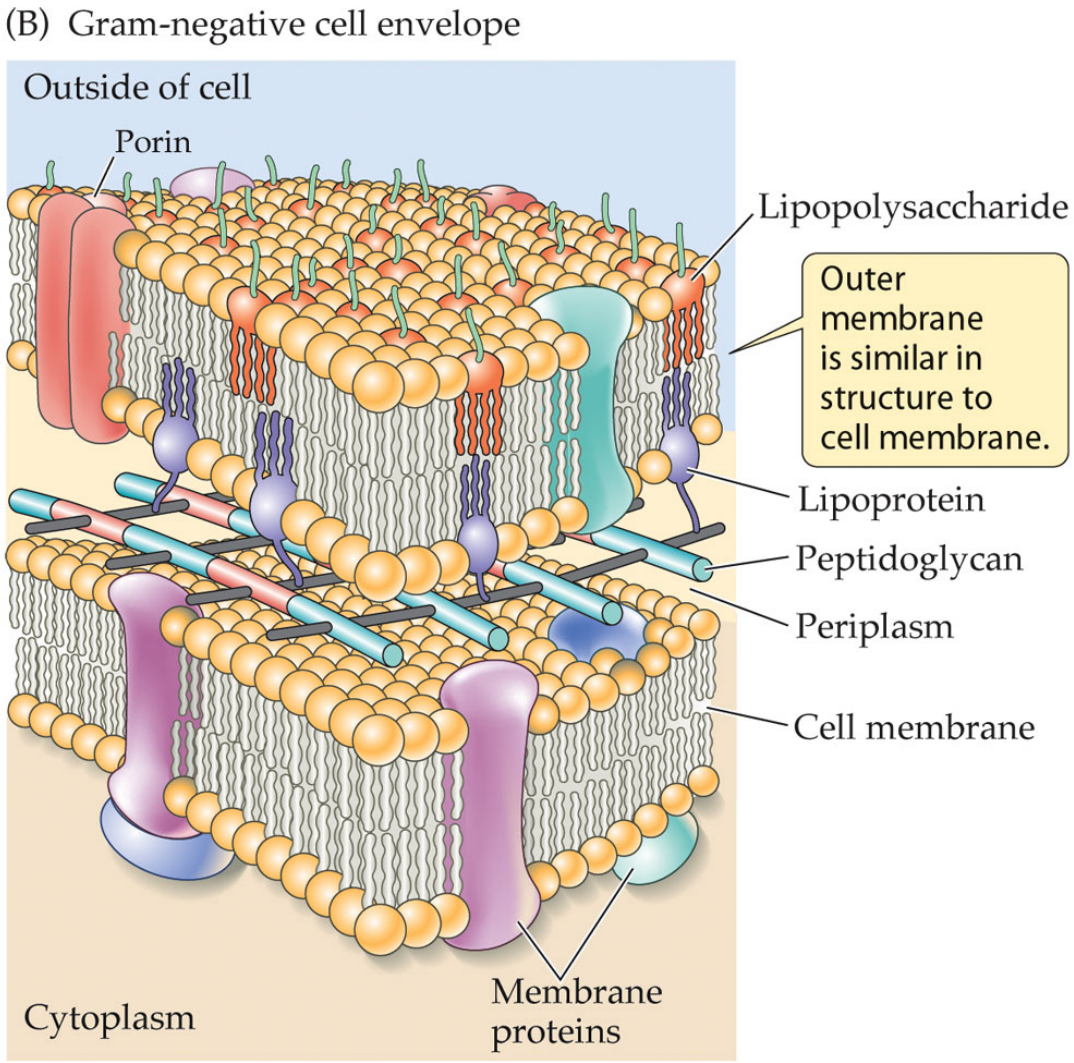


Cell envelopes of *Bacteria*

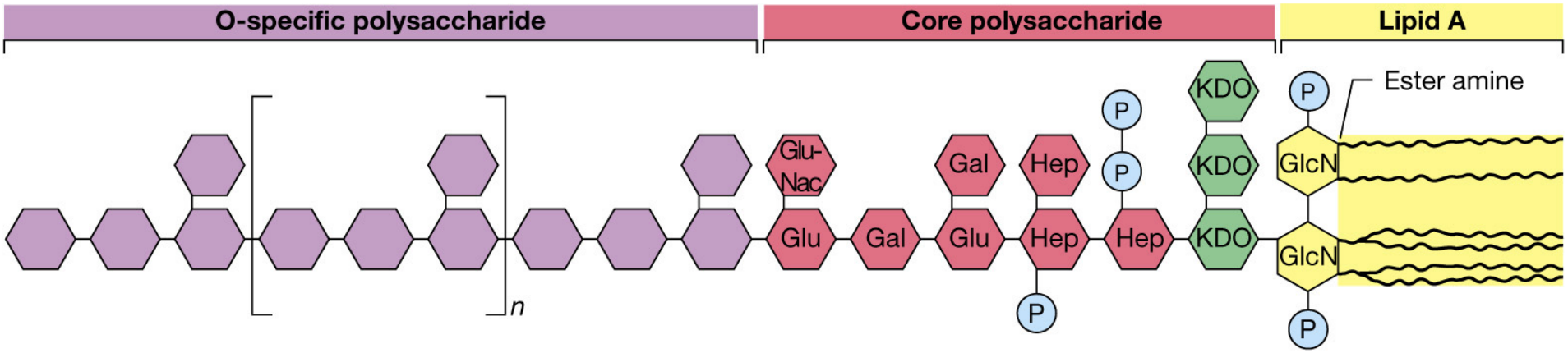
(A) Gram-positive cell envelope



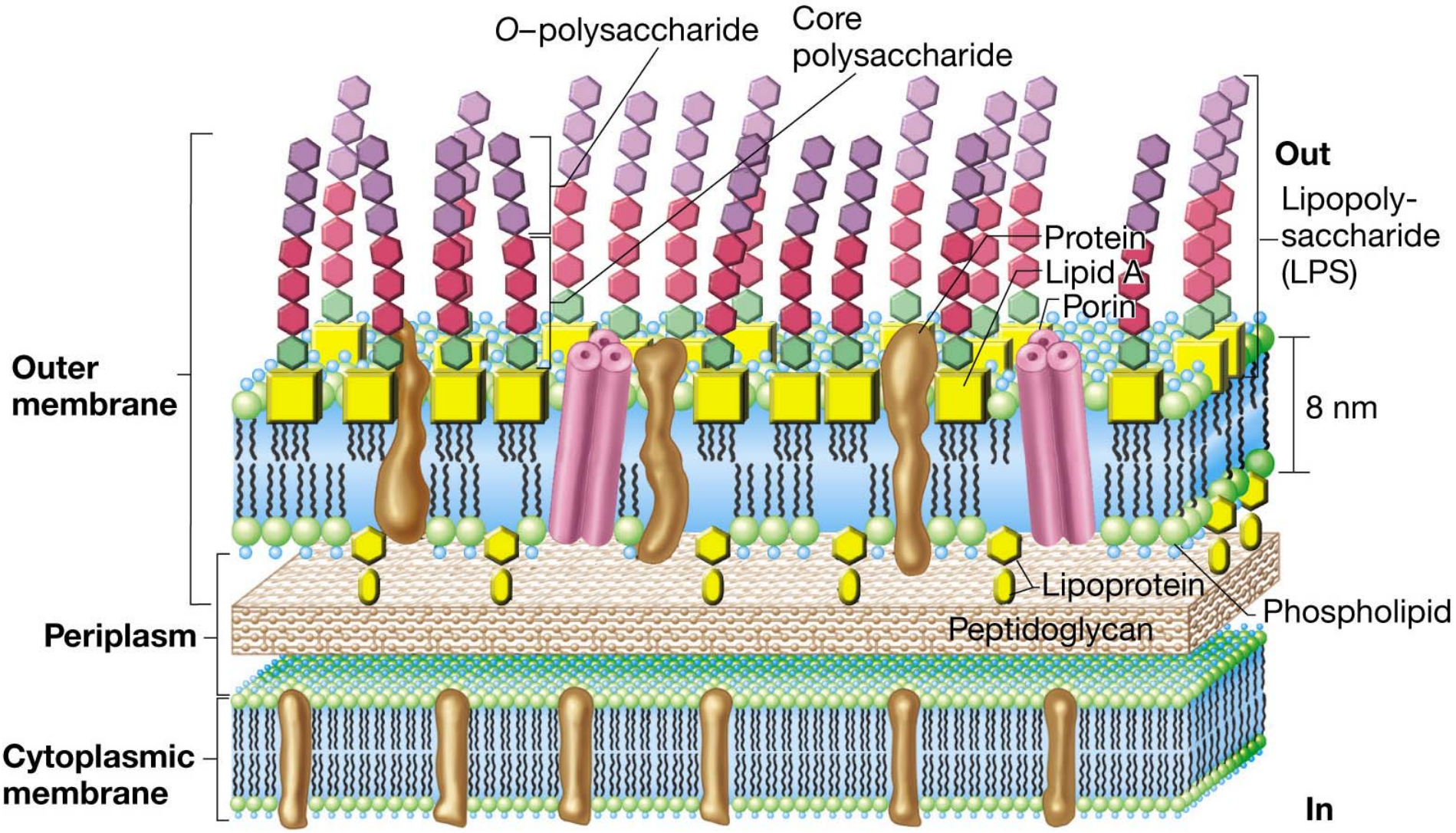
Cell envelopes of *Bacteria*

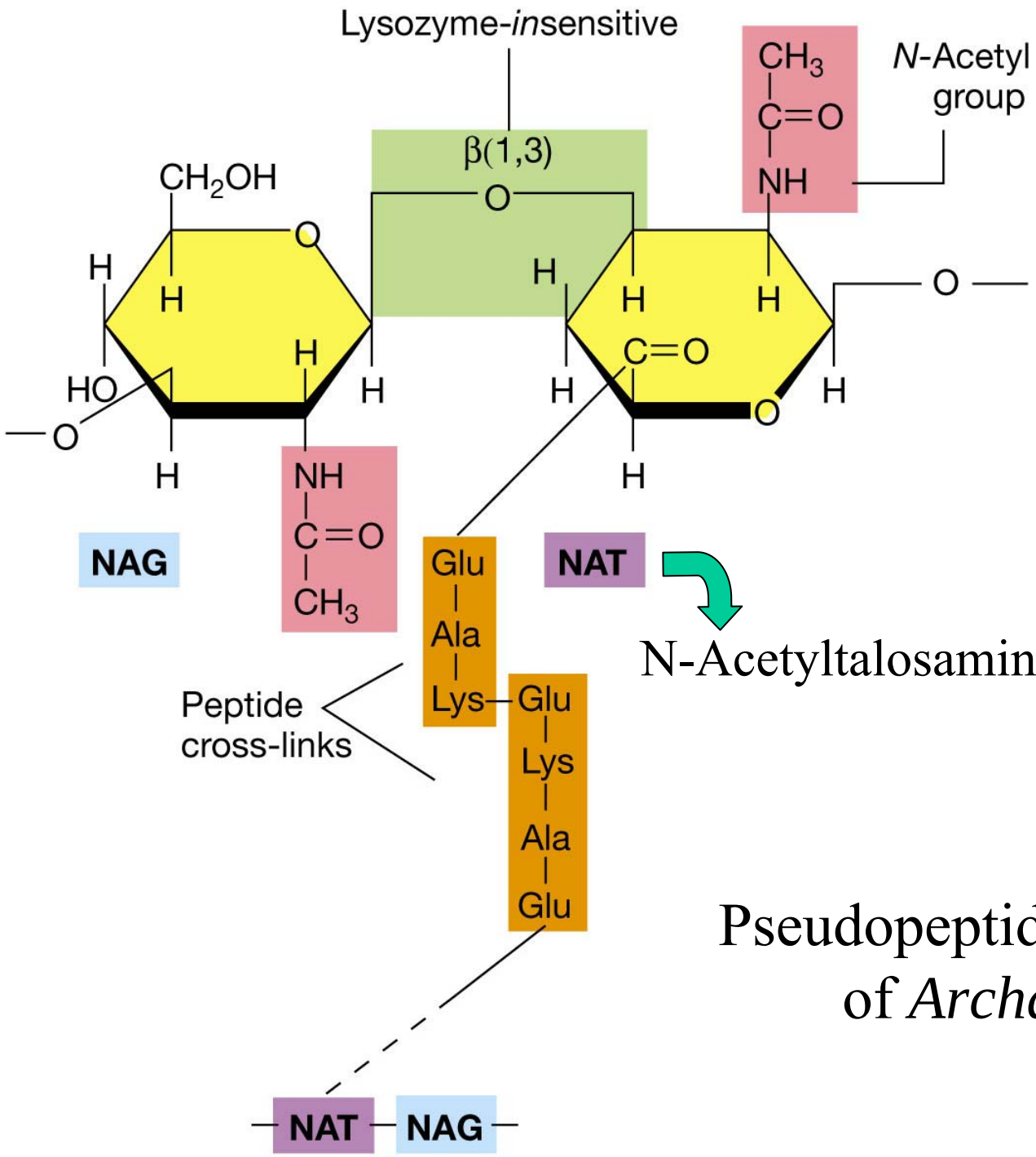


Structure of the lipopolysaccharide of gram-negative *Bacteria*



The gram-negative cell wall

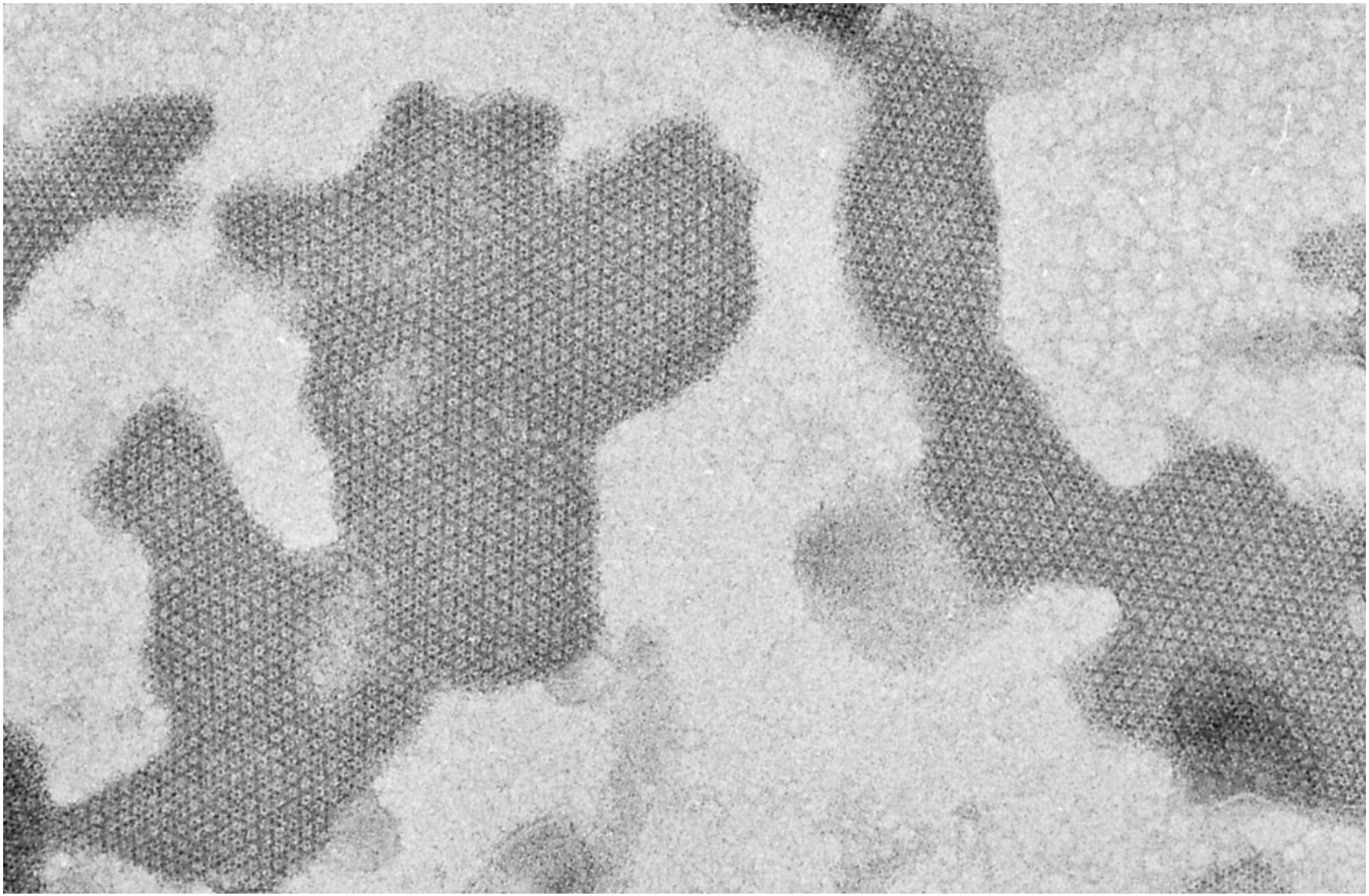




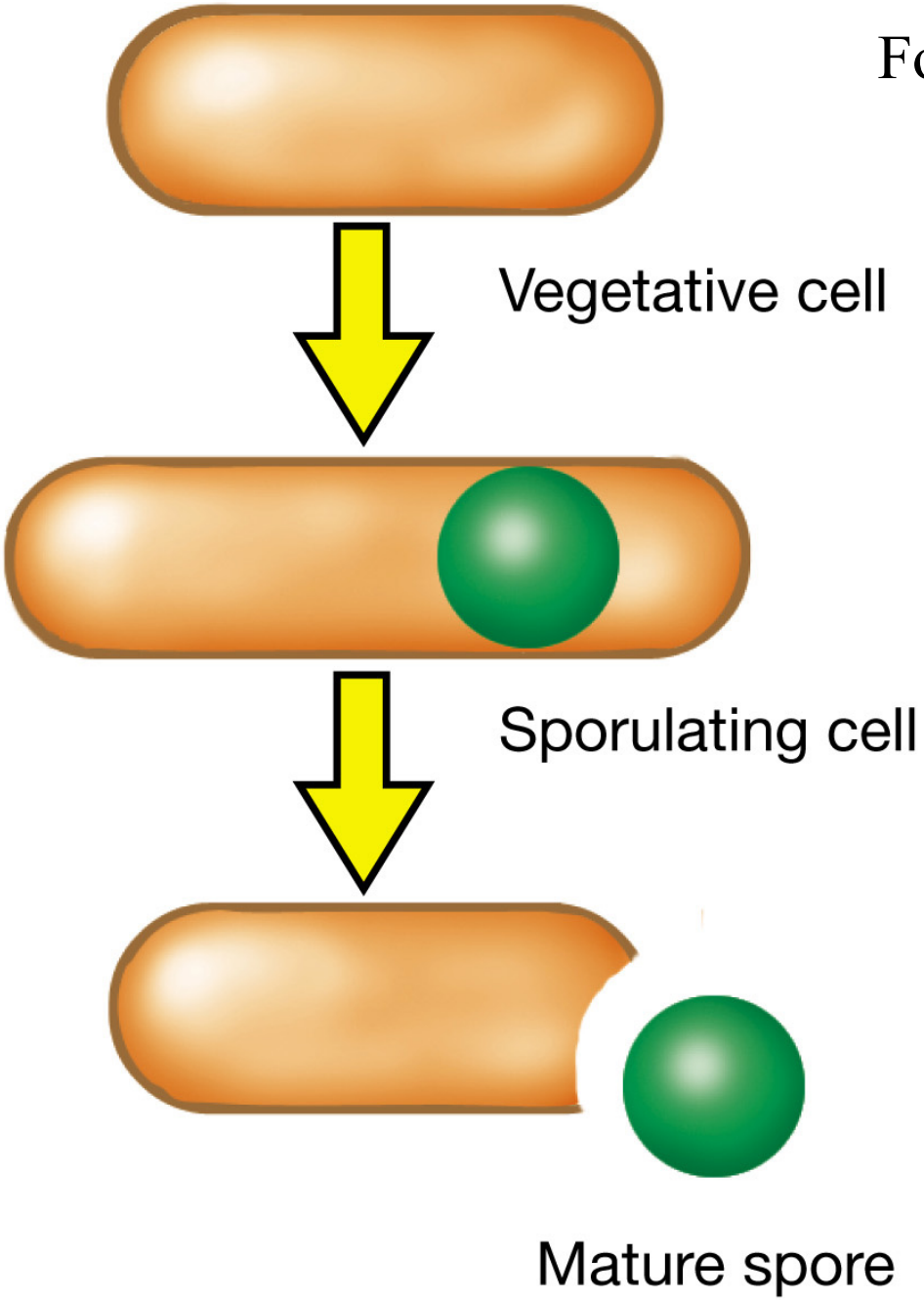
N-Acetyltalosaminuronic acid

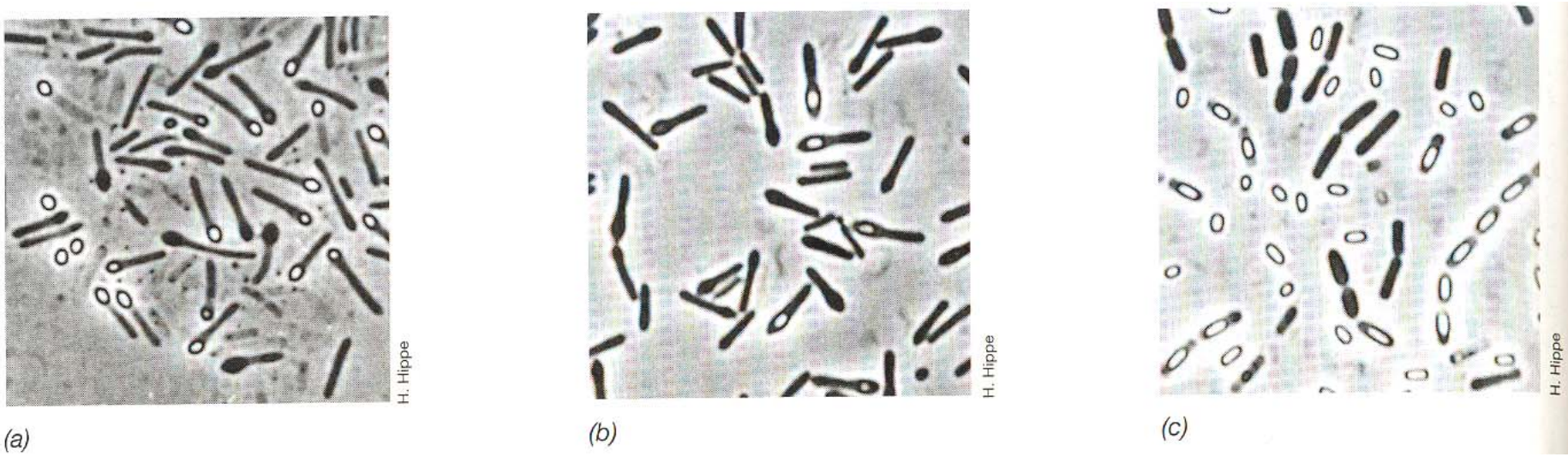
Pseudopeptidoglycan of *Archaea*

Paracrystalline S-layer: A protein jacket for *Bacteria* & *Archaea*



Formation of the endospore





Morphology of the bacterial endospore
(a) Terminal (b) Subterminal (c) Central

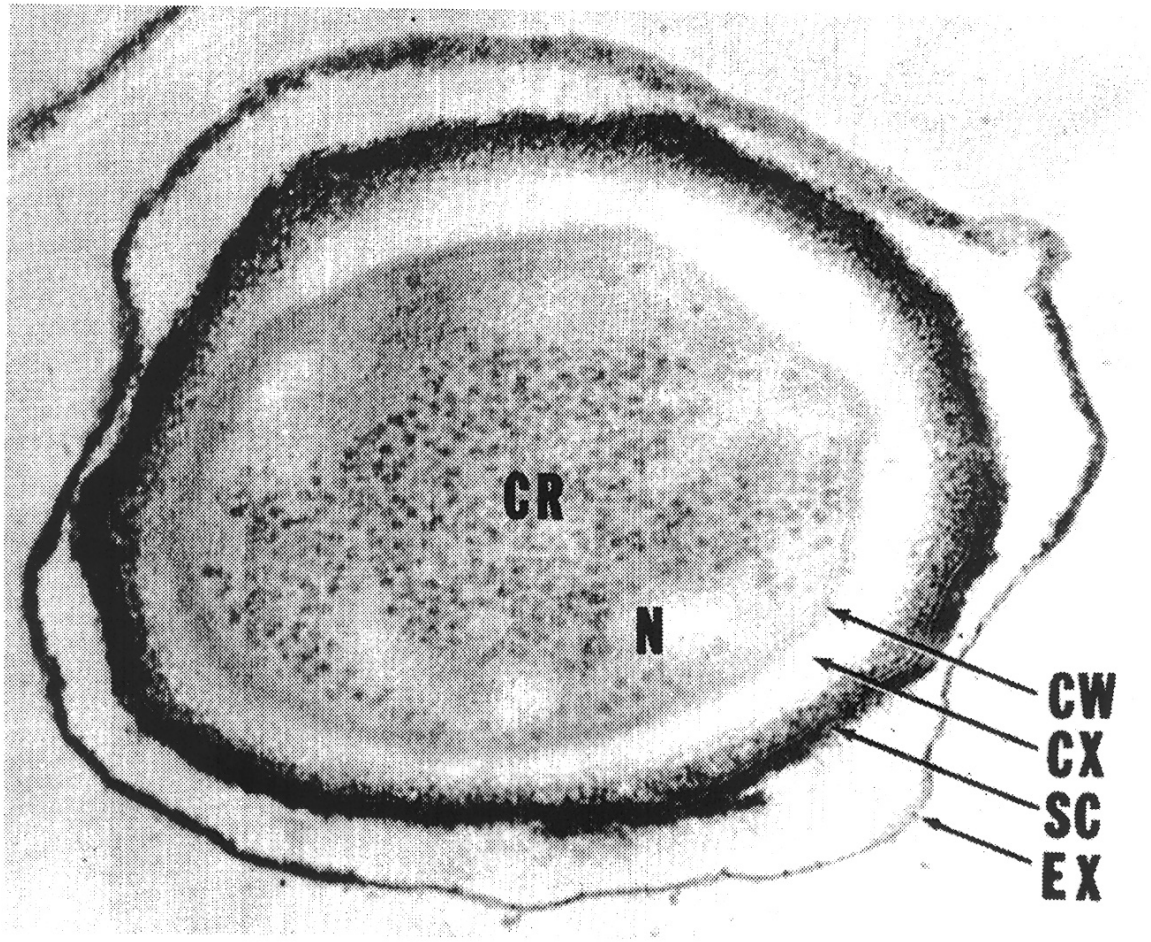
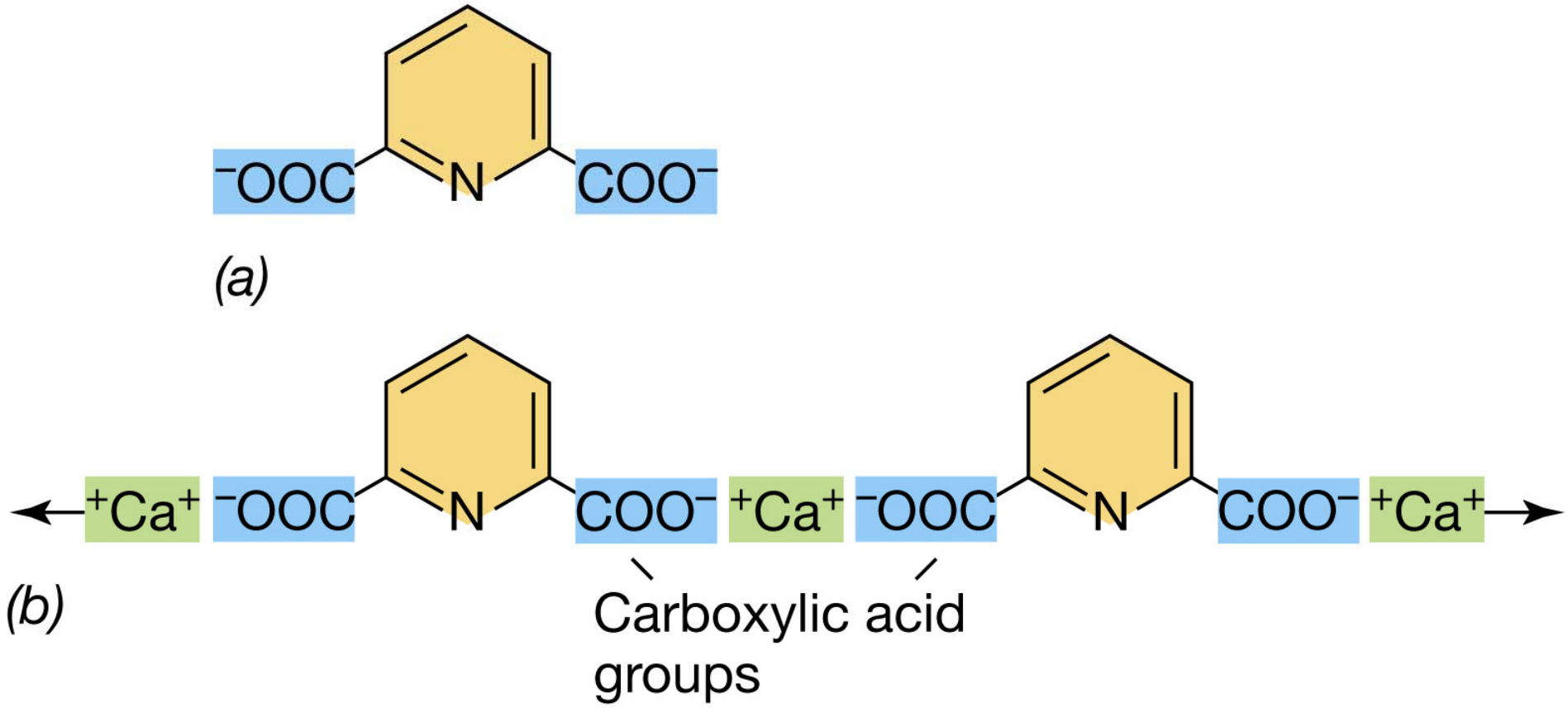


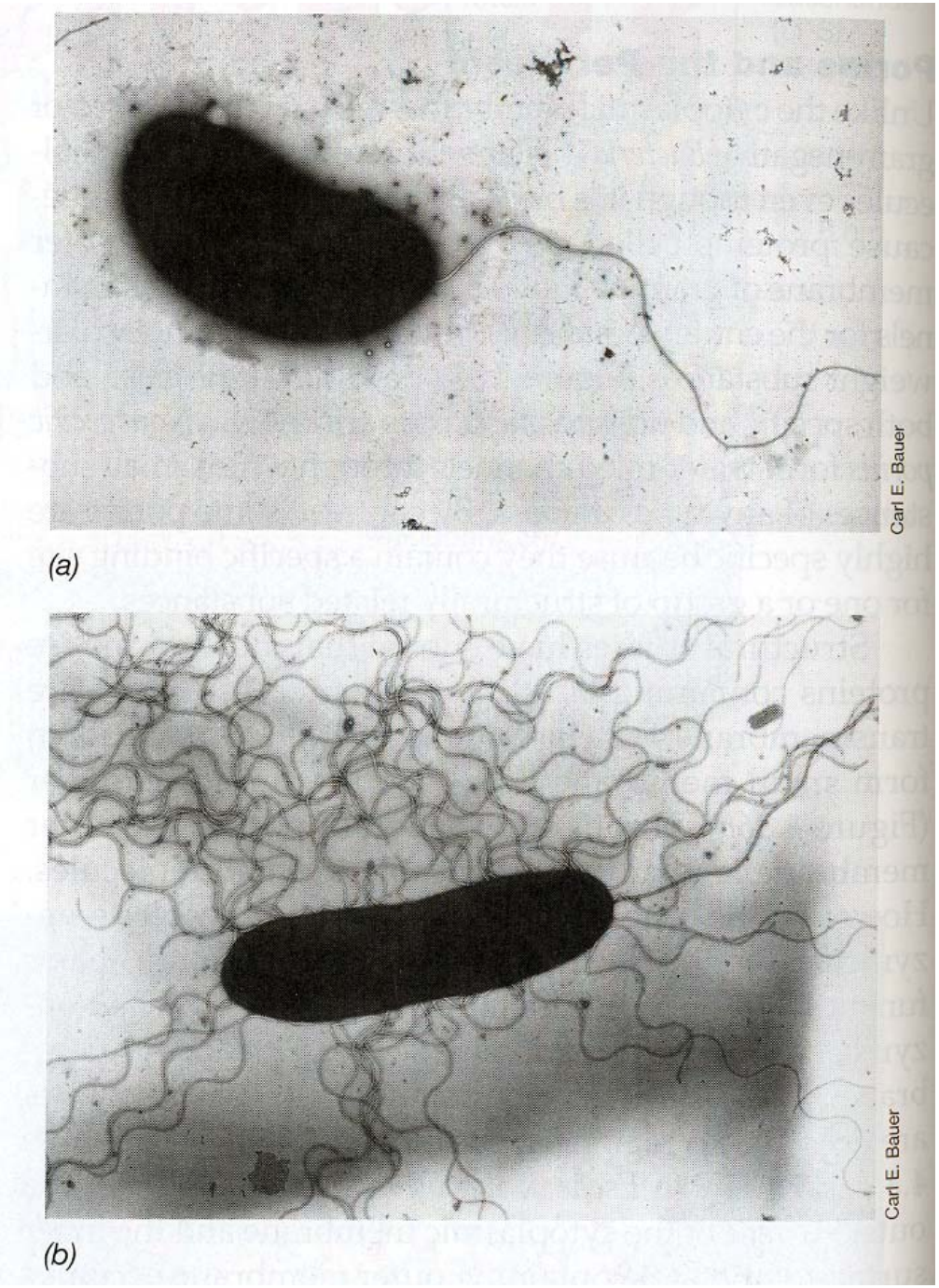
Figure 3.45 Endospore Structure. *Bacillus anthracis* endospore (×151,000). Note the following structures: exosporium, EX; spore coat, SC; cortex, CX; core wall, CW; and the protoplast or core with its nucleoid, N, and ribosomes, CR.



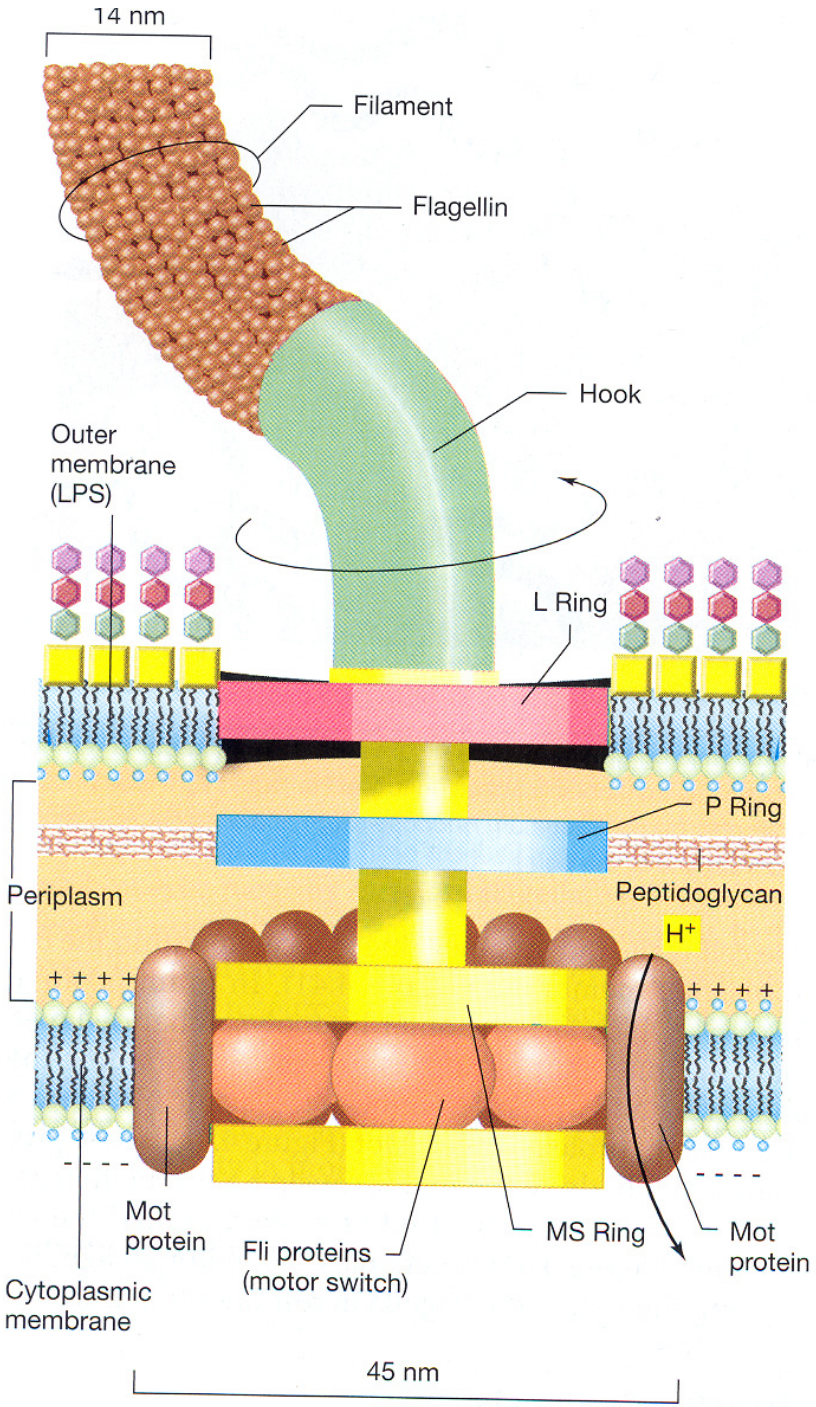
(a) Structure of Dipicolinic Acid & (b) crosslinked with Ca^{++}

Table 4.2 Differences between endospores and vegetative cells

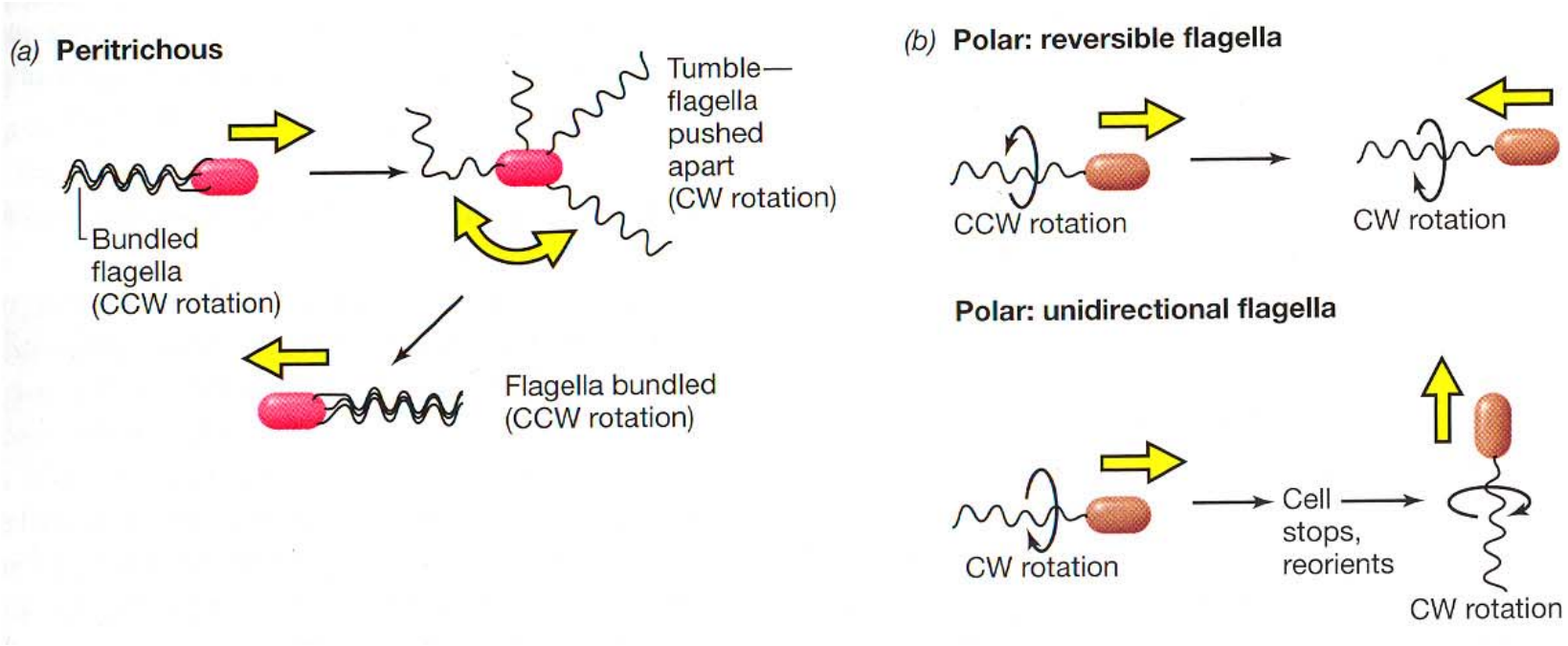
Characteristic	Vegetative cell	Endospore
Structure	Typical gram-positive cell; a few gram-negative cells	Thick spore cortex Spore coat Exosporium
Microscopic appearance	Nonrefractile	Refractile
Calcium content	Low	High
Dipicolinic acid	Absent	Present
Enzymatic activity	High	Low
Metabolism (O_2 uptake)	High	Low or absent
Macromolecular synthesis	Present	Absent
mRNA	Present	Low or absent
Heat resistance	Low	High
Radiation resistance	Low	High
Resistance to chemicals (for example, H_2O_2) and acids	Low	High
Stainability by dyes	Stainable	Stainable only with special methods
Action of lysozyme	Sensitive	Resistant
Water content	High, 80–90%	Low, 10–25% in core
Small acid-soluble proteins (product of *ssp* genes)	Absent	Present
Cytoplasmic pH	About pH 7	About pH 5.5–6.0 (in core)



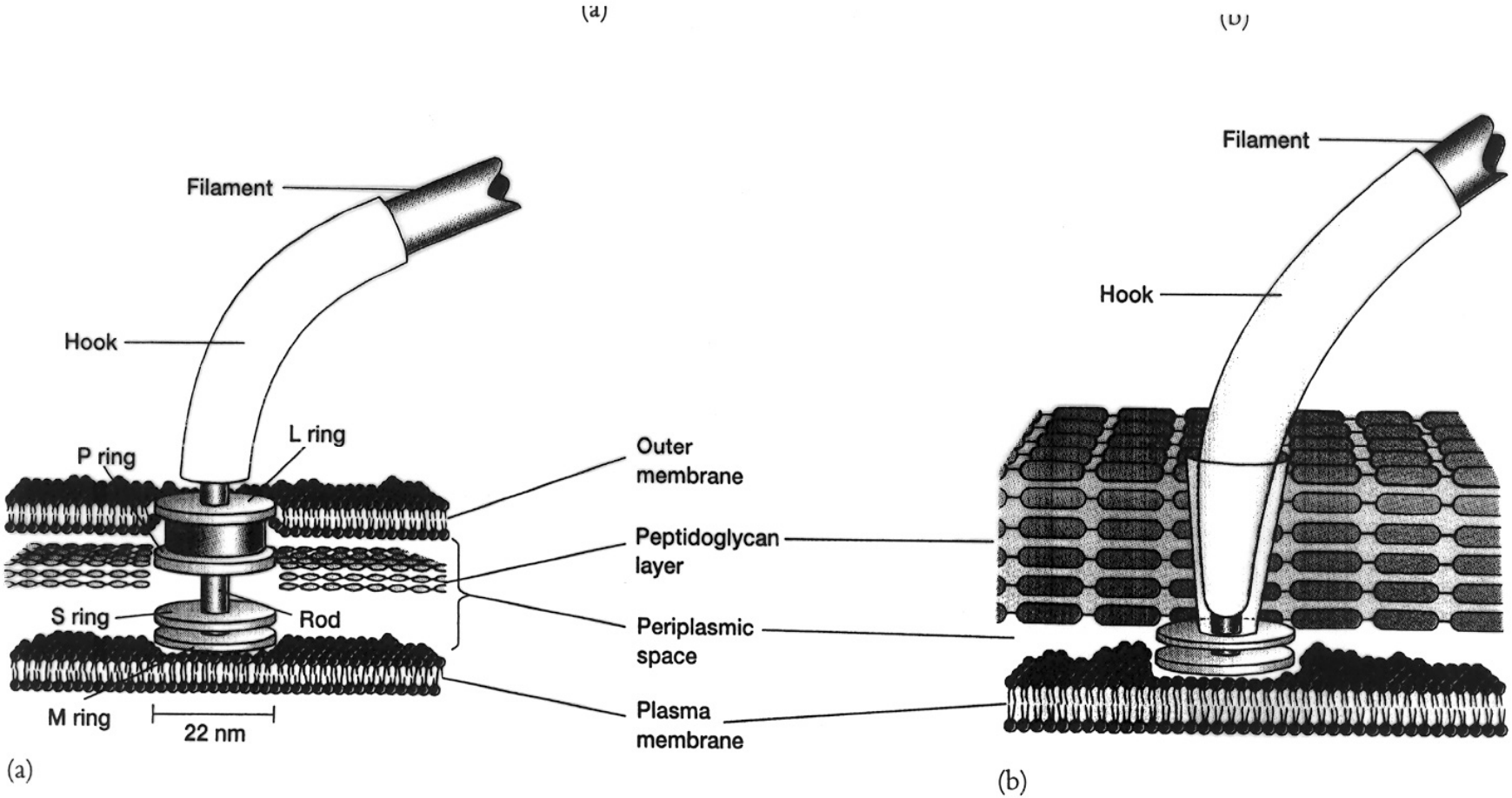
Bacterial flagella
(a) Polar (aka monotrichous)
&
(b) Peritrichous



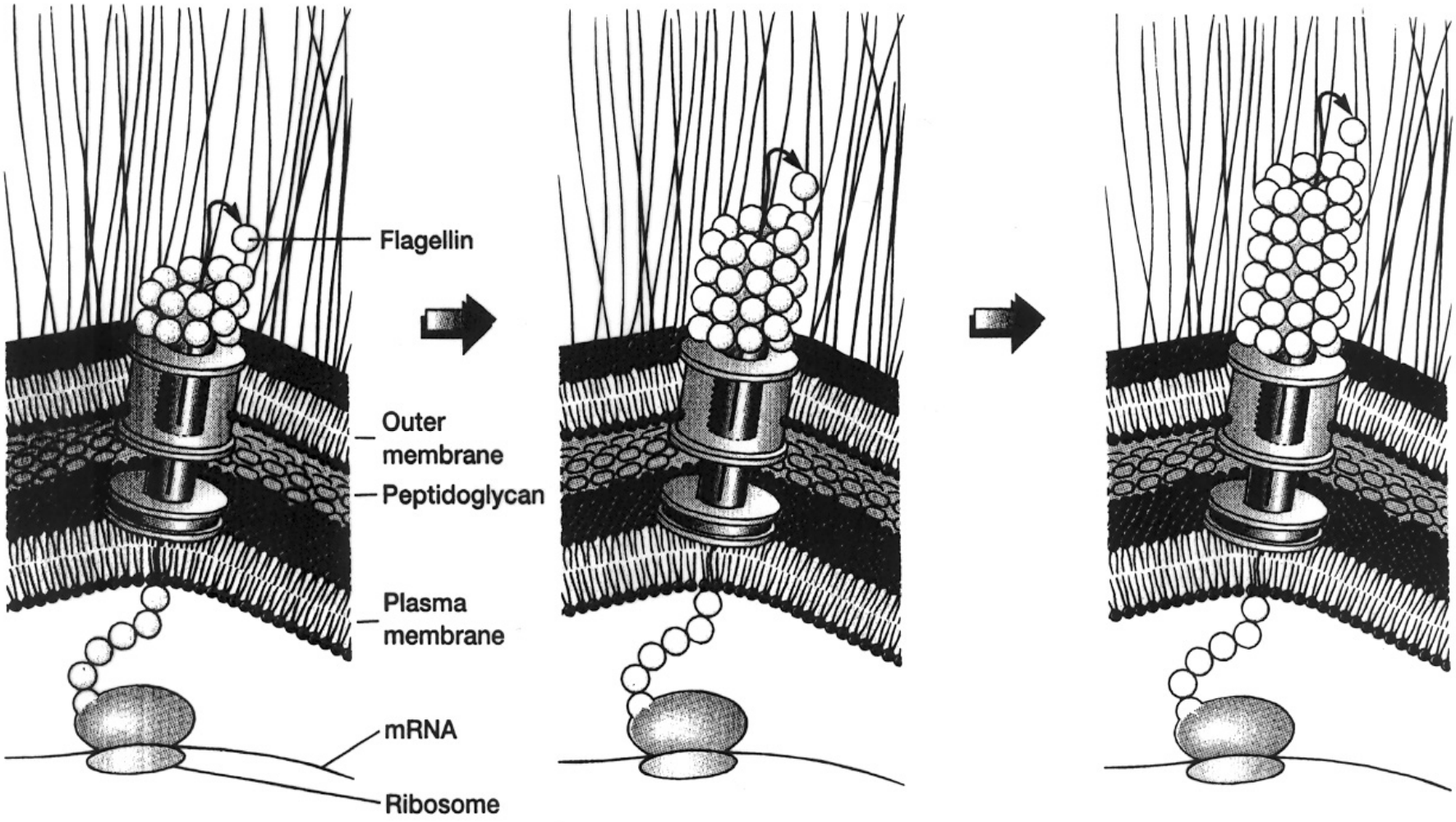
Structure of the bacterial flagellum



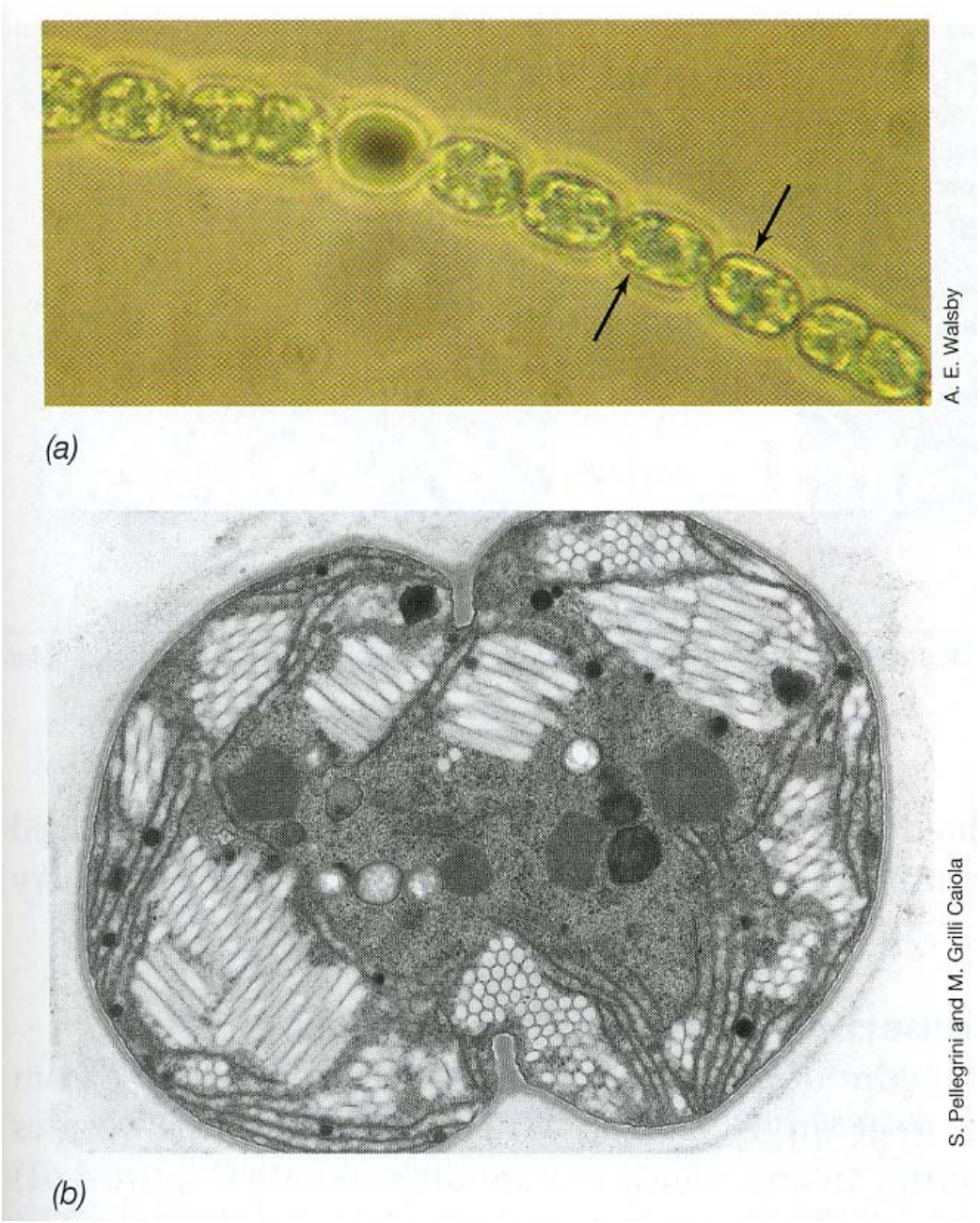
Flagellar Motility: Relationship of flagellar rotation to bacterial movement.



The Ultrastructure of Bacterial Flagella. Flagellar basal bodies and hooks in (*a*) gram-negative and (*b*) gram-positive bacteria.



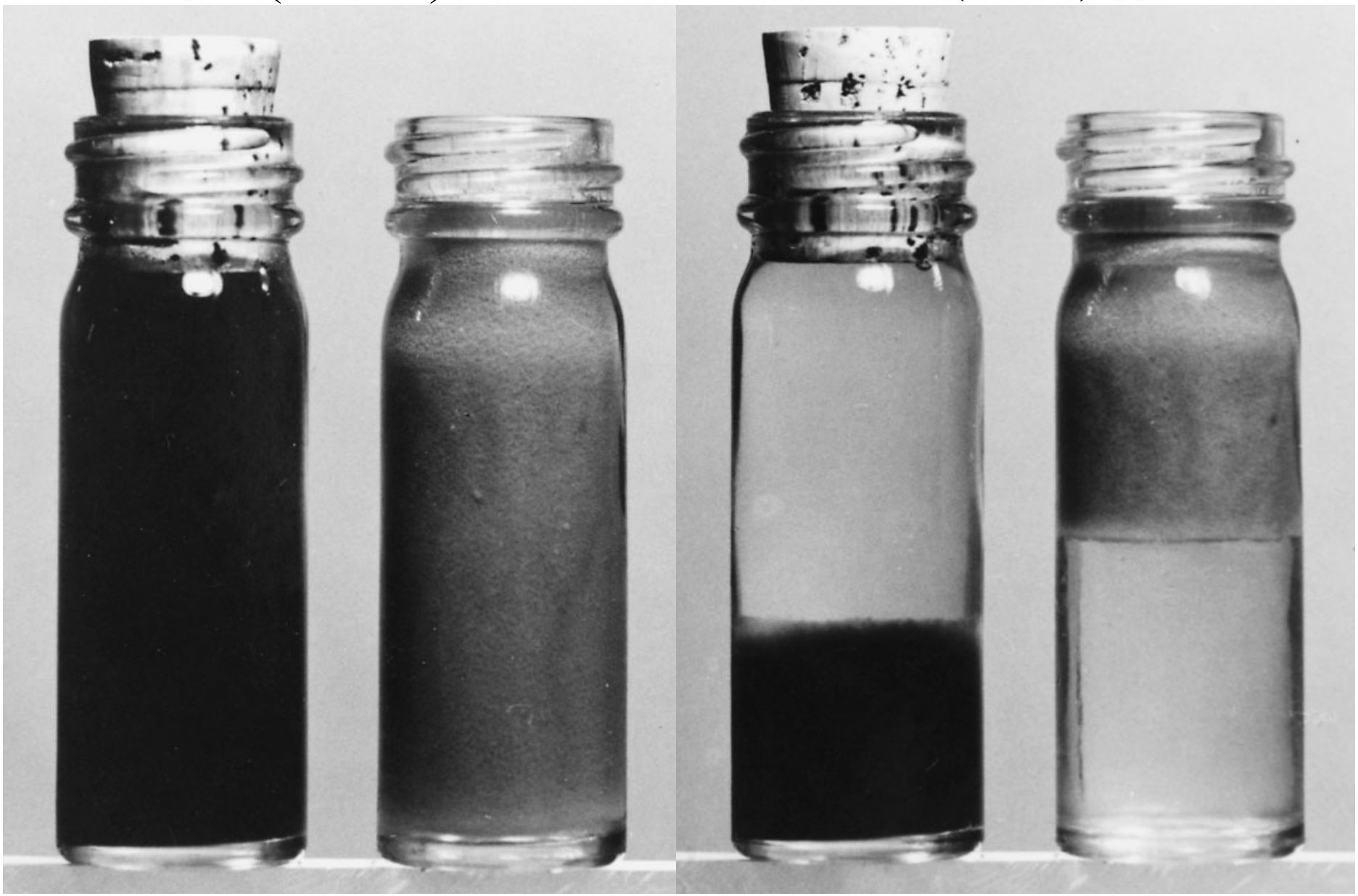
Growth of Flagellar Filaments. Flagellin subunits travel through the flagellar core and attach to the growing tip.



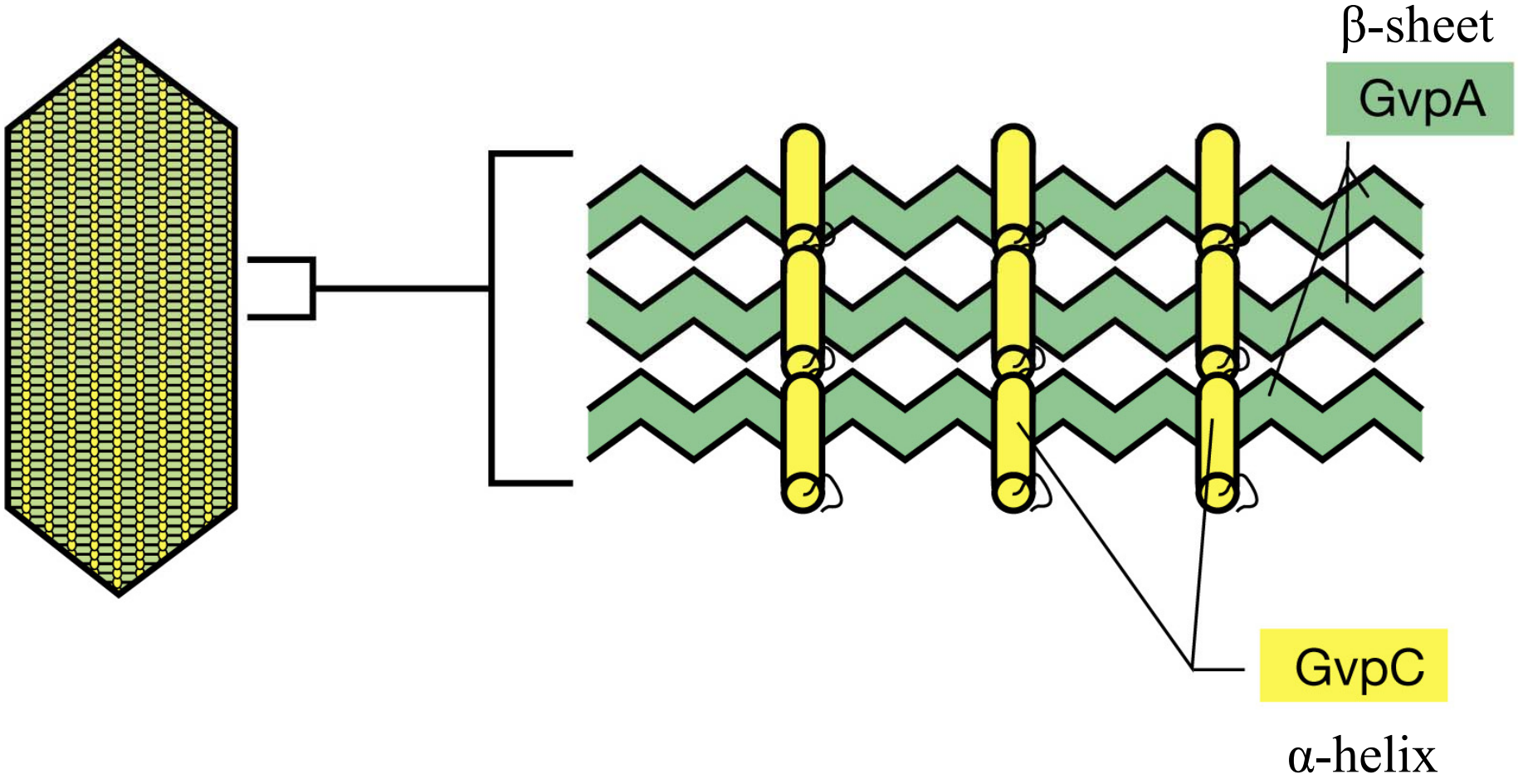
Gas Vesicles
(a) *Anabaena flos-aquae*
(b) *Microcystis* sp.

Hammer & Stopper Experiment

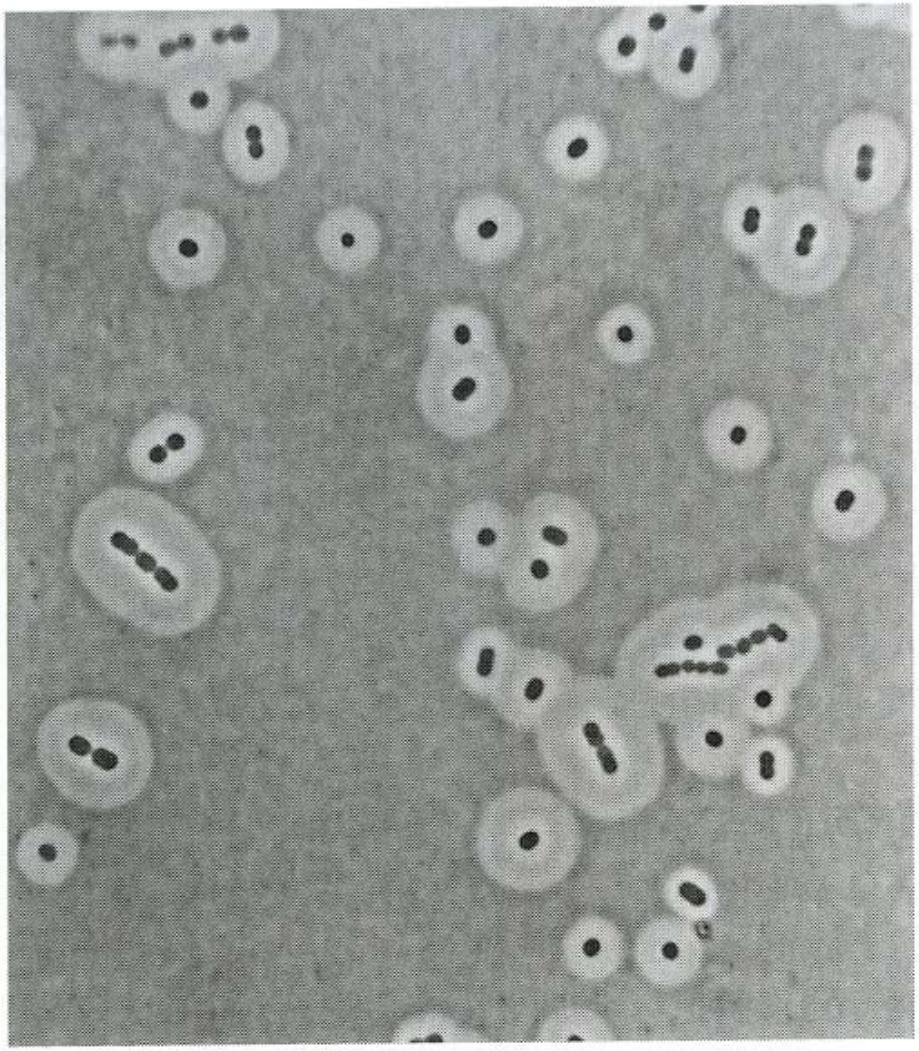
(Before) (After)



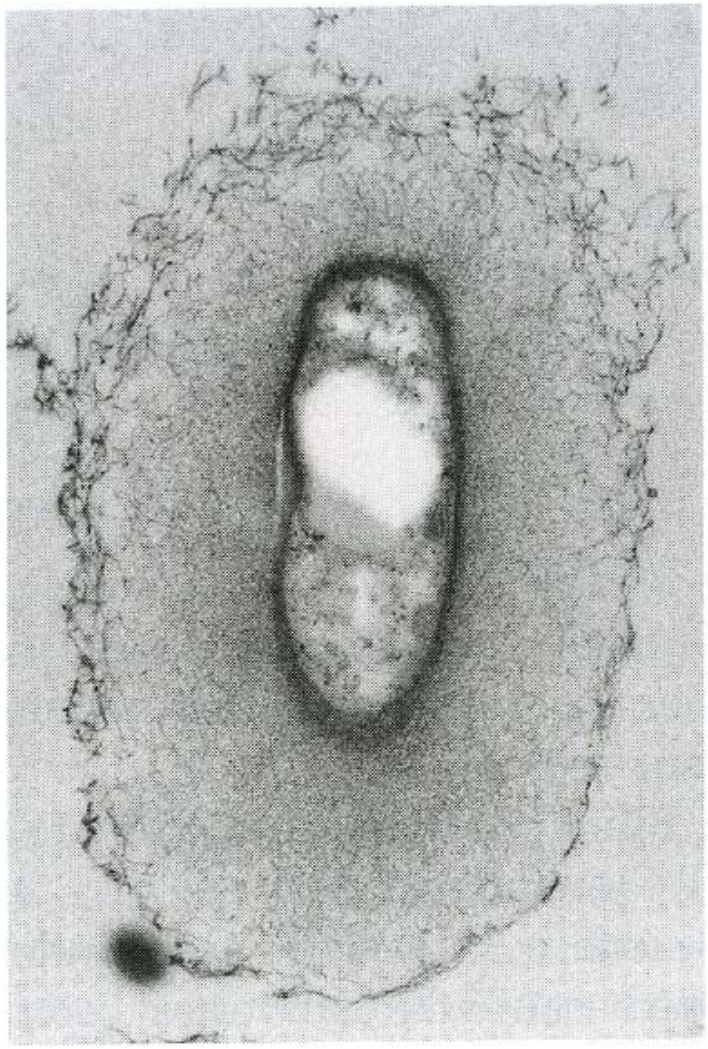
Model of how the two proteins that make up the gas vesicle, GvpA and GvpC, interact to form a watertight but gas-permeable structure.



Bacterial Capsules (a) *Acinetobacter* sp. (b) *Rhizobium trifolii*



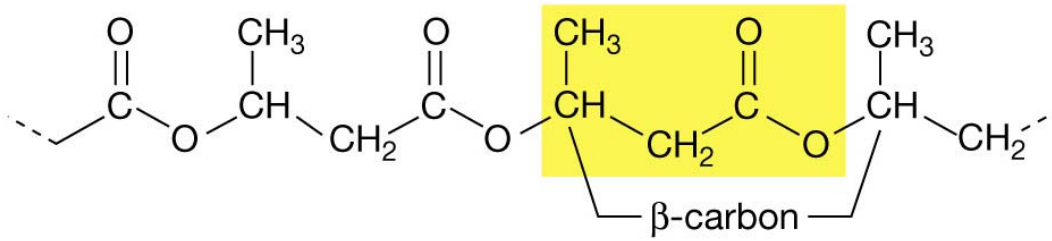
(a)



(b)

negative stain

Storage of PHB



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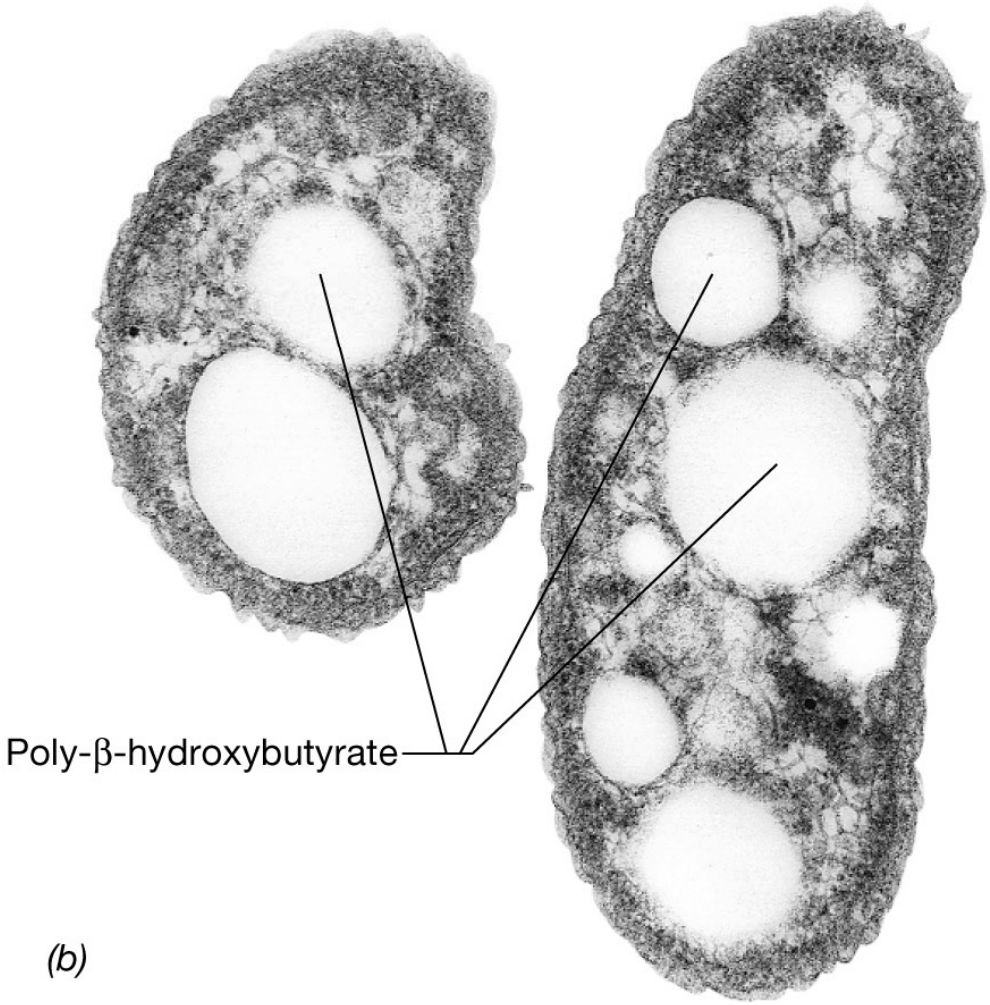

(b)

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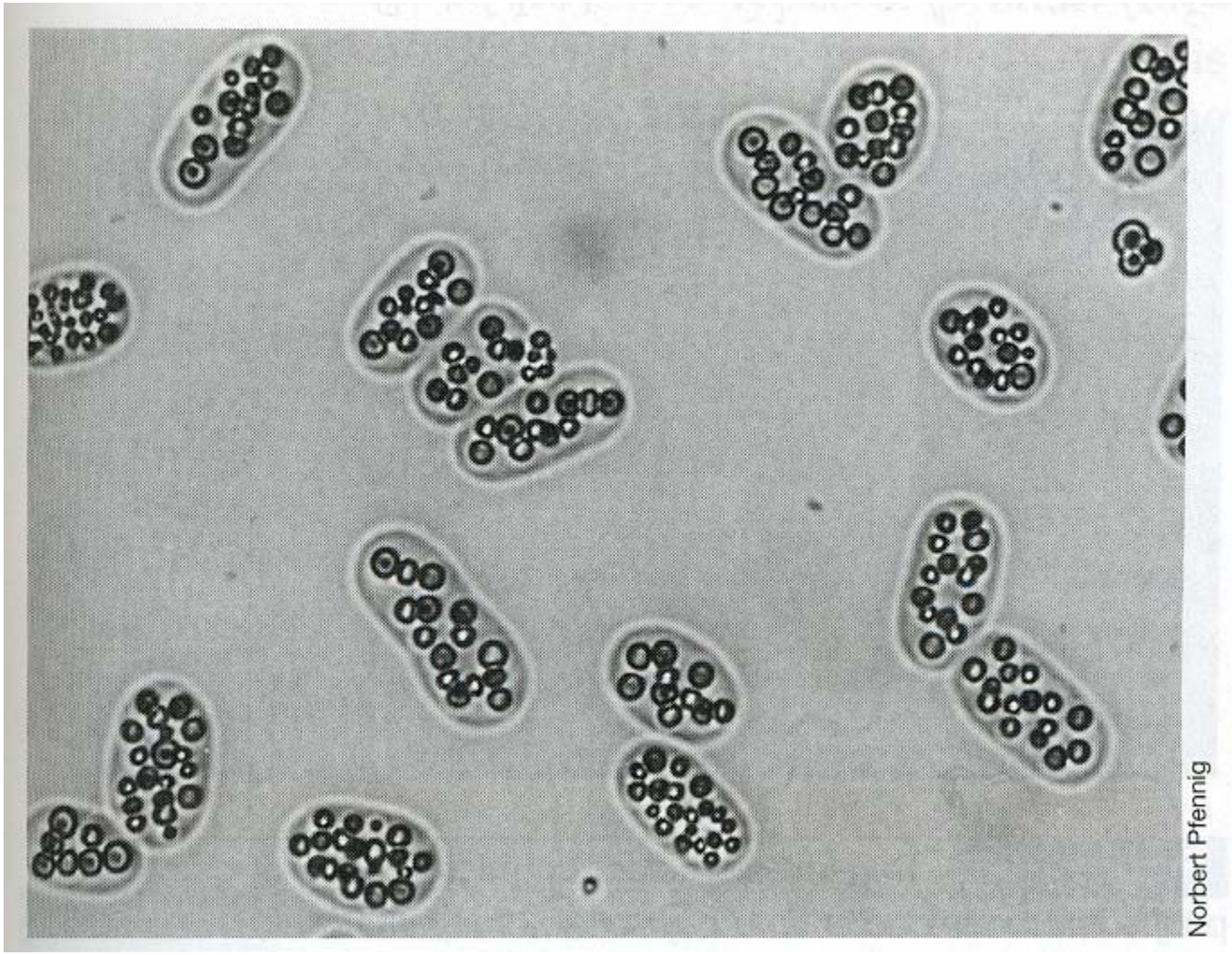
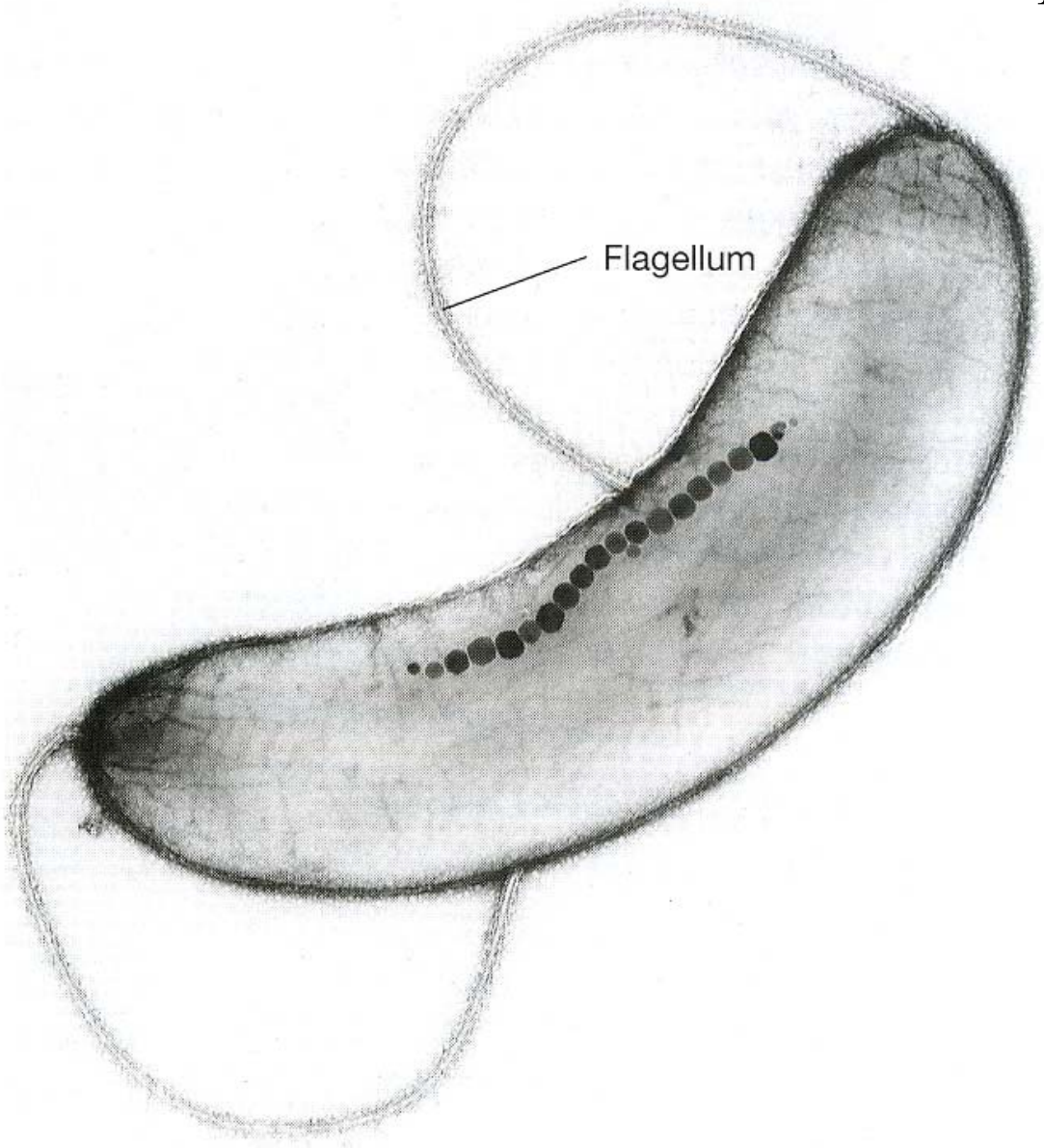
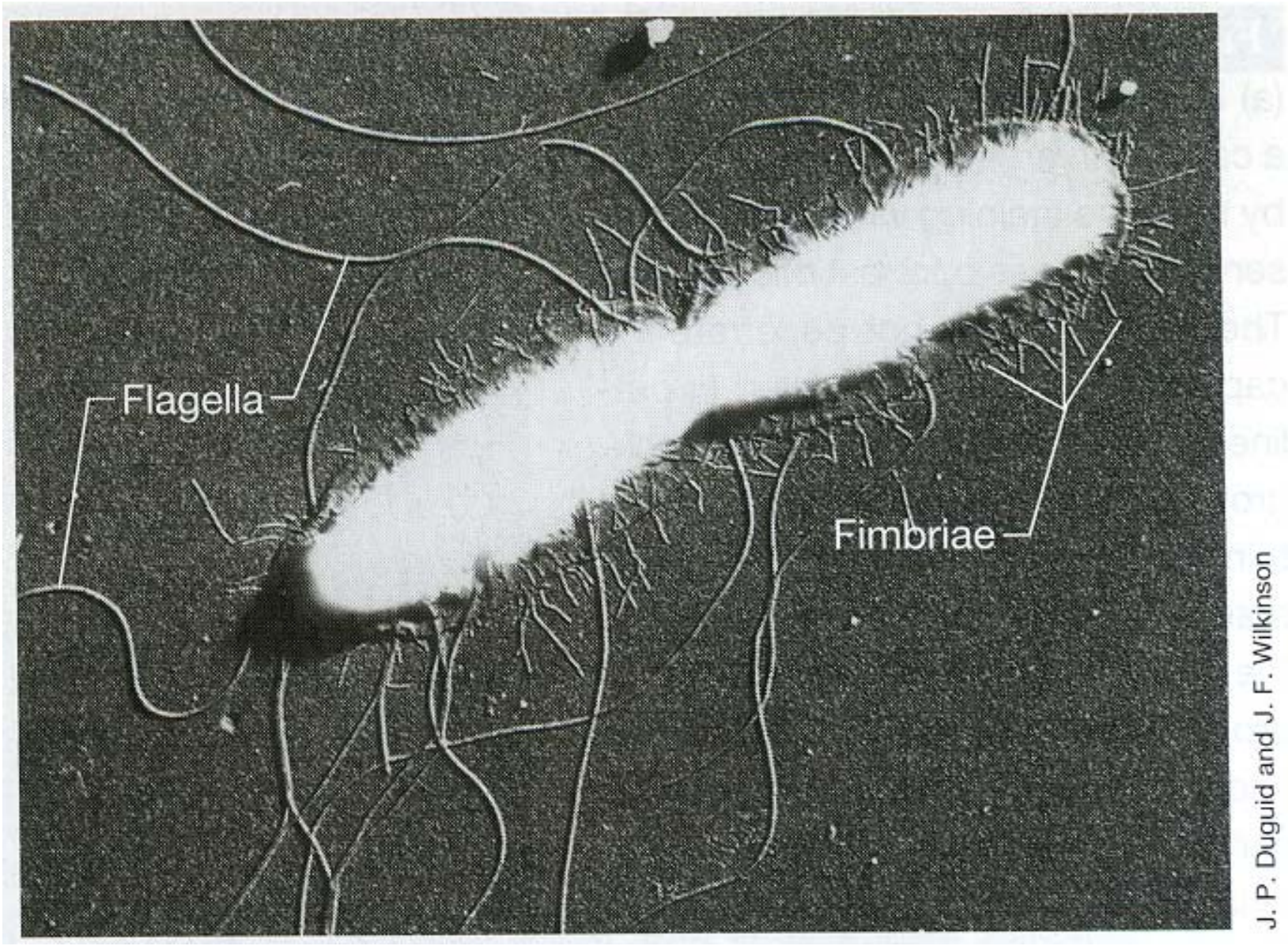


Sulfur globules inside the purple sulfur bacterium *Isochromatium buderi*

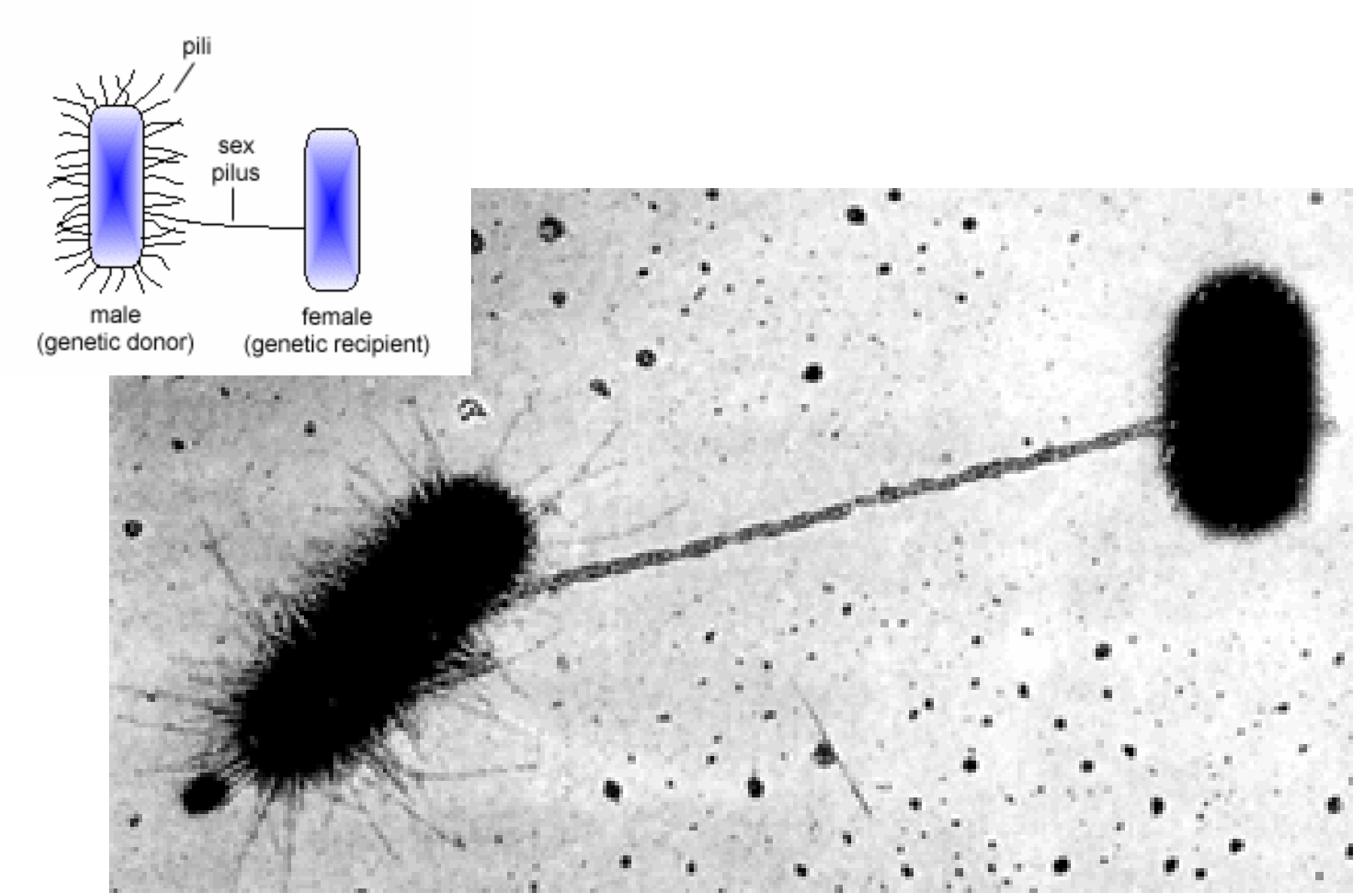
Magnetotactic bacteria with Fe_3O_4 (magnetite) particles called magnetosomes



R. Blakemore



EM of *Salmonella typhi*



"Sex" Pili used in bacterial conjugation of *E. coli* cells