Bacterial Cell Structure

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Bacterial Cell Organization Common Features

– Cell envelope – ٣ layers

- Plasma membrane
- Cell wall
- Layers outside the cell – glycocalyx (capsule, S layer, slime layer)

– Cytoplasm

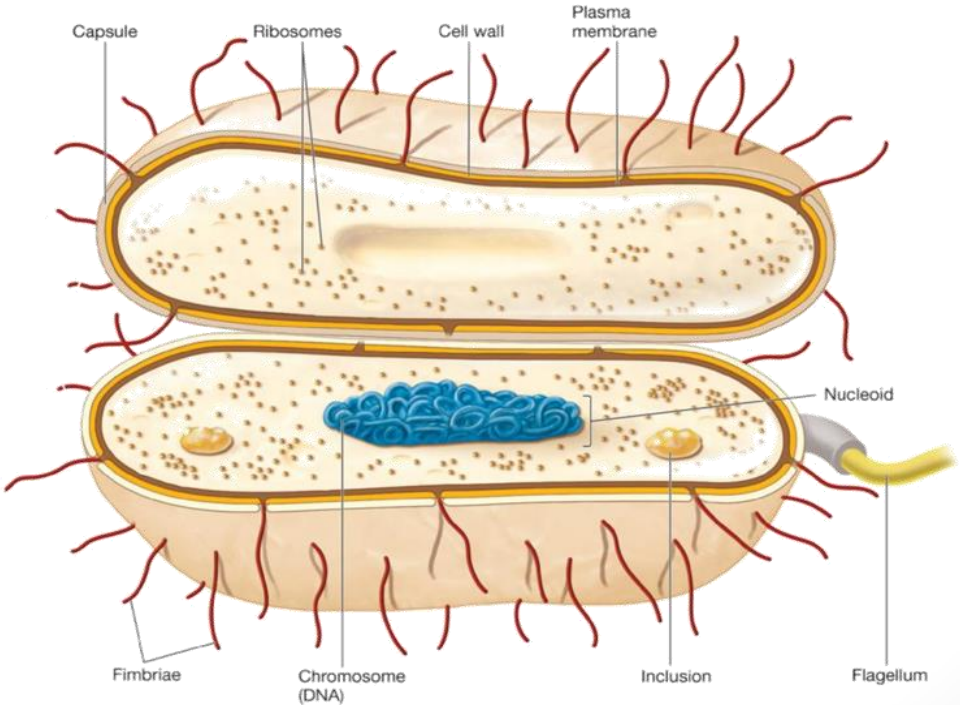
- Nucleoid and plasmids
- Ribosomes
- Inclusion bodies
- Cytoskeleton
- Intracytoplasmic membranes

– External structures

- Flagella
- Fimbriae

Table 3.1 Common Bacterial Structures and Their Functions

Plasma membrane	Selectively permeable barrier, mechanical boundary of cell, nutrient and waste transport, location of many metabolic processes (respiration, photosynthesis), detection of environmental cues for chemotaxis
Gas vacuole	An inclusion that provides buoyancy for floating in aquatic environments
Ribosomes	Protein synthesis
Inclusions	Storage of carbon, phosphate, and other substances
Nucleoid	Localization of genetic material (DNA)
Periplasmic space	In typical Gram-negative bacteria, contains hydrolytic enzymes and binding proteins for nutrient processing and uptake; in typical Gram-positive bacteria, may be smaller or absent
Cell wall	Protection from osmotic stress, helps maintain cell shape
Capsules and slime layers	Resistance to phagocytosis, adherence to surfaces
Fimbriae and pili	Attachment to surfaces, bacterial conjugation and transformation, twitching and gliding motility
Flagella	Swimming and swarming motility
Endospore	Survival under harsh environmental conditions



Uptake of Nutrients

• Microbes can only take in dissolved particles across a selectively permeable membrane

• Some nutrients enter by passive diffusion

• Microorganisms use transport mechanisms

– facilitated diffusion – all microorganisms

– active transport – all microorganisms

– group translocation – Bacteria and Archaea

– endocytosis – Eukarya only

Bacterial Cell Wall

• **Peptidoglycan (murein)**

– rigid structure that lies just outside the cell plasma membrane

– two types based on structure which shows up with Gram stain:

• **Gram-positive**: stain purple; thick peptidoglycan

• **Gram-negative**: stain pink or red; thin peptidoglycan and outer membrane.

Cell Wall Functions

• Maintains shape of the bacterium

– almost all bacteria have one

• Helps protect cell from osmotic lysis

• Helps protect from toxic materials

• May contribute to pathogenicity

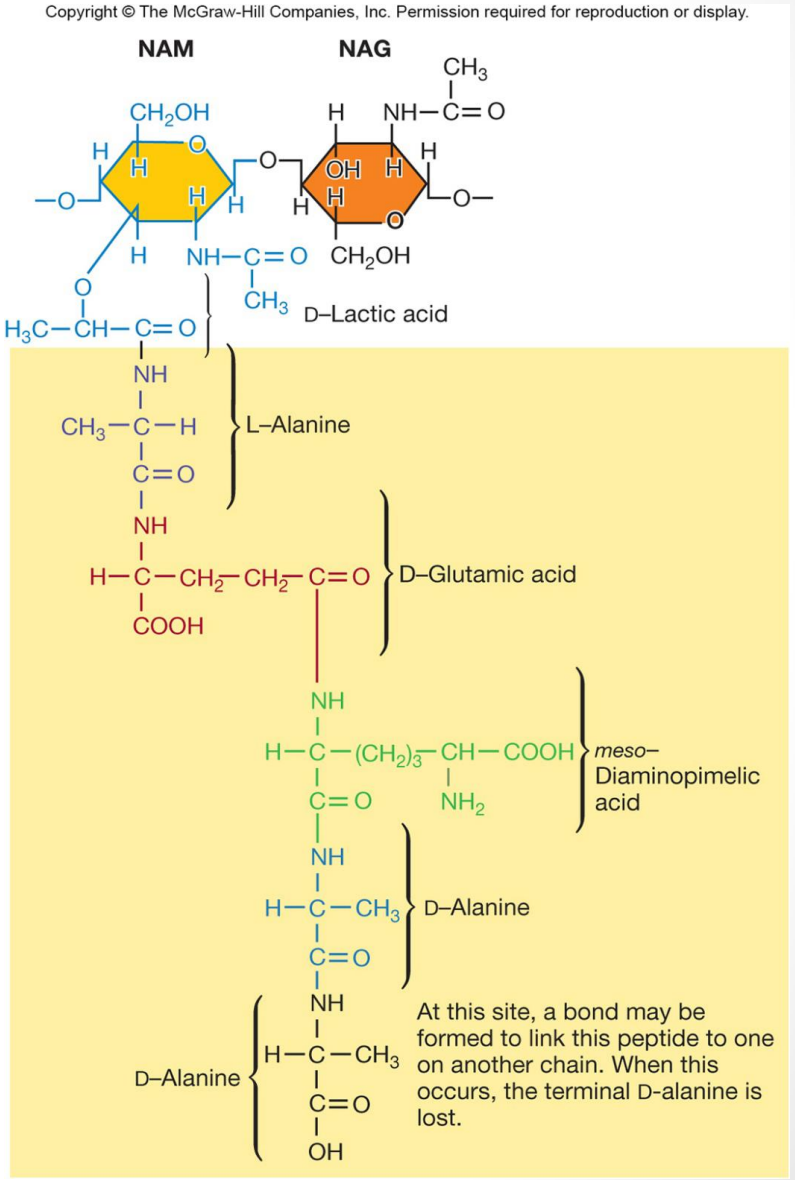
Peptidoglycan Structure

Meshlike polymer of identical subunits forming long strands

– two alternating sugars

- N-acetylglucosamine (NAG)
- N- acetylmuramic acid

– alternating D - and L - amino acids



Strands Are Crosslinked

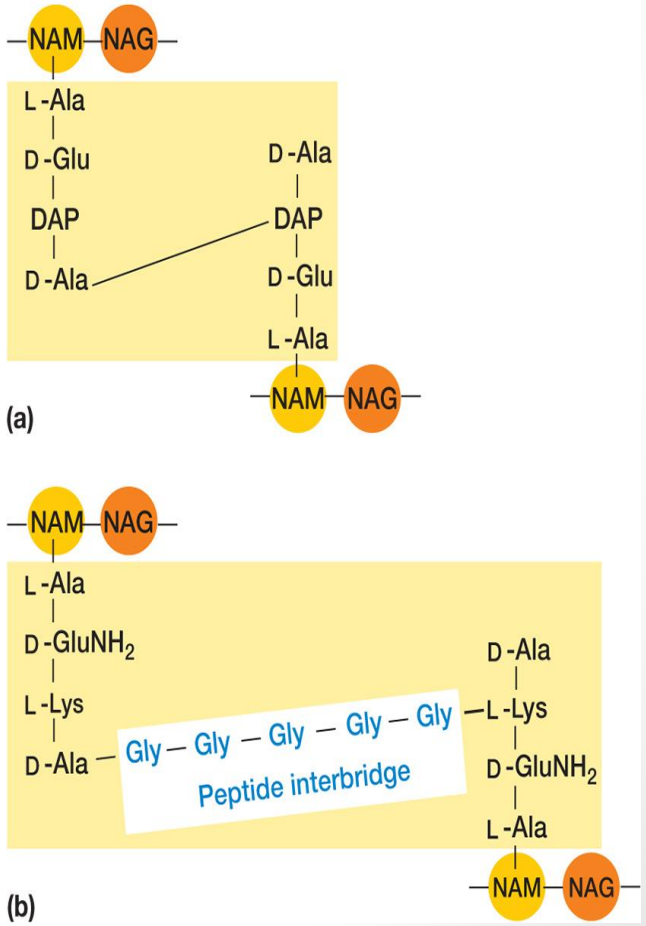
Peptidoglycan strands have a helical shape

Peptidoglycan chains are crosslinked by peptides for strength

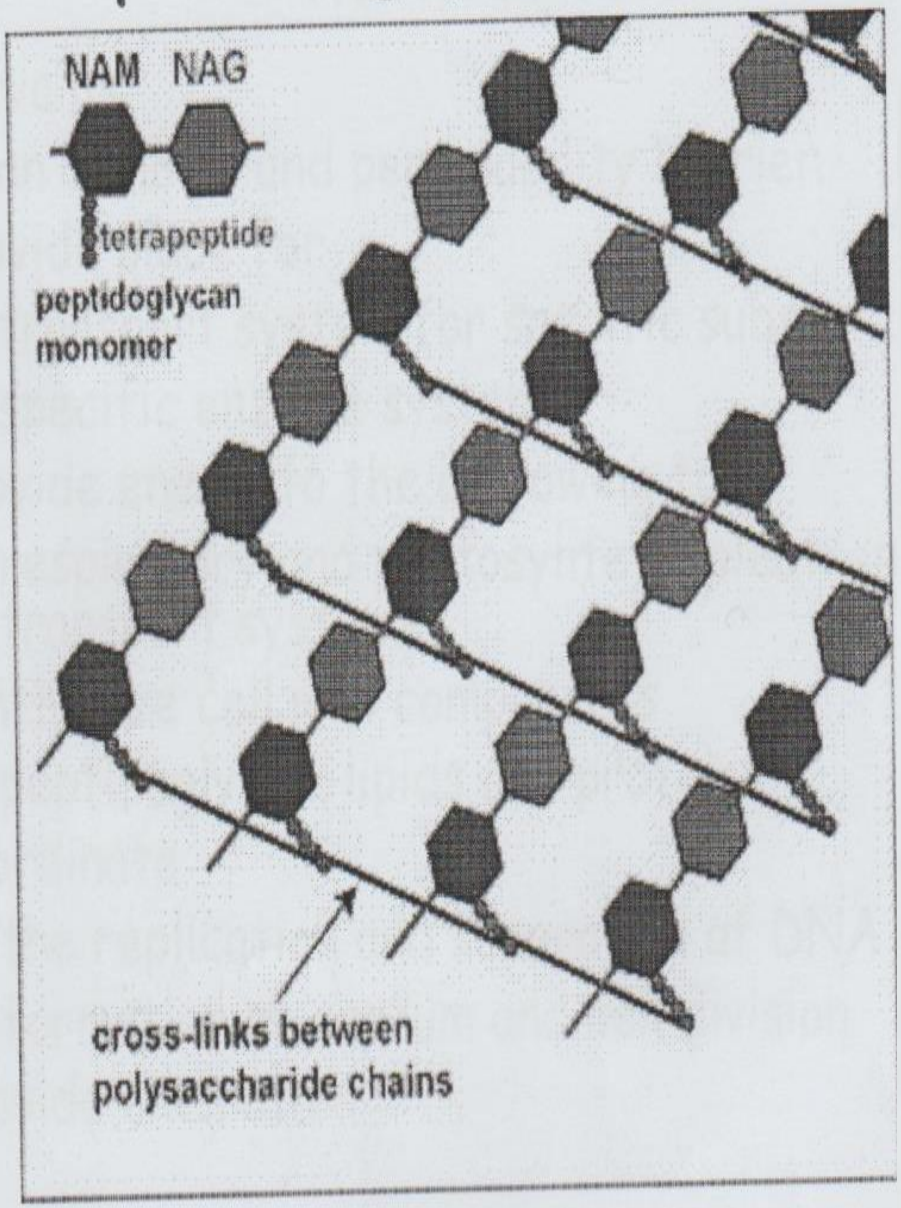
interbridges may form

peptidoglycan sacs – interconnected networks

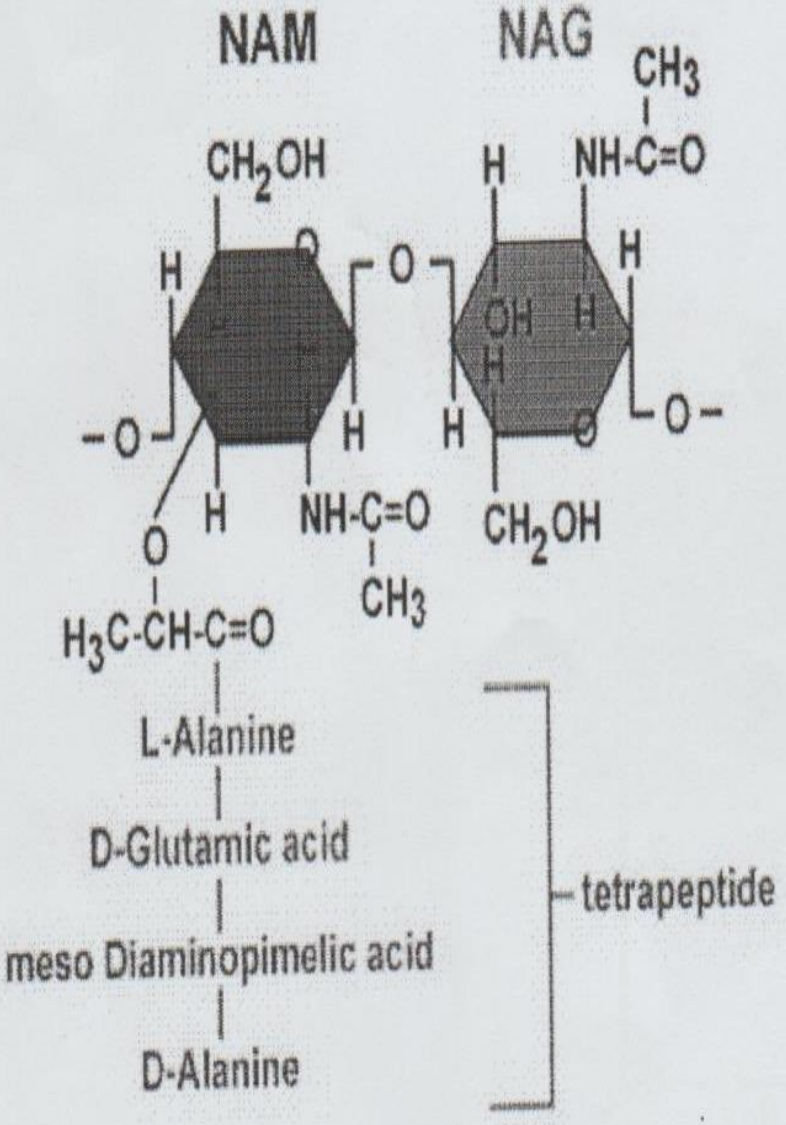
–various structures occur



Peptido-glycan layer



Peptidoglycan monomer



Gram-Positive Cell Walls

- Composed primarily of peptidoglycan
- May also contain teichoic acids (negatively charged)

help maintain cell envelope

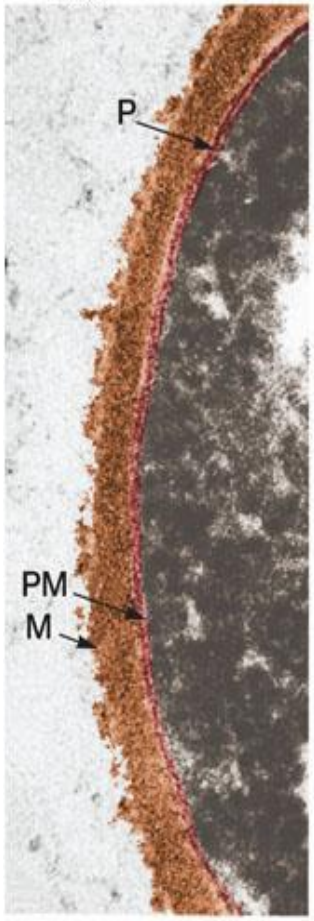
protect from environmental substances

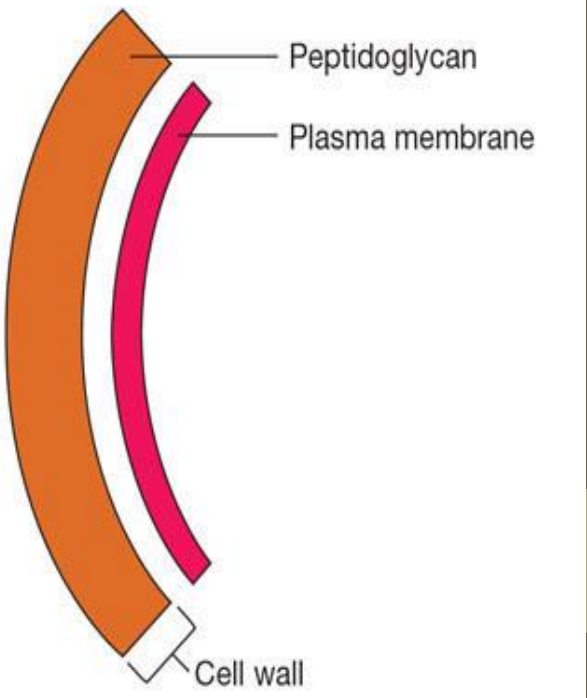
may bind to host cells

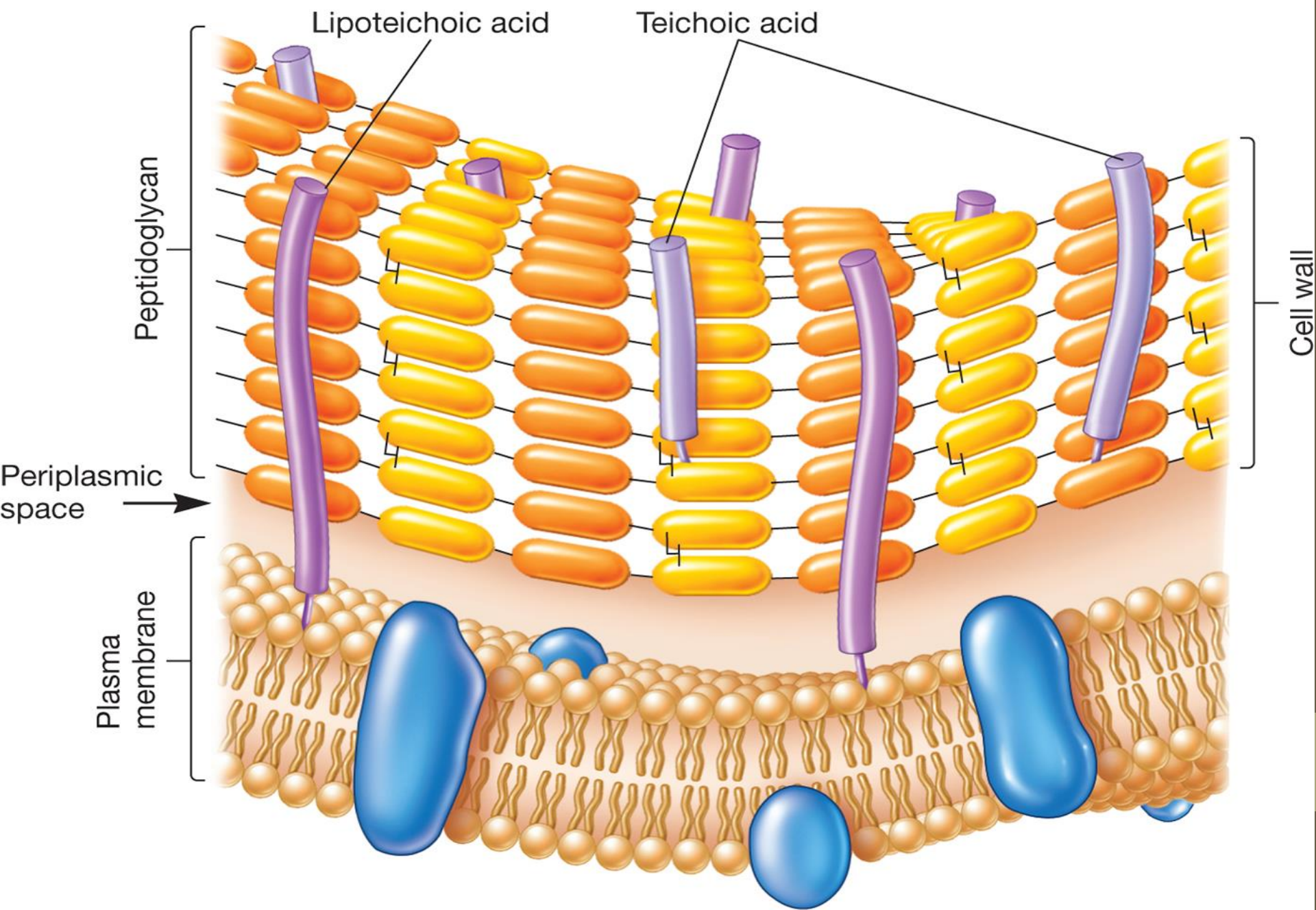
- some gram-positive bacteria

have layer of proteins on surface

of peptidoglycan







Periplasmic Space of Gram + Bacteria

- Lies between plasma membrane and cell wall and is smaller than that of Gram-negative bacteria
- Periplasm has relatively few proteins
- Enzymes secreted by Gram-positive bacteria are called exoenzymes

aid in degradation of large nutrients

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