

# General microbiology

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## Lecture-8

Microbial cell structure  
Prokaryotes-1

# Microbial cell structure

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- Domains of living cells
- Principles of microbial cell structure
  - Elements of Microbial cell Structure
  - Eukaryotes
  - **Prokaryotes & chemistry of cellular components**

# Principles of microbial cell structure

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All cells have the following in common:

- Cytoplasmic membrane
- Cytoplasm
- Ribosomes
- Genetic materials

## Eukaryotic vs. Prokaryotic Cells

### **Eukaryotes**

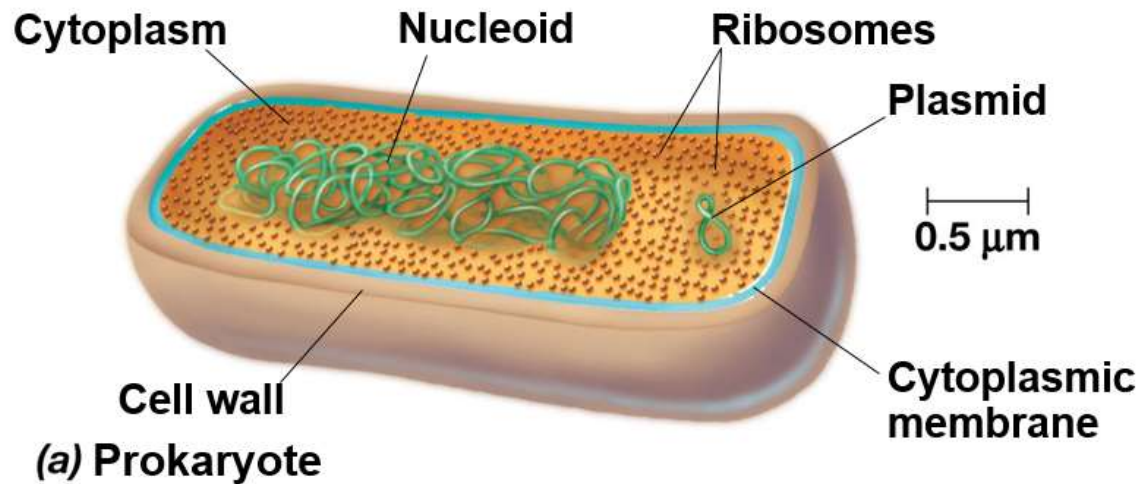
DNA enclosed in a membrane-bound nucleus  
Cells are generally larger and more complex  
Contain organelles

### **Prokaryotes**

No membrane-enclosed organelles, no nucleus  
Generally smaller than eukaryotic cells

## Prokaryotic cells consist of:

- Cell wall
- Cytoplasmic membrane (cell membrane)
- Cytoplasm
- Ribosomes
- Genetic materials
- Other internal and external structures may exist



## Prokaryotes



# Prokaryotes, cell structure

## Cell wall

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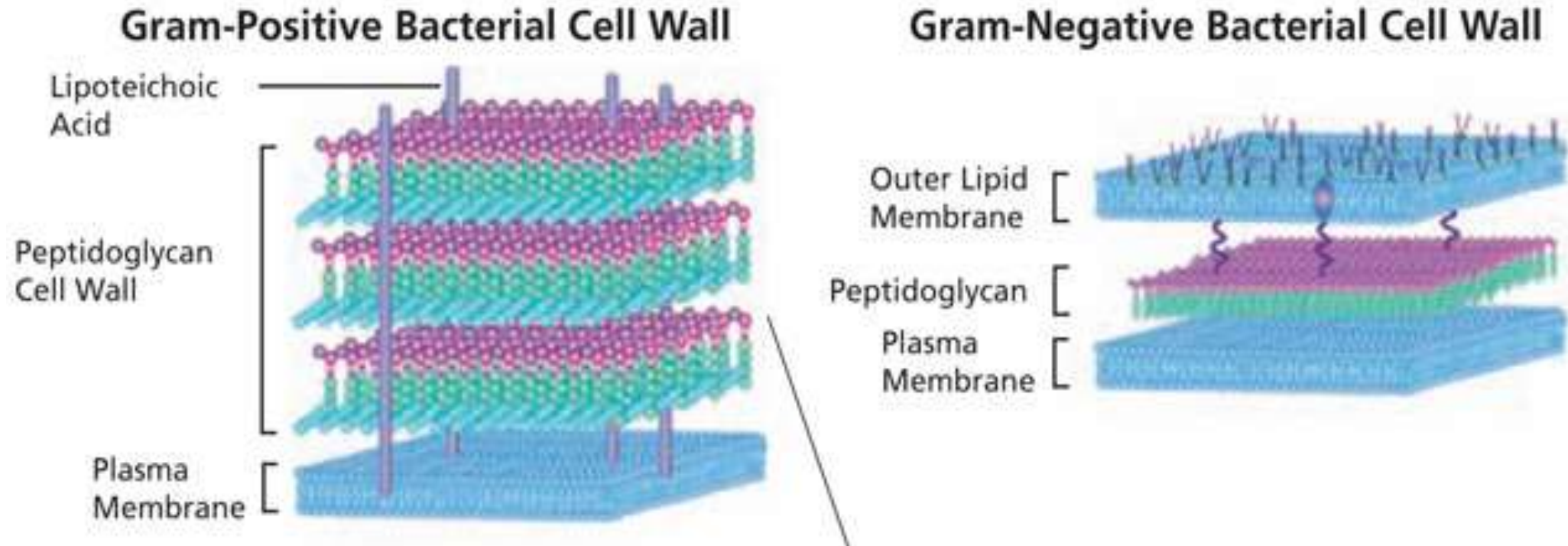
- Cell wall in prokaryotes is complex , semi rigid structure surrounds the cytoplasmic membrane .

### The Cell wall play an important role :

- 1- Maintains the characteristic shape of the cell.
- 2- prevents the cell from bursting when fluids flow into the cell by osmosis.

## Components of cell wall:

gram positive (+ve)	gram negative (-ve)
Peptidoglycan (many layers )	Peptidoglycan
-	Outer membrane (bilayer membrane)
Plasmic space	Plasmic space

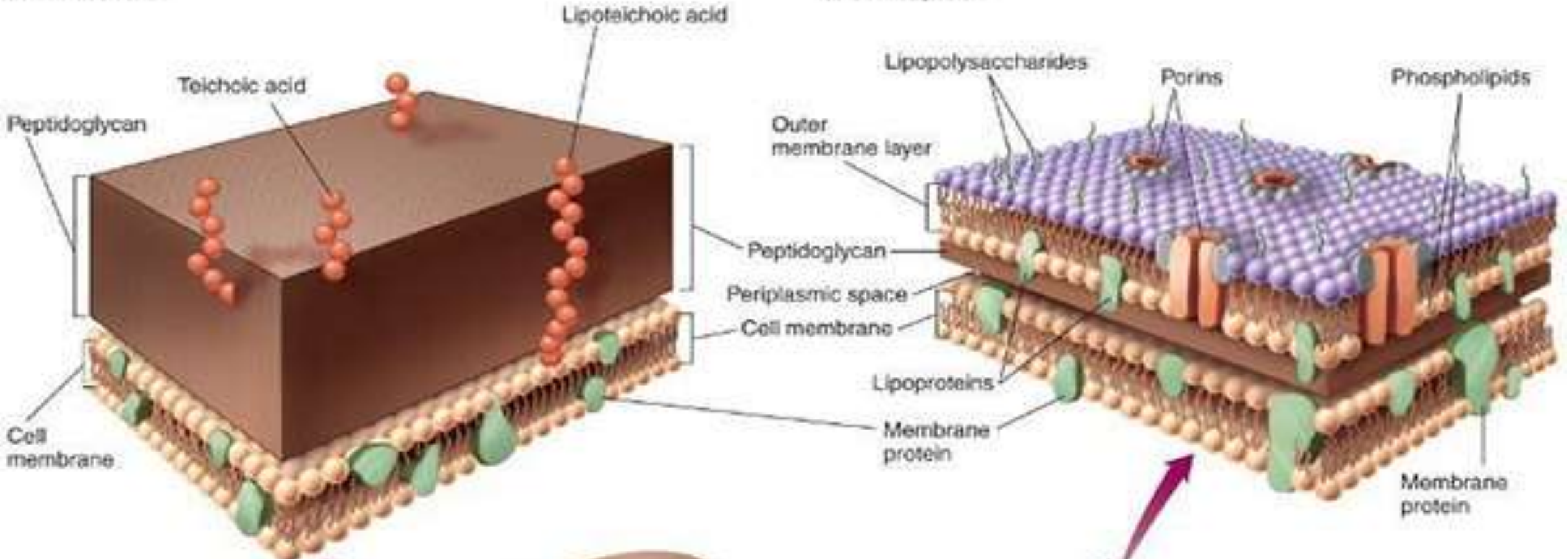


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Gram-Positive

Gram-Negative



# cell structure

## Peptidoglycan (murein):

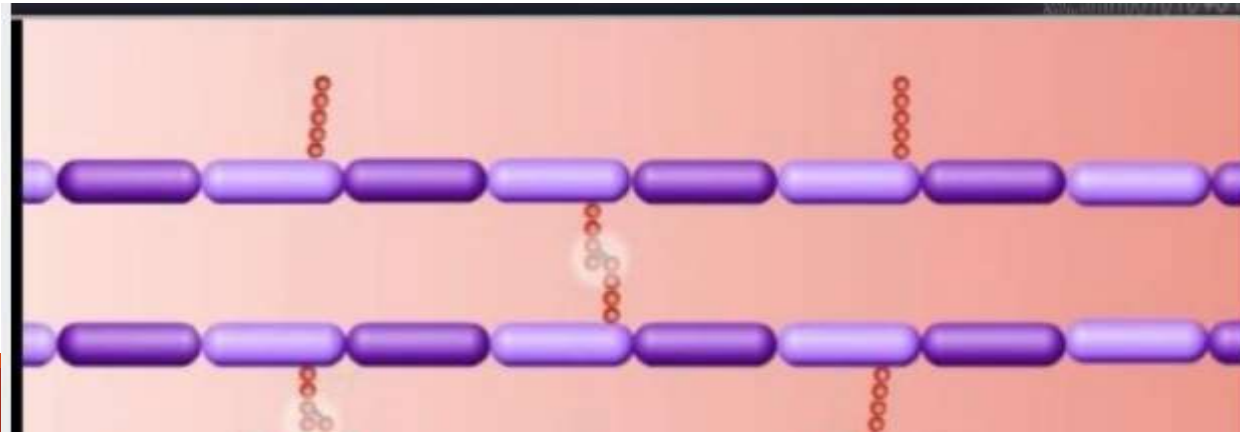
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- The most important component in bacterial cell wall.
- A large polymer consist of the following molecules:

N-acetylglucosamine (gluNAc)

N-acetylmuramic acid (murNAc)

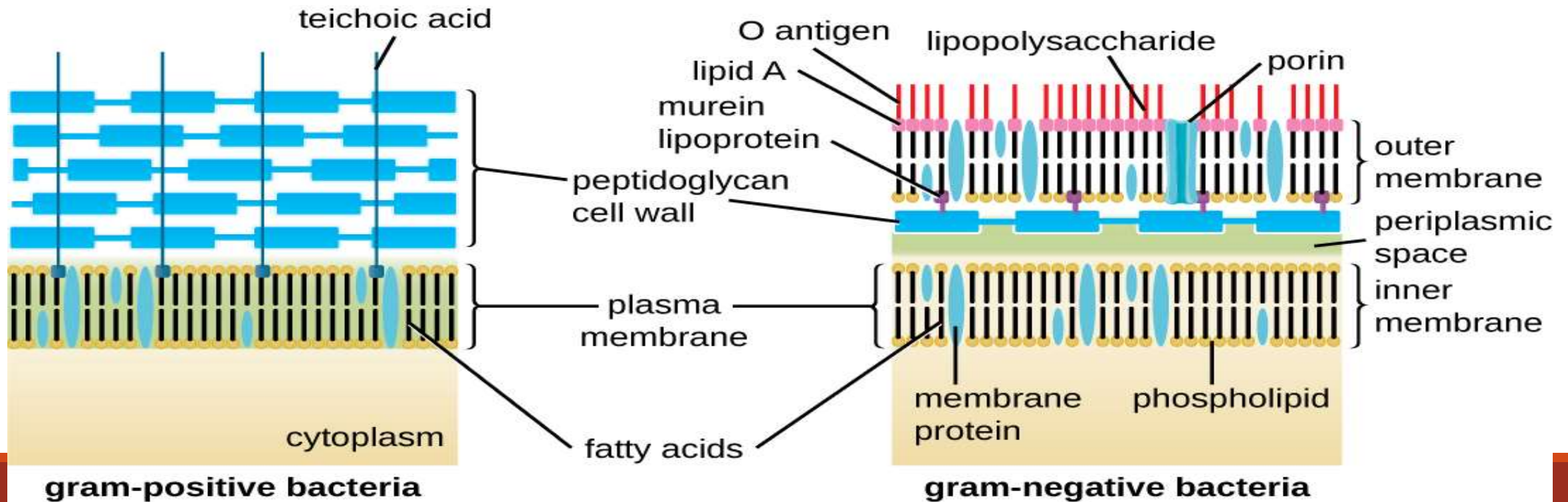
cross linked by tetrapeptides (chains of four amino acids)





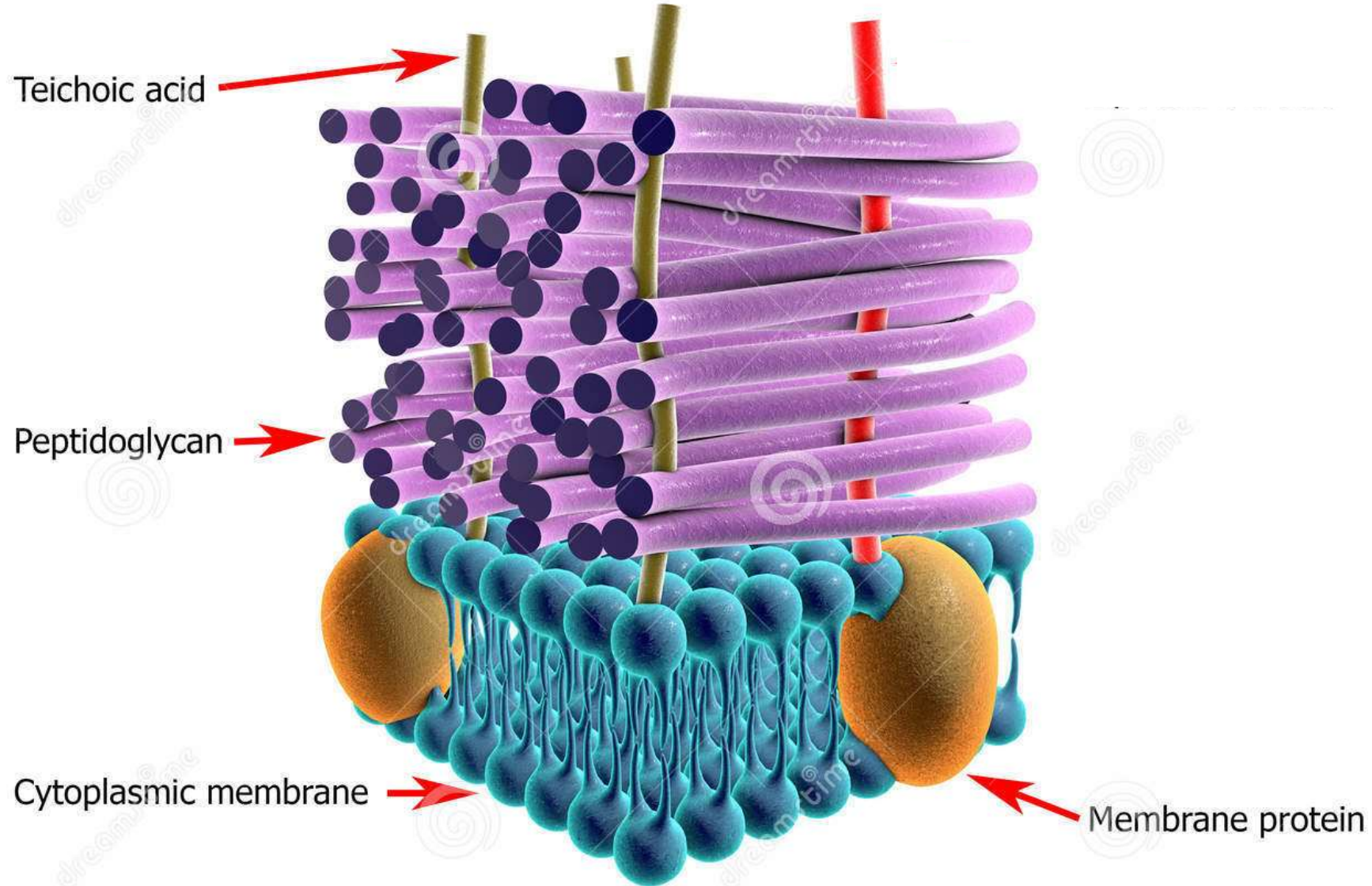
## Gram-positive cell walls

- The cell wall consists of many layers of peptidoglycans
- Thick and rigid structure.
- The cell walls of +ve bacteria contain **teichoic acids** and phosphate .
- Teichoic acid provide much of the wall's antigenic specificity .



# Gram-positive cell walls

Not required



## Gram-negative Cell walls

Outer membrane: (Primarily in gram -ve bacteria)

○ Outer membrane is bilayer membrane attached covalently to the peptidoglycan by a layer of lipoprotein molecules.

○ Outer membrane is consists of:

▪ lipoproteins

▪ phospholipids

▪ lipopolysaccharides (LPS) also called **endotoxin**

lipopolysaccharides consists of 1- polysaccharides

2- O polysaccharide

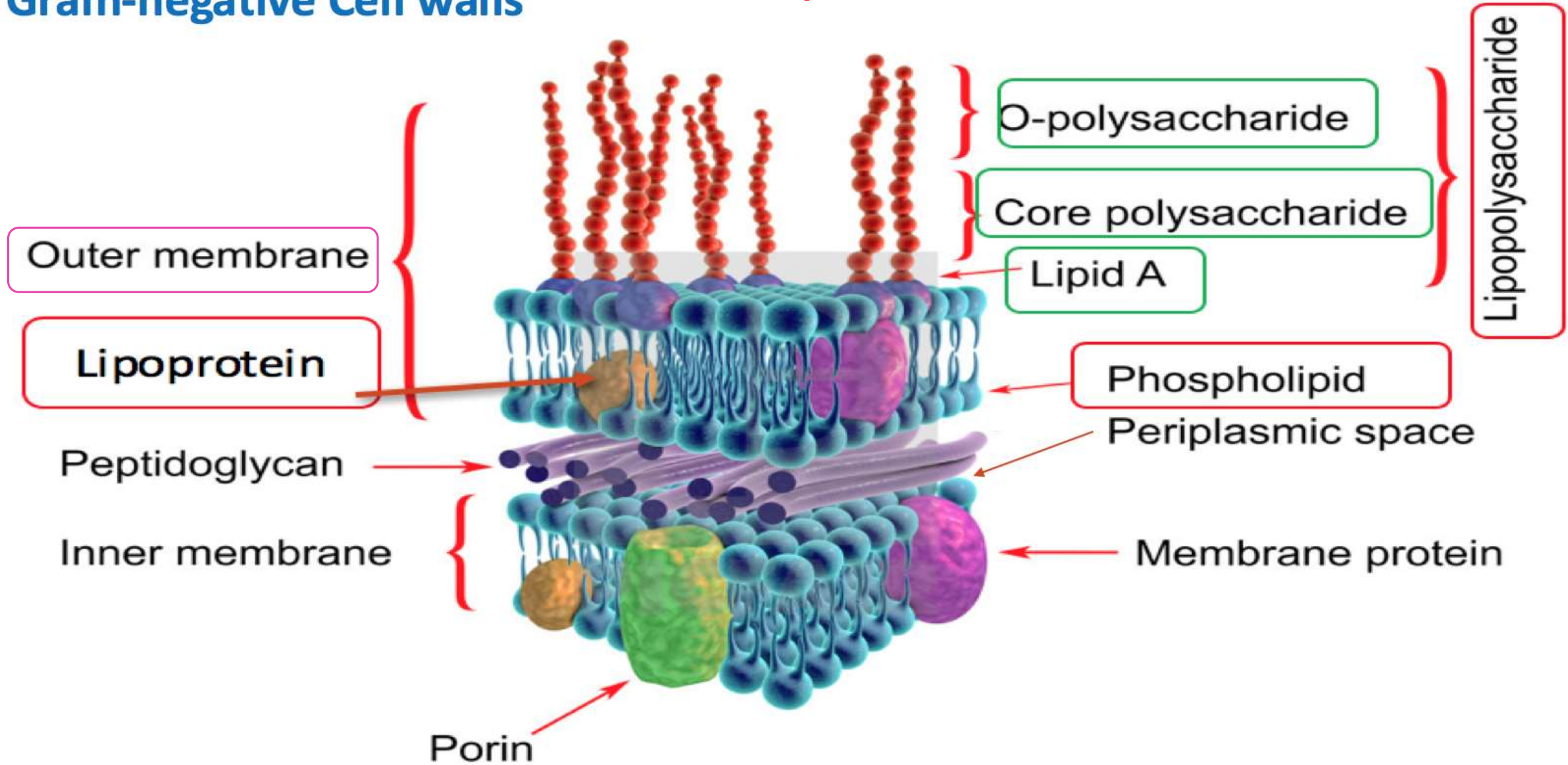
3- lipid A (which is responsible for the toxic properties)

❖ -ve bacteria cell wall do **not** contain teichoic acids.

❖ FUNCTION: controls the transport of certain proteins. Example: protects gram -ve bacteria from penicillin by inhibiting its entrance into the cell.

# Gram-negative Cell walls

Not required



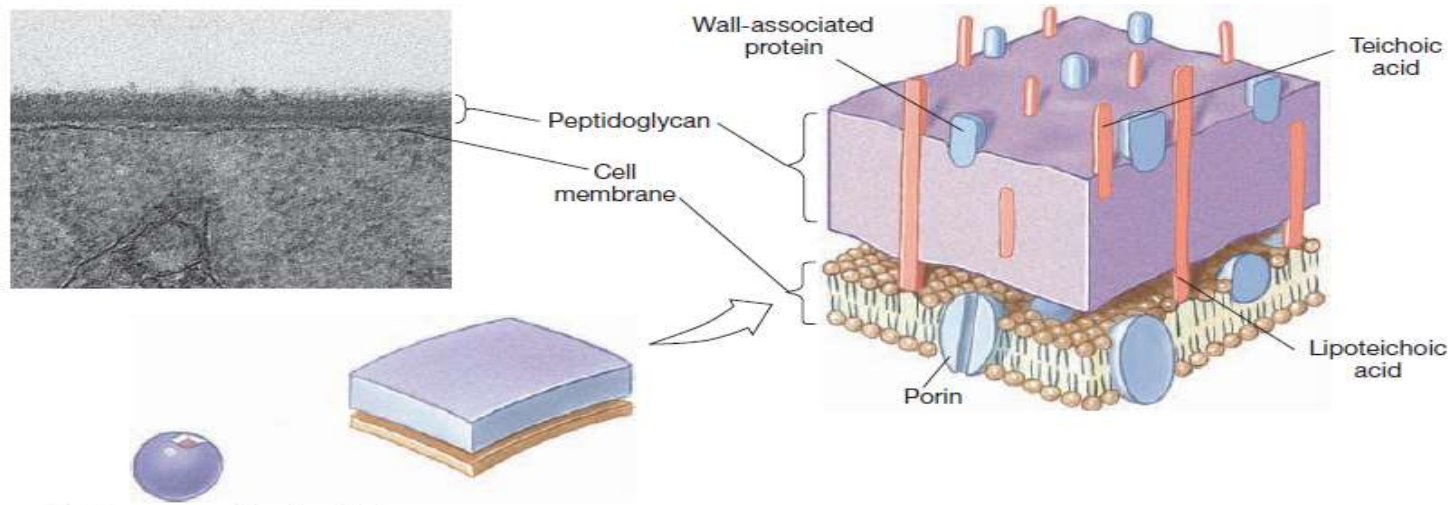
## Periplasmic space.

- A gel-like fluid between the cell membrane and the cell wall.
- Observed by electron microscopy of gram-ve bacteria, rarely observed in gram+ve bacteria.

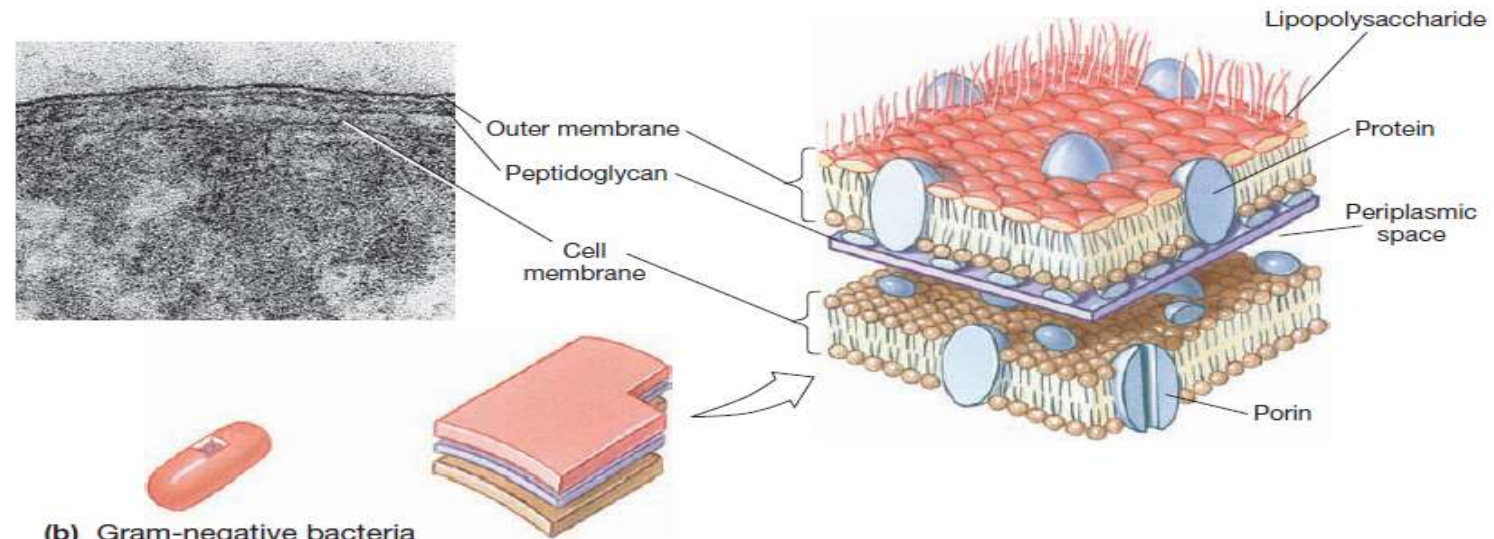
## FUNCTIONS:

\_active area of cell metabolism. Contains: digestive enzymes and transport proteins.

Characteristics of the Cell Walls of Gram-Positive, Gram-Negative, and Acid-Fast Bacteria		
Characteristic	Gram-Positive Bacteria	Gram-Negative Bacteria
Peptidoglycan	Thick layer	Thin layer
Teichoic acid	Often present	Absent
Lipids	Very little present	Lipopolysaccharide
Outer membrane	Absent	Present
Periplasmic space	Absent	Present
Cell shape	Always rigid	Rigid or flexible
Results of enzyme digestion	Protoplast	Spheroplast
Sensitivity to dyes and antibiotics	Most sensitive	Moderately sensitive



(a) Gram-positive bacteria



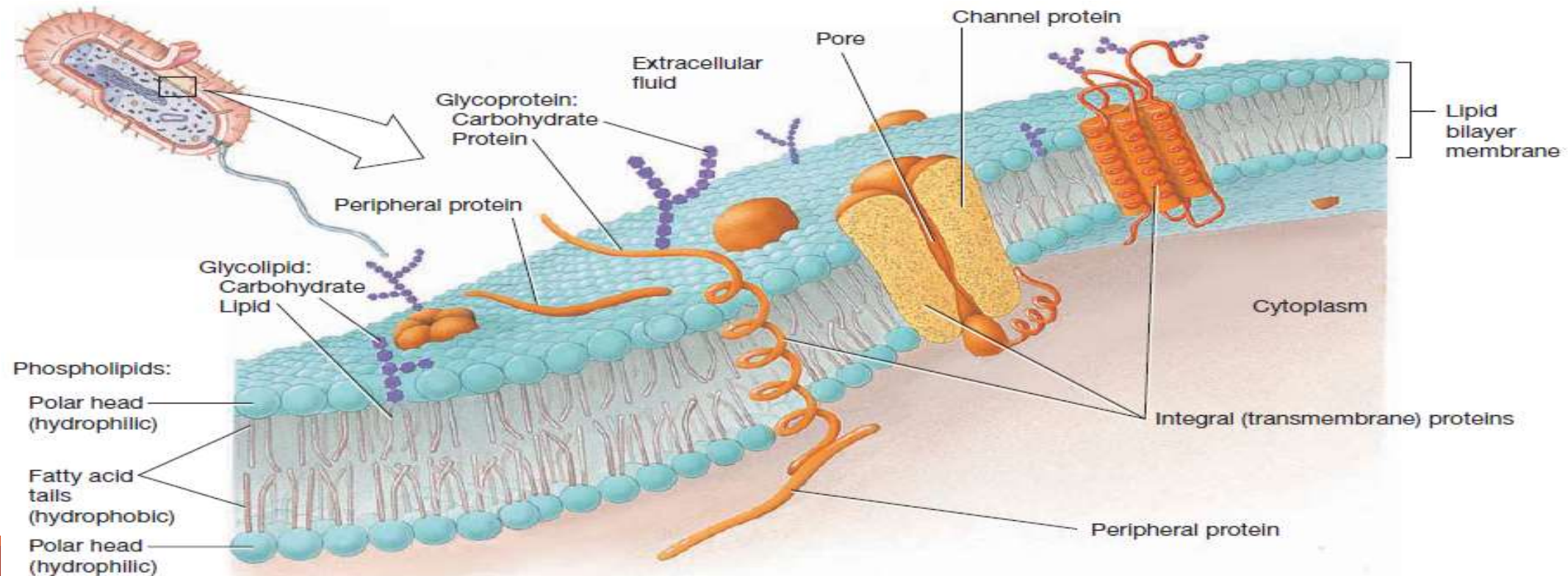
(b) Gram-negative bacteria

Overall view of cell wall component in gram-positive (up) and gram-negative bacteria

## Cell membrane (Called also cytoplasmic membrane)

- Cell membrane is a living membrane forms the boundary between a cell and its environment.
- Consist mainly of **phospholipids** and **proteins**.

Membrane phospholipids form a **bilayer** (two layers).

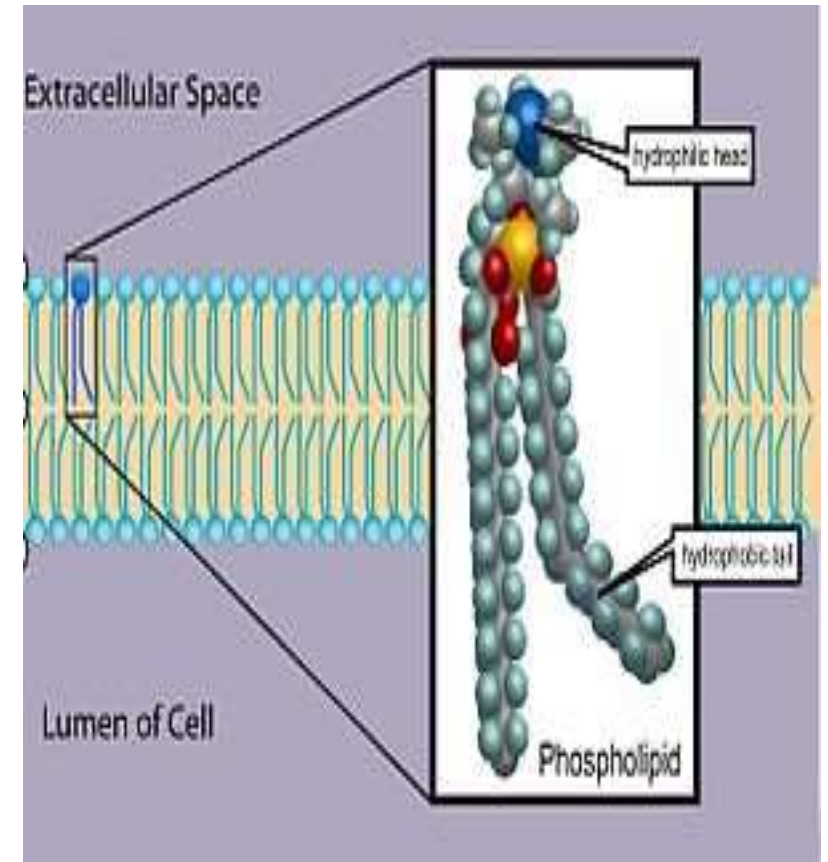


## Membrane phospholipids

Each layer has phosphate ends of the lipid molecules extend toward the membrane surface and fatty acid ends extend inward.

The **phosphate group and glycerol ends** are hydrophilic (love water) → interact with the watery environment.

The **fatty acid ends** are hydrophobic (hate water) → forms a barrier between the cell and environment.

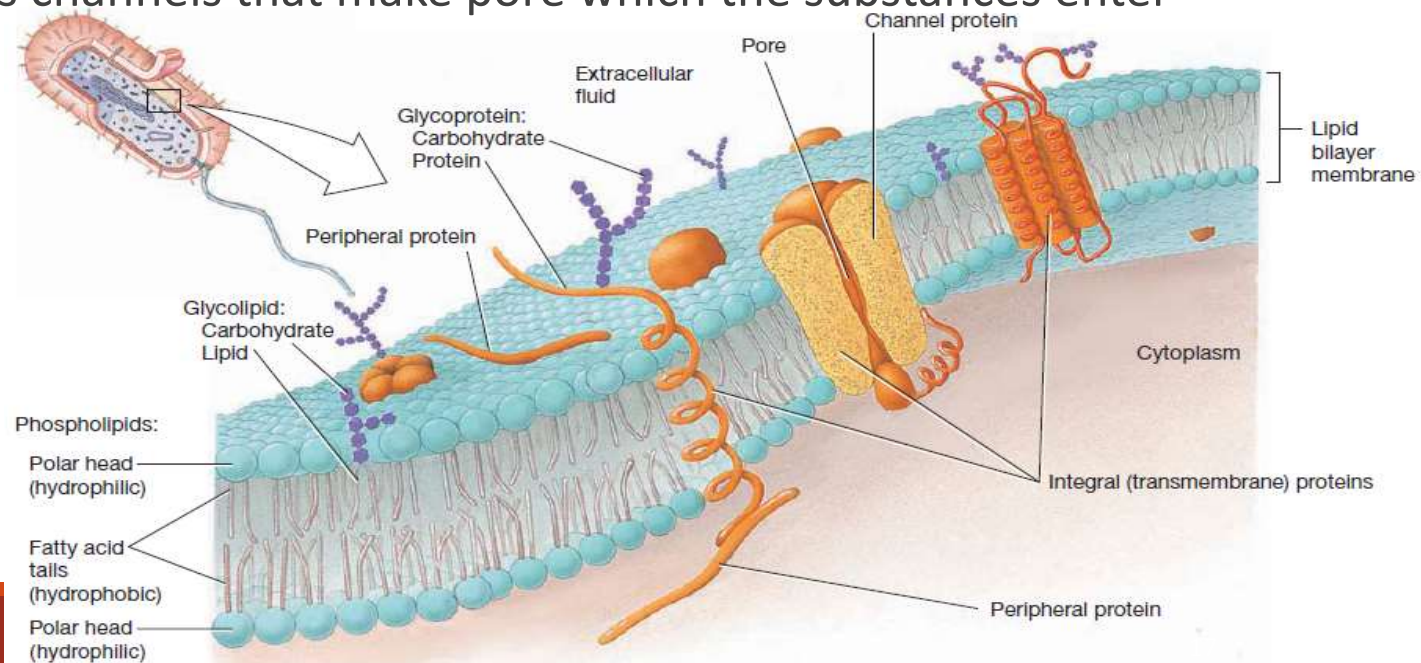




# Cell membrane

## proteins

- The protein molecules in the membrane can be **peripheral proteins** and **integral protein**.
- The **peripheral protein** can easily removed. It function as an enzyme that catalyze the reactions or scaffold for sport the membrane shape.
- Integral protein** difficult to remove, It function as channels that make pore which the substances enter through it.



# Cell membrane function

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- The most important function of plasma membrane is to serve as a selective barrier through which materials enter and exit the cell .
- In this function , plasma membrane have **selective permeability**.
- Plasma membrane in bacteria contain enzymes capable to catalyzing the chemical reactions that break down nutrients and produce ATP.

ANY  
QUESTIONS