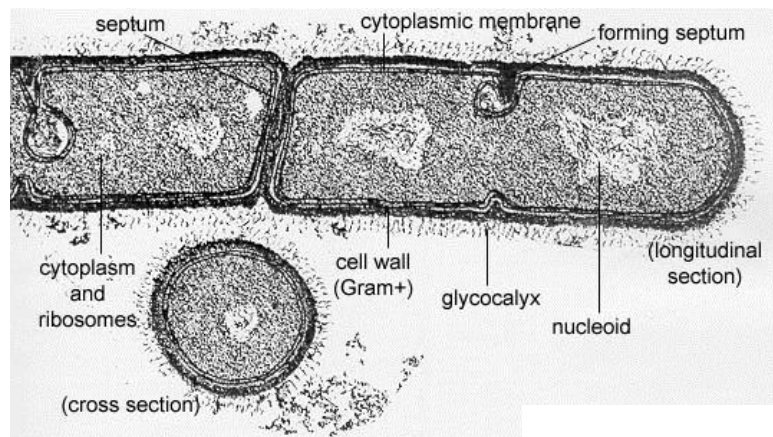


Microbiology and immunology

summer term 1

- Microbiology **general** and special)
 - bacteriology
 - virology (viruses + prions)
 - mycology
 - parasitology
 - *helminthology, *entomology, *protozoology
- **Immunology - general, - special,**
 - serology, - allergology, - autoimmunology,
 - tumor, - transplantation,



Cytológia

Rigidita
Delenie bunky
Peptidoglykan kys.
muramová
G +, G -

Bunková stena

Abnormálne formy
sféroplasty,
protoplasty,
involučné formy,
L formy

Bičíky – pohyb

Fimbrie – adherencia

Pilli – adherencia, konjugácia

Cytoplazma – ribozómy, inklúzie
– granuly, mezozómy

Cytoplazmatická membrána

Metabolické pochody, 3 -
vrstvová, lipoproteinová,
semipermeabilná, aktívny
transport – permeázy

hlienová vrstva
mikropúzdro
púzdro

Object of study

medically important microorganisms

- shape - morphology
- structure - cytology,
- life cycle - physiology and genetics,
- ability to cause the disease - pathogenicity and virulence,
- mechanisms and way of causing disease - pathogenesis,
- reaction of macroorganism - immunology,
- injury of macroorganism caused when combating the infection - immunopathology (autoimmunity, alergology)
- possibilities to destroy microbes - antibiotics, decontamination, immunisation
- laboratory prove of microbial ethiology

Terminology

- Latin names
- Binominal nomenclature - *italics*
double-word names, genus a species
- Genus - capital or abbreviation
Staphylococcus (S.), Escherichia (E.)
- Species - small letter *aureus, coli*
- transcription to Slovak - general use - stafylokoky,
bacily, klostrídiá....

Cells

- Cells **procaryotic**
 - archebacteria - extrem conditions
 - **eubacteria - majority of medically important bacteria**
- Cells eucaryotic
 - plants
 - annimals - **insects, worms**
 - fungi - **molds, yeast**
 - protista - **protosoa**

Procaryotic - bacterial cell

- Structure
- **Envelope**
 - plasmatic membrane
 - cell wall
- **Cytoplasm**
 - nuclear mass, ribosomes, inclusions
- **External structures**
 - capsule, slimes, flagella, fimbriae, pilli

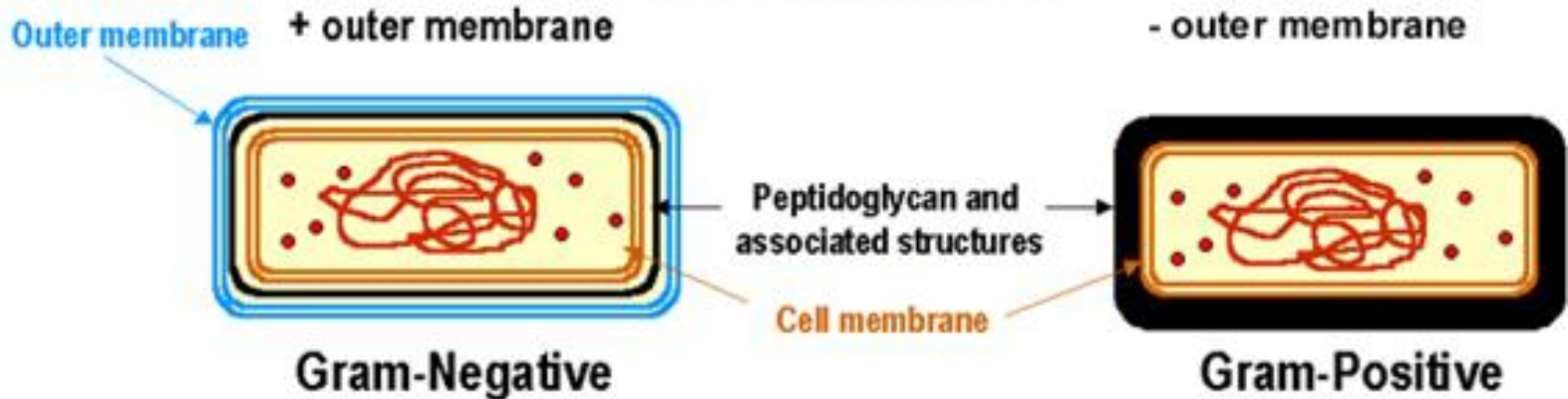


Animal Cell

Compartmentalized interior
No cell wall

Bacterial Cell

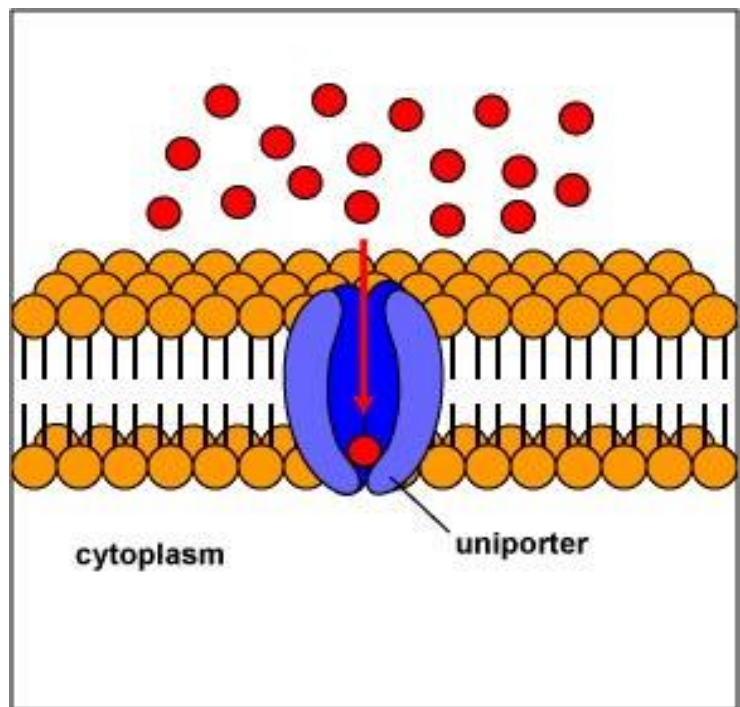
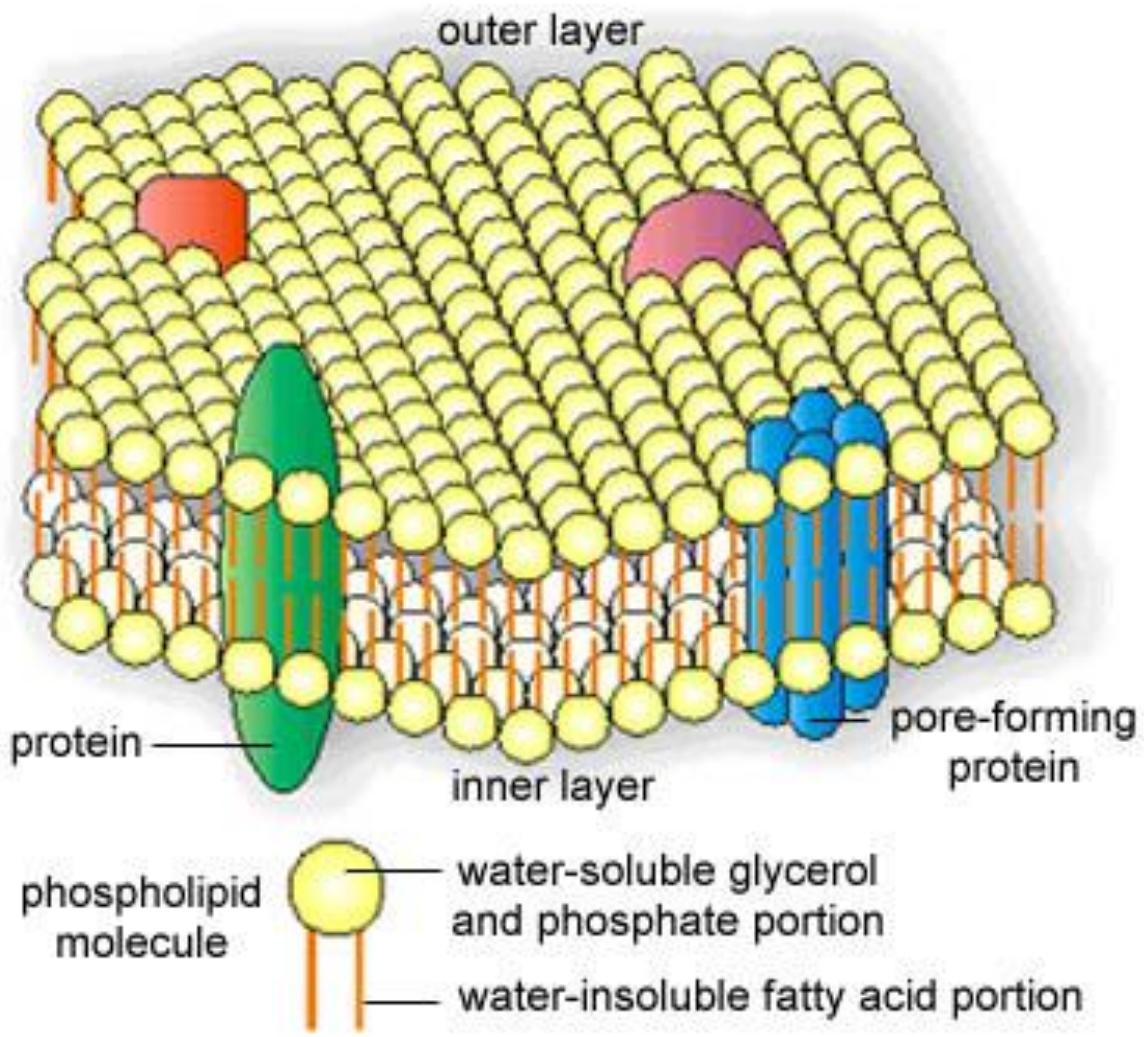
Non-compartmentalized interior
Cell wall (peptidoglycan)



Plasmatic membrane -

cytoplasmatic membrane, cell membrane

- **Phospholipid double membrane** with proteins
- Selective permeability - determines the direction and composition of transferred structures by:
 - diffusion
 - osmosis
 - transport by transport proteins
 - *supported diffusion (aquaporins, uniporters, symporters)
 - *active transport- antiporter)

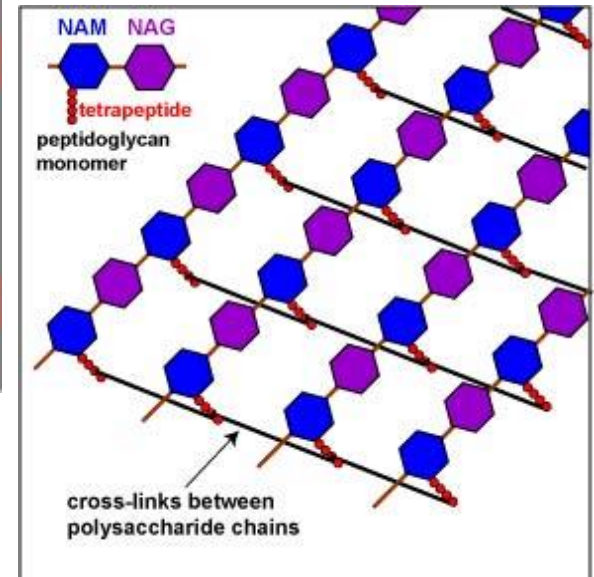
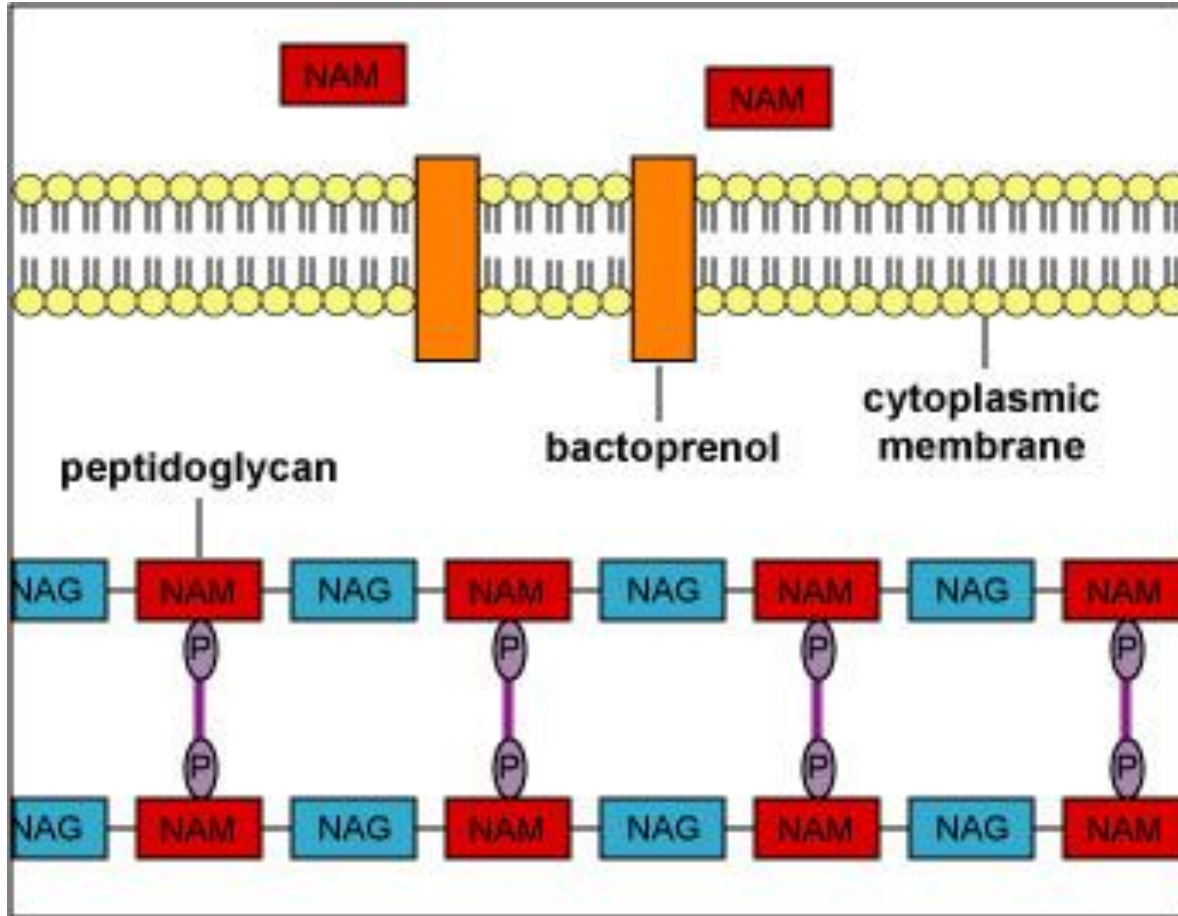


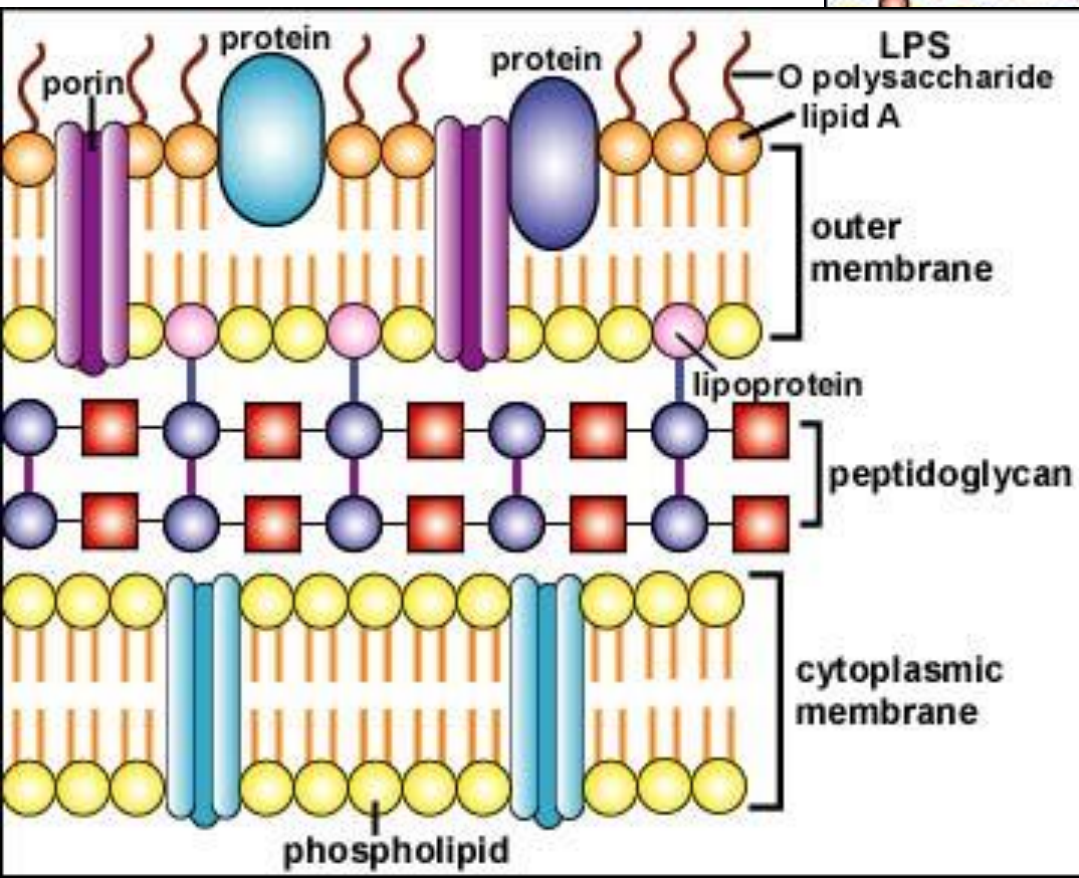
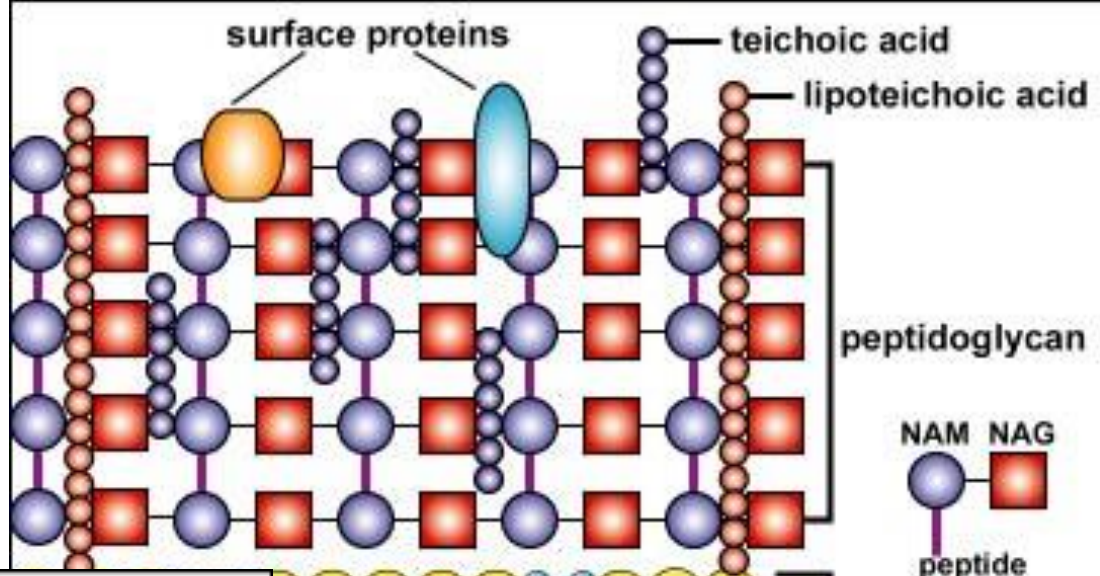
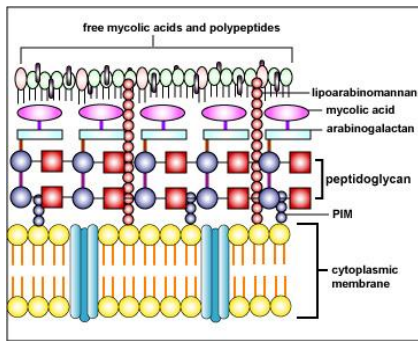
Function of cytoplasmatic membrane

- selective permeability
- production of energy (site of transport system a enzymes)
- synthesis of peptidoglycan
- cooperation in cell division (divisom)
- secretion of bacterial products
- transport of waste products
- sporulation

Cell wall of bacteria

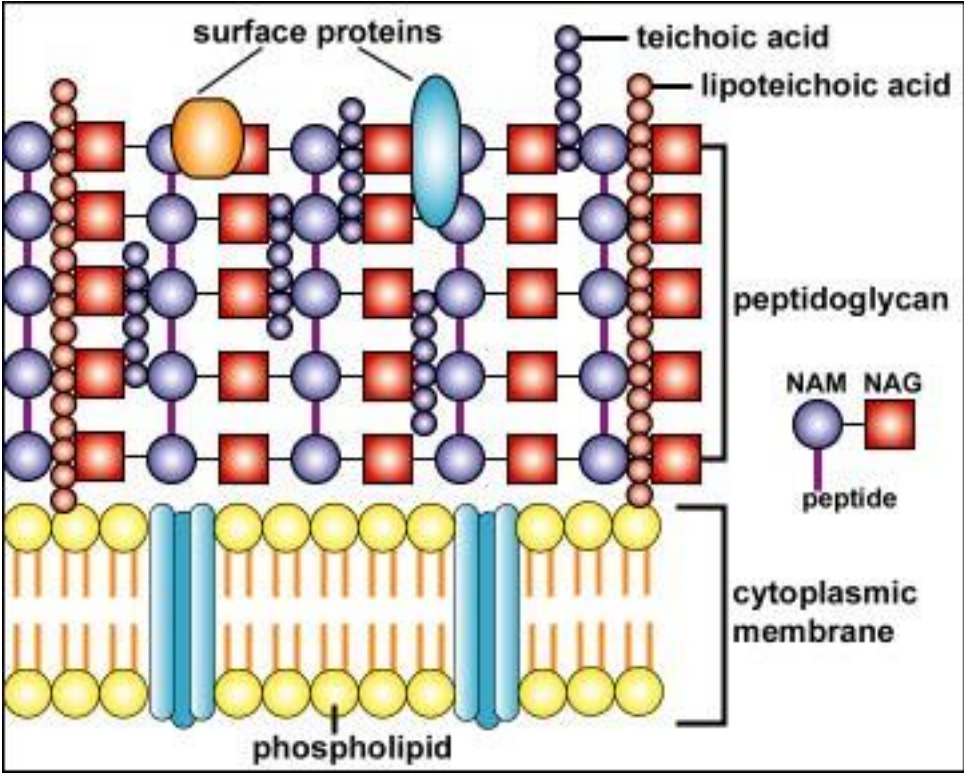
- Elementary structure unit - **peptidoglycan** (murein)
 - convolution of monomers of N acetyl muramic acid and N acetylglucosamin bound by 1,4 glycosidic binding
- Synthesis in cytoplasm, transfer via plasmatic membrane, incorporation in pre existing cell wall in the position where it has been desintegrate by enzymes, integrated together with transpeptidase (= aim place for PNC: penicilin binding protein PBP - interfer with function of enzym, reintegration not occuring - osmotic lysis of cells)
- different ratio of peptidoglycan and other structures





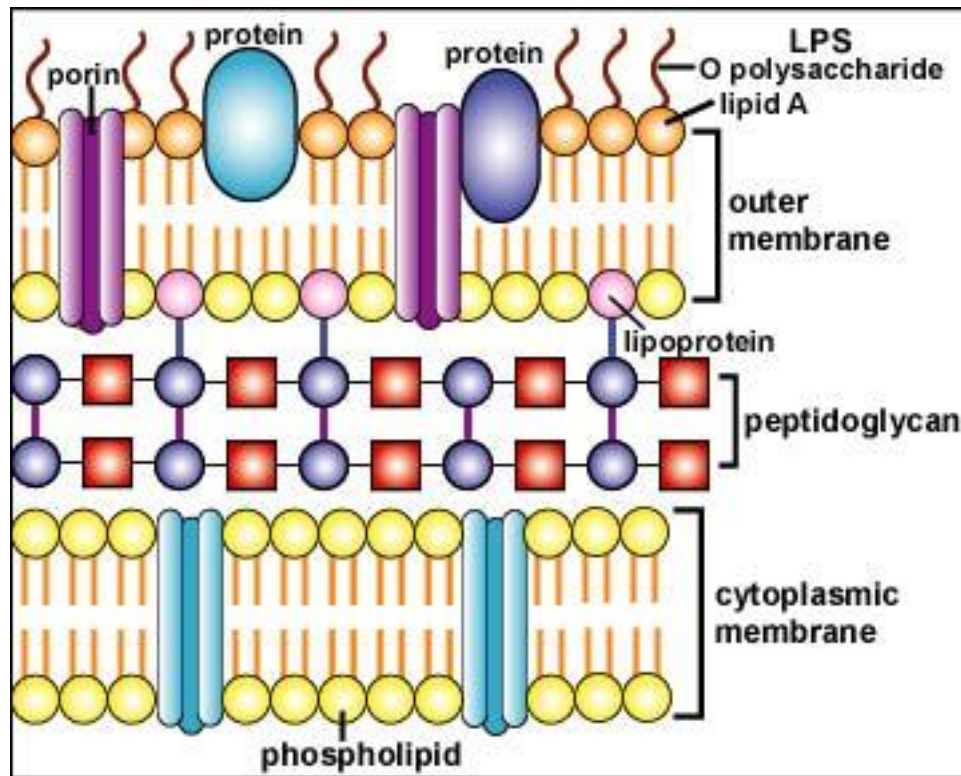
G+ bacterial cell

- Thick multilayer wall of peptidoglycan bound together with teichoic acid (polymers of glycerol, phosphates, ribitol, lipids) and superficial proteins
- Lysozyme disrupt 1,4- glycosidic binding



G- bacterial cell

- Thin layer of peptidoglycan - inner membrane
outer membrane: lipid double layer
 - phospholipids (**inner part of lipid double layer**)
 - lipopolysaccharid **outer part of lipid double layer**)LPS = lipid A - core - polysaccharide O Ag
 - *with internalised proteins (antigens) and lipoproteins (communication with peptidoglycan)
 - *semipermeabil, transport with aid of pores and proteins, interfere with enter of some structures (lysosome, PNC)
 - *LPS - rigidity, endotoxin properties
- Periplasmatic space - gelous mass between peptidoglycan and plasmatic membrane



Bacteria without cell wall

- **Mycoplasma** - naturally cell wall free, their plasmatic membrane consists of sterols - rigidity.
Osmotic stability - active transport of Na^+
- **L forms** - forms of cell wall free bacteria growing from normal bacteria during infection, or in special condition
 - spheroplasts G-
 - protoplasts G+

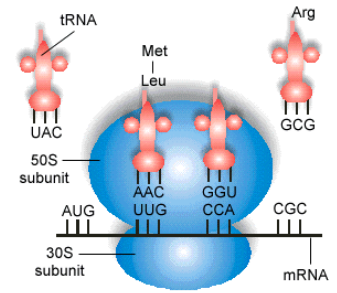
Cytoplasm

- Colloid solution of water, DNA, RNA, enzymes, amino acids, organic and inorganic materials, minerals
- Place of bacterial metabolism
 - catabolic reactions (nutrition hydrolysed by bacterial exoenzymes, smaller molecules transported in bacteria)
 - anabolic reactions (synthesis of own molecules and structures with endoenzymes)
- Nucleoid, ribosomes, plasmids, endospores, inclusions

Nucleoid

- Genetic material (genom)
= circular DNA = one molecule of double strain DNA, the ends are covalently bound = nuclear mass (bacterial chromosome) = nucleoid = gens encoding synthesis of proteins
- Extrachromosomal DNA - molecules of DNA situated in cytoplasm and not in nucleoid - **plasmids** - encoding properties of bacteria that are not necessary for life but are favorable
- **Transposon** - short pieces of DNA in nucleoid or plasmid able to be transferred in another place

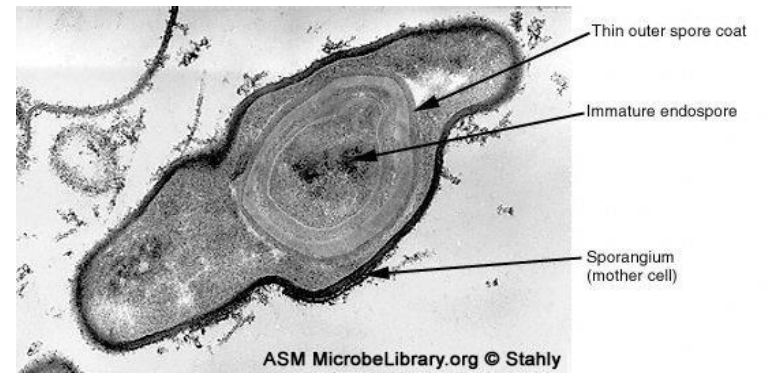
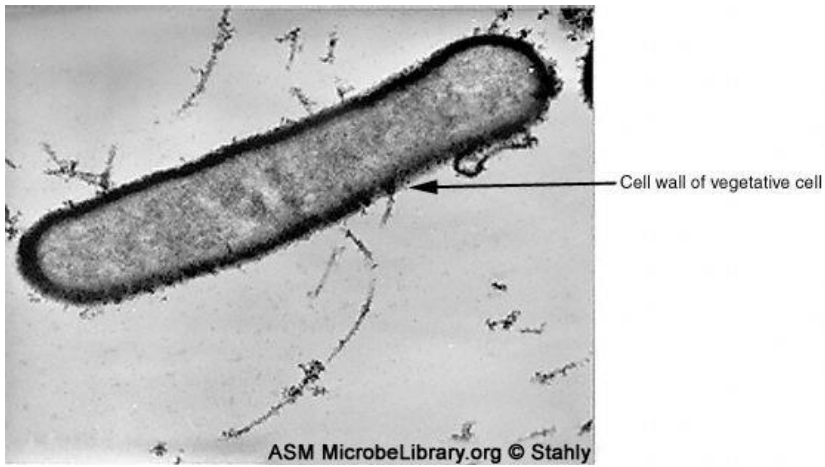
Ribosomes, inclusion



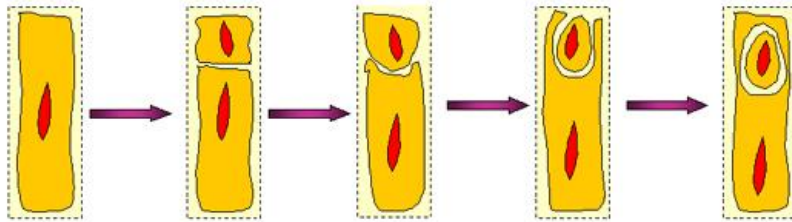
- Composition: rRNA + proteins
 - Structure: 2 subunits with sedimentation constant- 30S and 50S (Svedberg unit) - unique in nature differs from ribosomes of eukaryotic cells - selective action of some ATB
 - Proteosynthesis
-
- Inclusions - storage granules of glycogen, starch, sulphur granules, volutine granules.
 - Important for metabolism and identification
 - Volutin, metachromatic (end colour is different from the colour of applied stain and cytoplasm) - phosphat granules - Albert staining - *Corynebacterium diphtheriae*

Endospores and sporulation

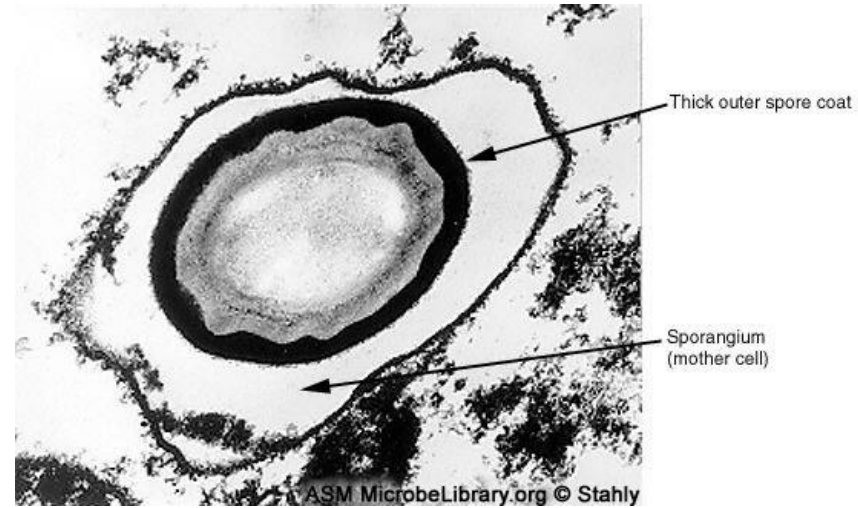
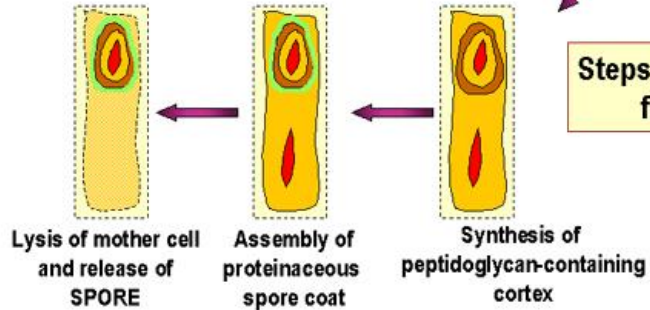
- Sleeping stage of life cycle of some bacteria (Bacillus and Clostridium)
- Highly resistant - not permeable coat consisting of dipicolinate and osmotic activity of coat = causes dehydration), sterility control and control of sterilisers
- Sporulation - in one vegetative cell one spore can be formed and vice versa. (Replication of DNA, formation of septum, formation of coats or exosporium, desintegration of the rest of vegetative cell and liberating of the spore)
- Germination - spores are not harmful until germination - activation (mild temperature, alanine) - water intake



End of vegetative growth Asymmetric septation Endocytosis or engulfment of daughter protoplast



Steps in endospore formation



Role of spores and false spores

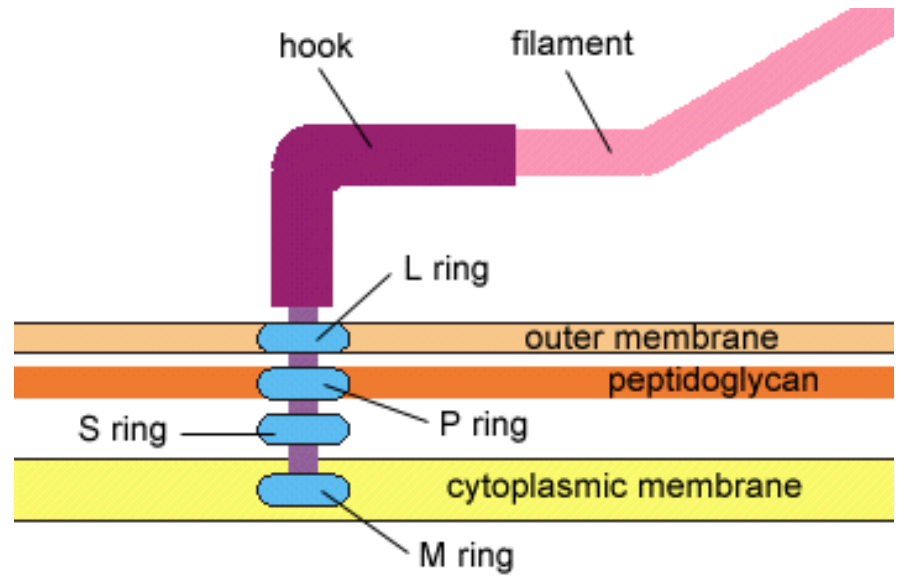
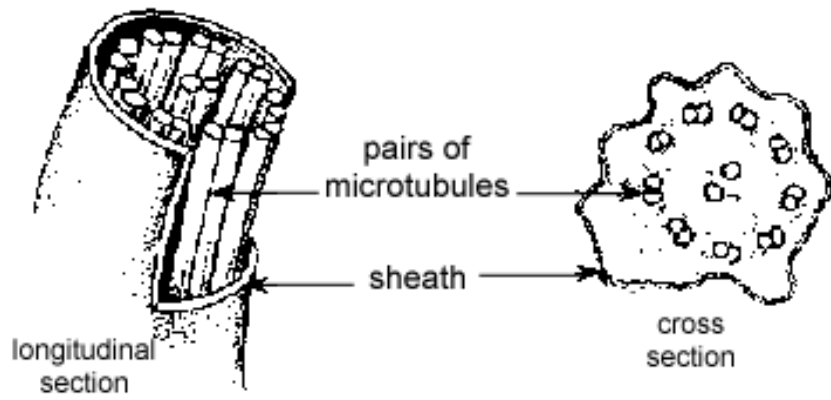
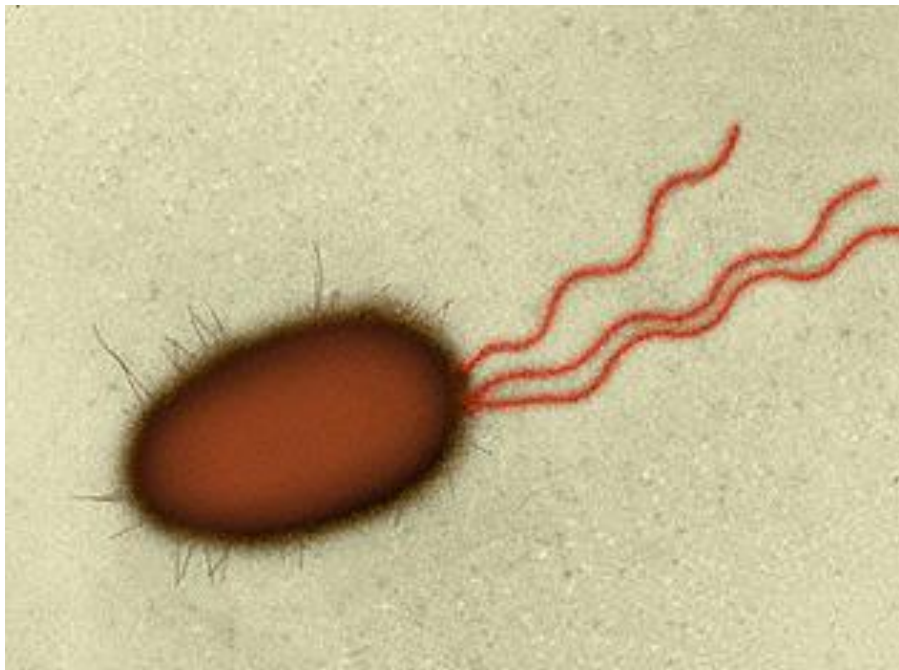
- Transmission of diseases - anthrax, tetanus, botulism, gas gangren
 - diagnosis - characteristic localisation in cell, not stained by Gram. Wirtz Conklin staining
- Exospores - thermostable structures after budding
- Cysts resistant to drying in viable vegetative cell
- Conidia - thermolabile reproductive organs of bacteria from the group *Actinomycetes*

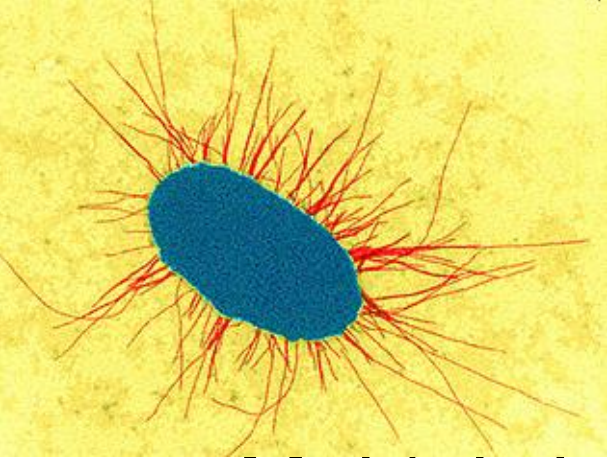
Capsule and Slime

- **Capsule**
 - Extracellular chemically defined and organised mass produced by bacteria tightly adhering on the cell wall
 - usually polysaccharid, immunogen (T independent antigen), different antigen type of one bacterial species according to chemical structure of capsule
- Role - antiphagocytic properties, interference with enter of ATB, tool of virulence, mostly in children under 3rd year,
- Detection - Burri staining method, agglutination, mucous colonies,
- *Bacillus anthracis* (protein capsule), *Neisseria meningitidis*, *Streptococcus pneumoniae*,
- **Slime** - Extracellular amorphous no uniform mass

Flagella

- Locomotory organ- rotation of flagella is caused by proton gradient and configuration changes of proteins in basal body
 - Localisation:
 - monotrichous
 - amfitrichous
 - lofotrichous
 - peritrichous
 - Structure
 - filament - hollow helical protein structure (flagelin, H antigen) forming core
 - hook - flexible connection of the filament and basal body
 - basal body - anchoring of flagella in cell wall
 - Axial filaments - inner flagella of spirochetes
- Dôkaz existencie bičíkov na základe dôkazu pohybu baktérie:
- natívny preparát
 - kultivácia v U rúrke,
 - rast mimo miesta v pichu,
 - Raussov fenomén





Fimbriae

- Multiple hairy protrusions on the surface of bacterial cell
- Adherence of microbes to other cells or artificial material - ability to resist the urine splash - colonisation of urinary tract by *E. coli* - condition of infection
- Tool of pathogenity and virulence



Pilli

Extracellular structures connecting two G- bacteria and making a pair of cells (sex pilli), transferring genetic information (usually ATB resistancusually situated in plasmid together with genes endcoding the formation of pilli