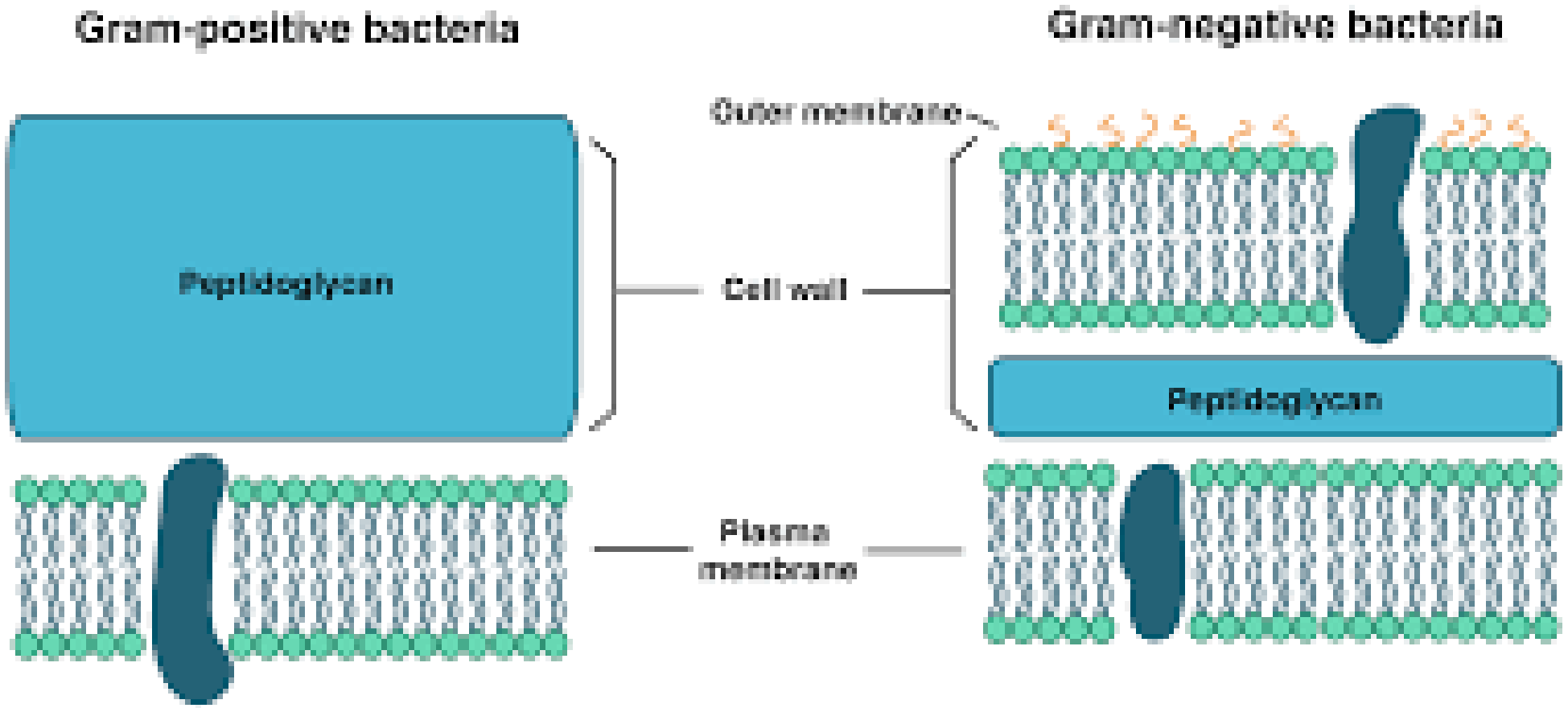
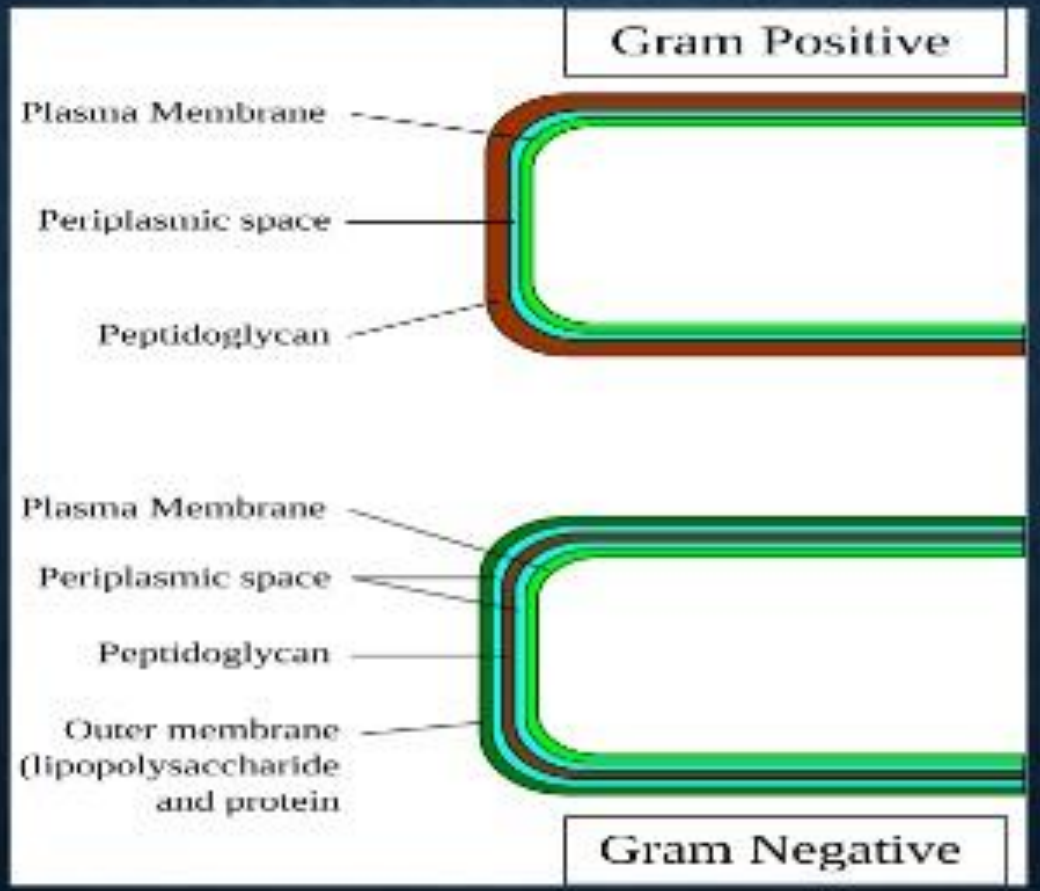
CONTENTS

- Structure of peptidoglycan
- Synthesis of peptidoglycan
- Role of cytoskeleton in cell wall synthesis
- Patterns of cell wall synthesis
- Significance of peptidoglycan cell wall


Gram-positive bacteria
Gram-negative bacteria
Outer membrane
Peptidoglycan
Cell wall
Peptidoglycan
Plasma membrane

PEPTIDOGLYCAN CELL WALL



ULTRA STRUCTURE OF CELL WALL

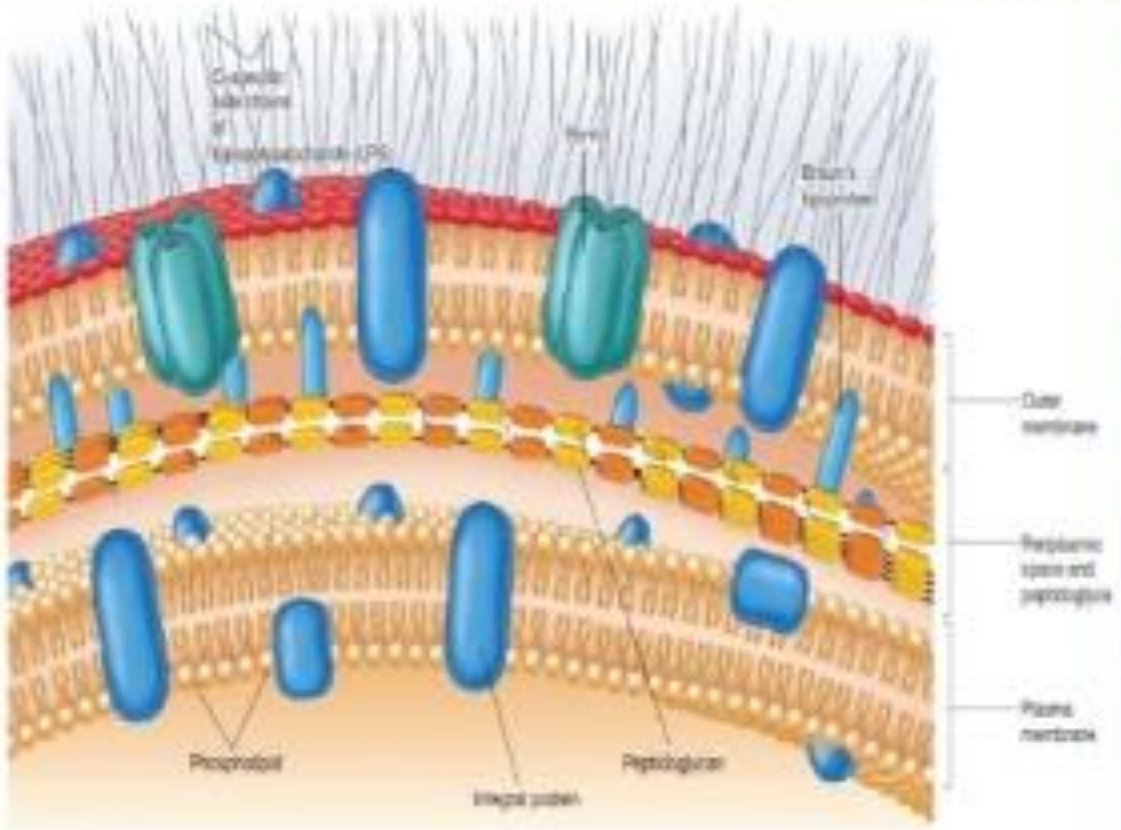


Figure 3.25 The Gram-Negative Envelope.

Gram negative bacterial cell wall

Gram positive bacterial cell wall

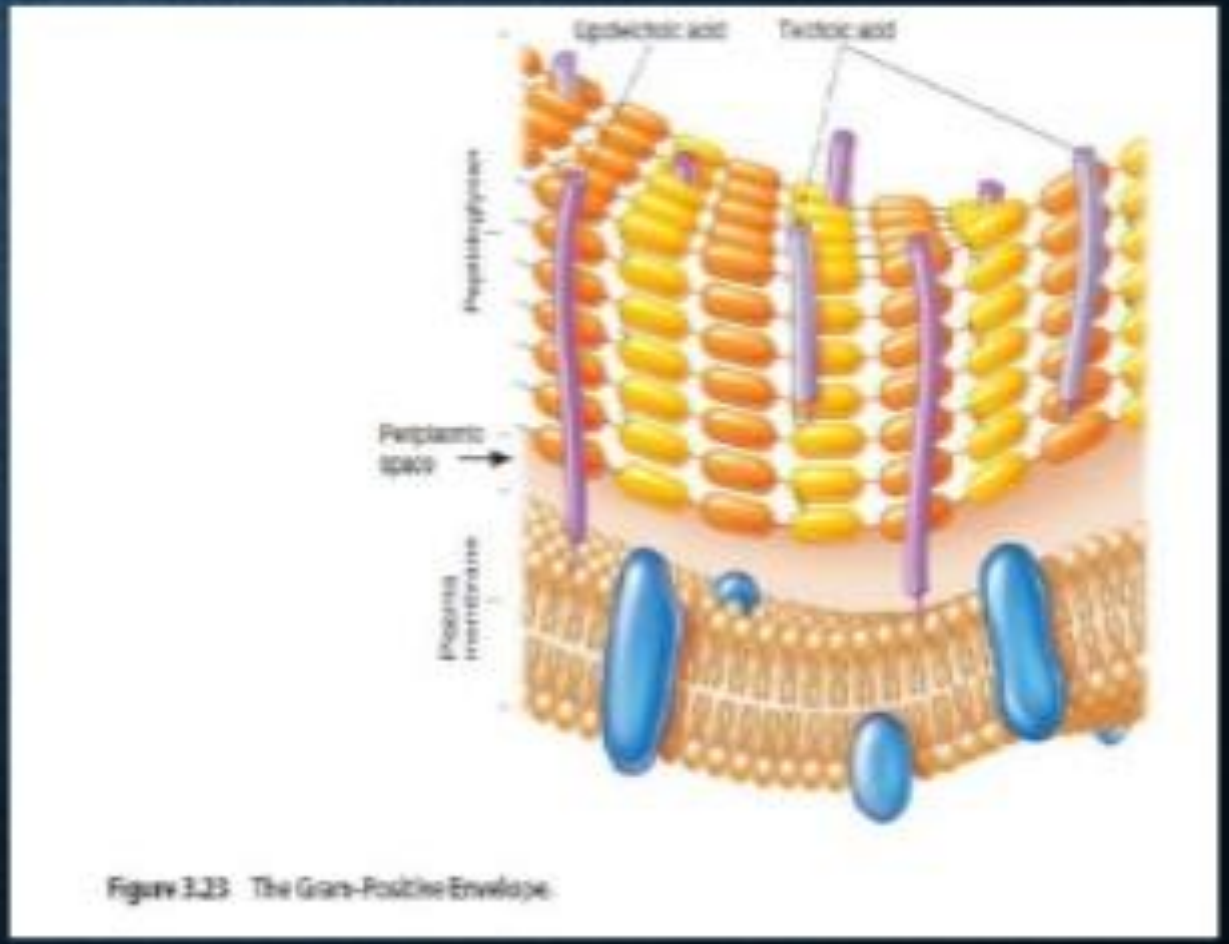


Figure 3.23 The Gram-Positive Envelope.

STRUCTURE OF PEPTIDOGLYCAN

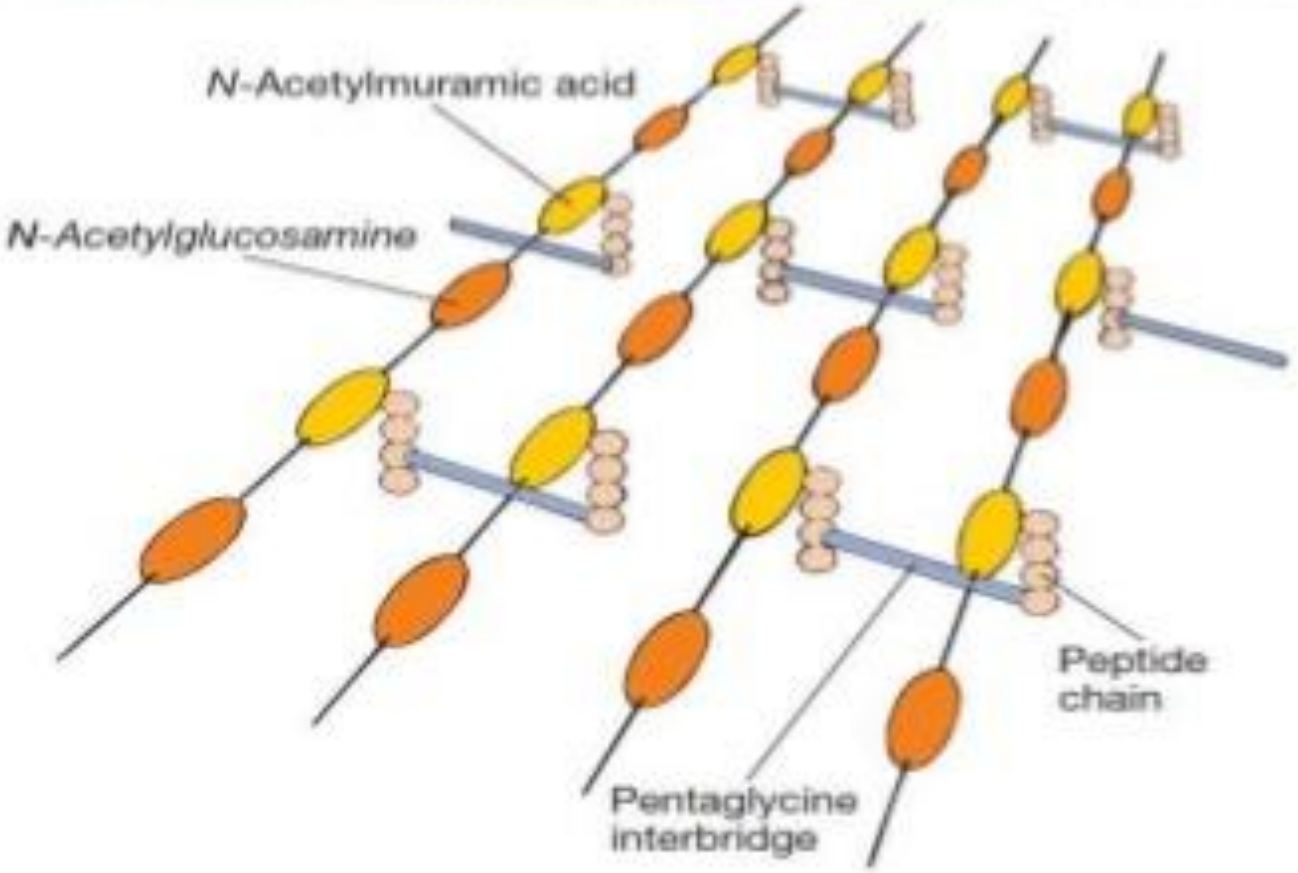
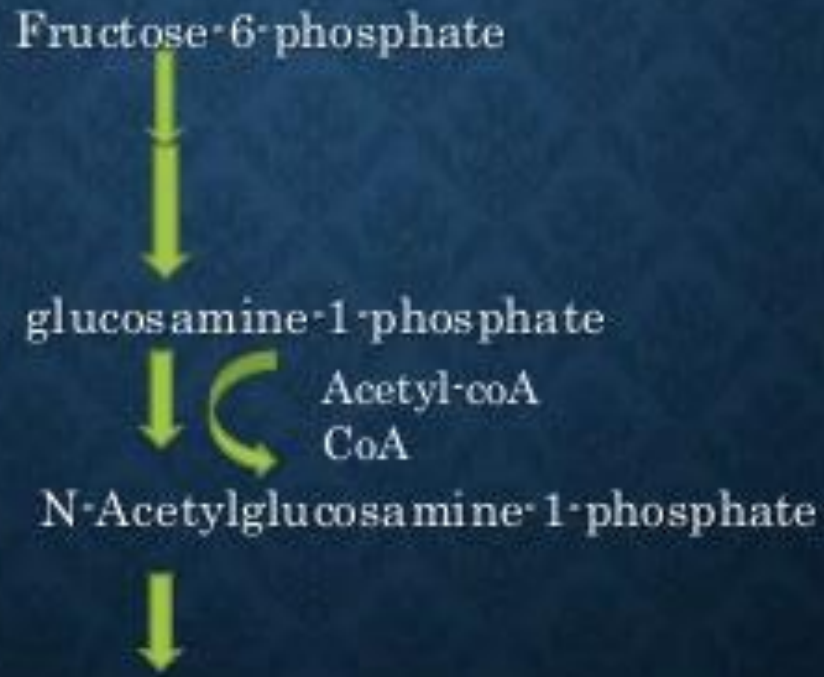


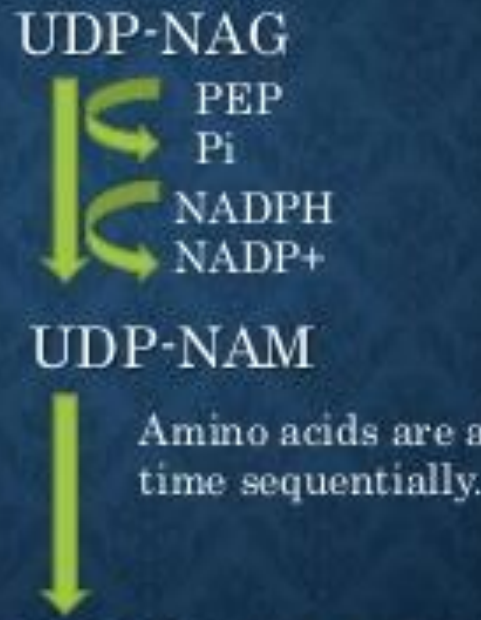
Figure 3.21 Peptidoglycan Structure. A schematic diagram of one model of peptidoglycan. Shown are the polysaccharide chains, tetrapeptide side chains, and peptide interbridges.

SYNTHESIS OF PEPTIDOGLYCAN

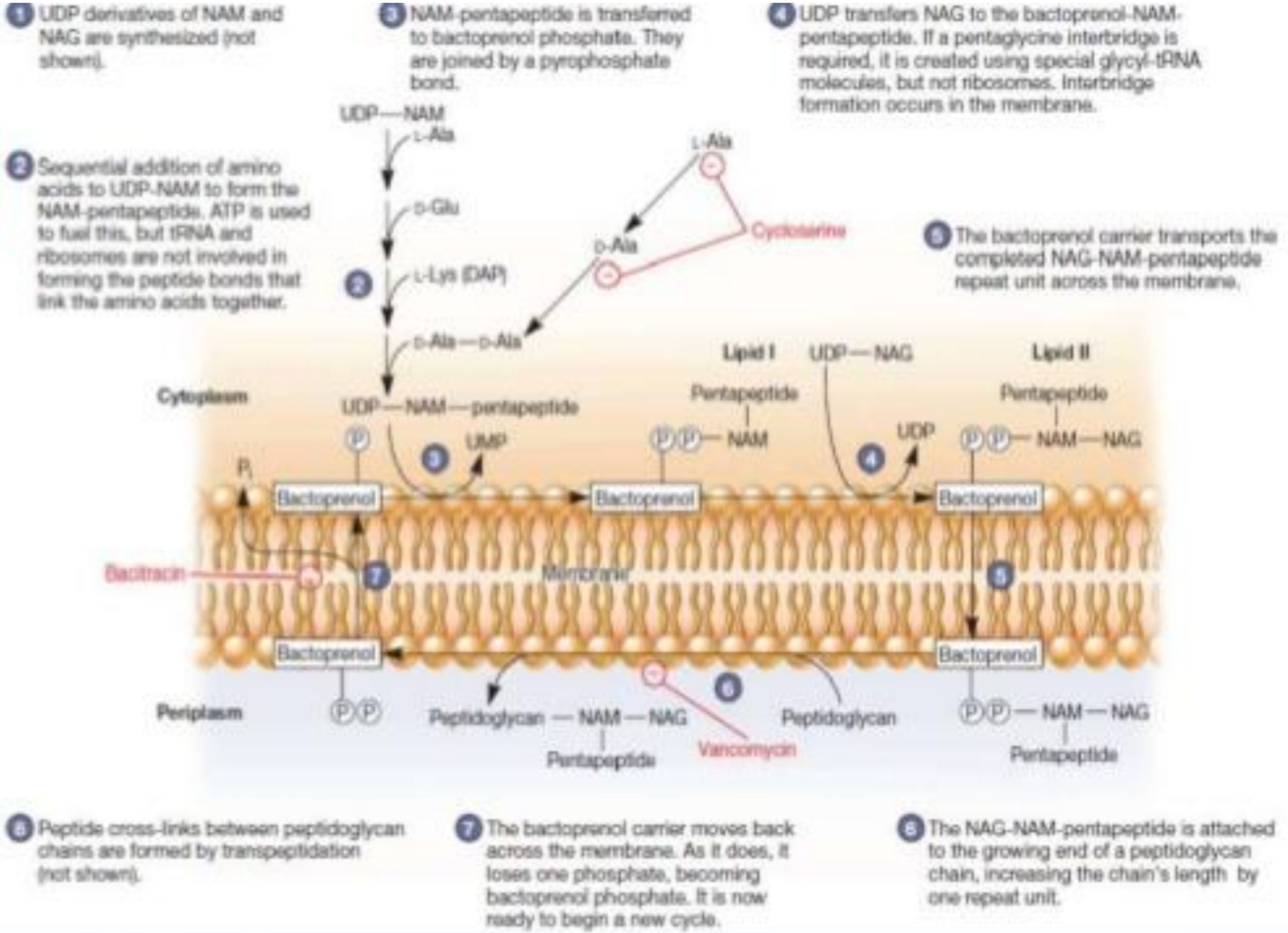
SYNTHESIS OF UDP-NAG

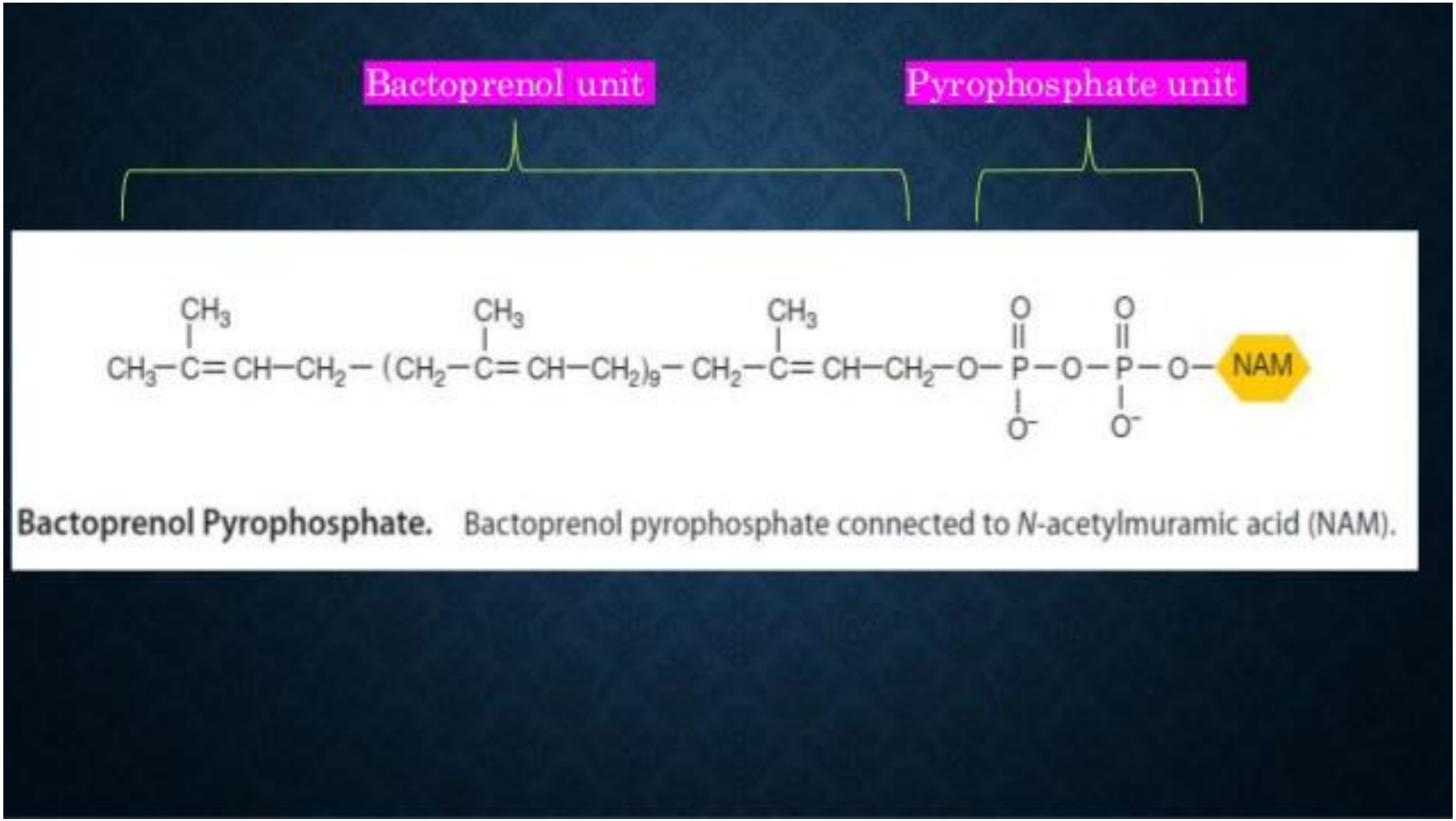


SYNTHESIS OF UDP-NAM



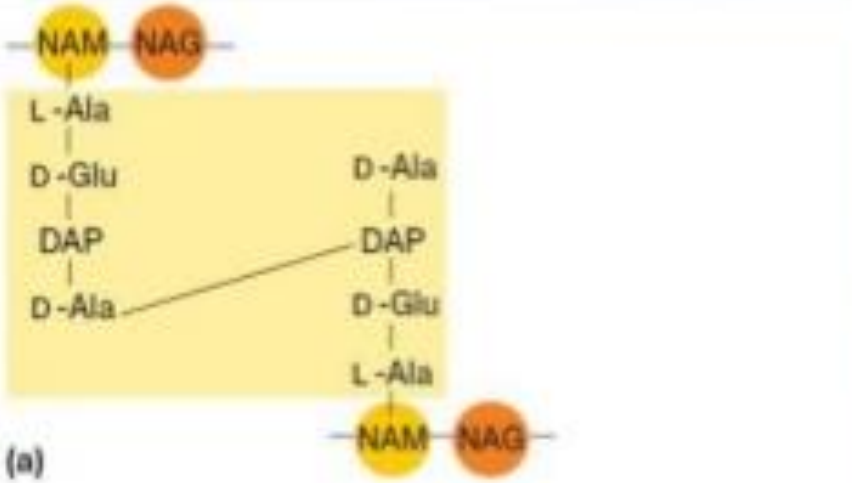
Peptidoglycan cell wall synthesis

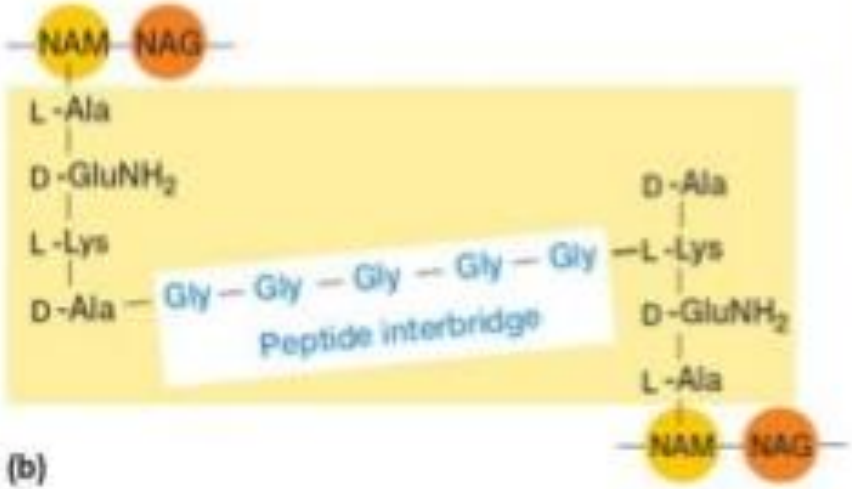




Bactoprenol Pyrophosphate. Bactoprenol pyrophosphate connected to *N*-acetylmuramic acid (NAM).

TRANSPEPTIDATION





Peptidoglycan Cross-Links. (a) *E. coli* peptidoglycan with direct cross-linking, typical of many gram negative bacteria.
(b) *Staphylococcus aureus* peptidoglycan. *S.aureus* is a gram-positive bacterium. NAM is N-acetylmuramic acid. NAG is N-acetylglucosamine. Gly is glycine. Although the polysaccharide chains are drawn opposite each other for the sake of clarity, two chains lying side-by-side may be linked together

Transpeptidation mechanism

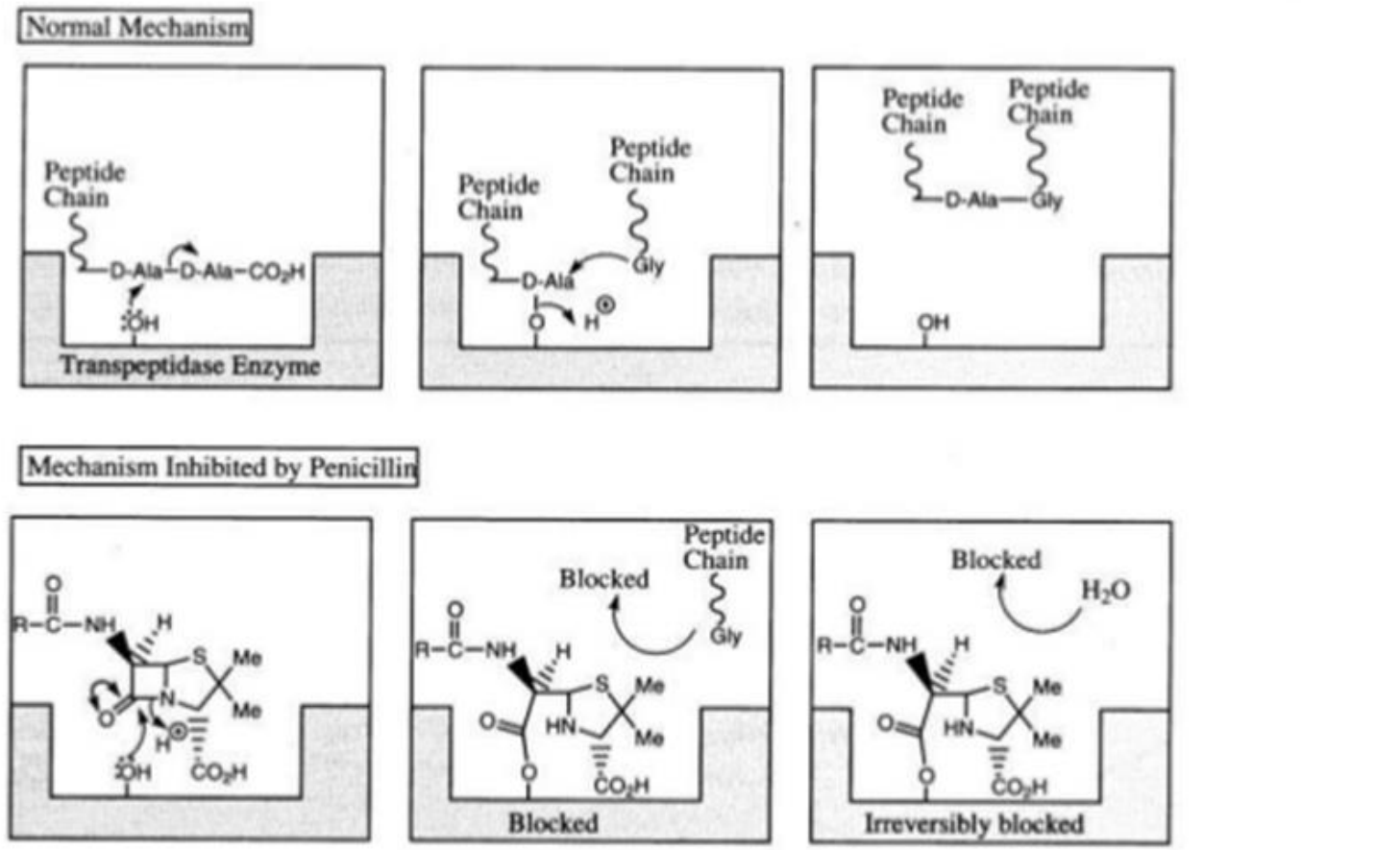
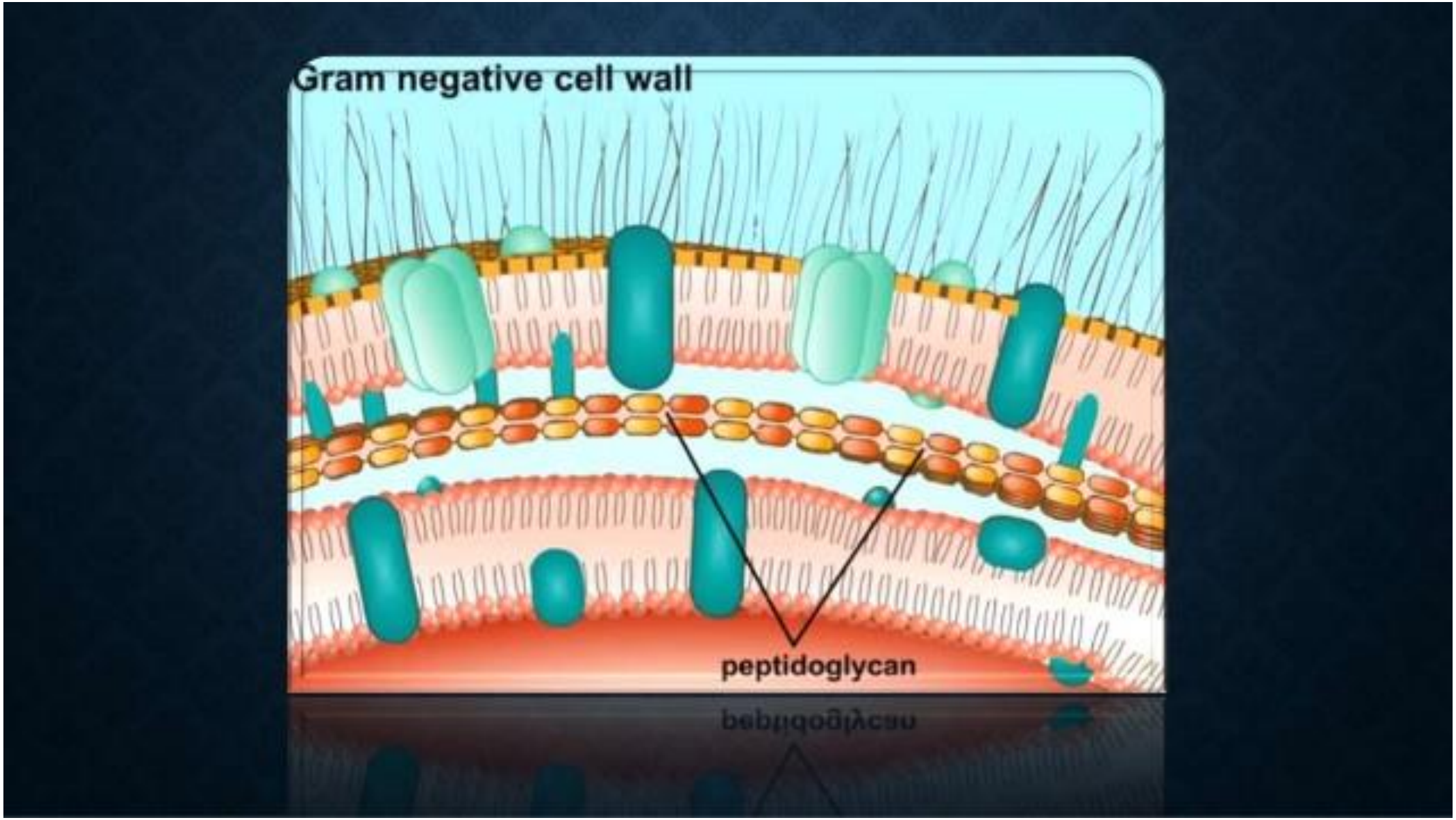


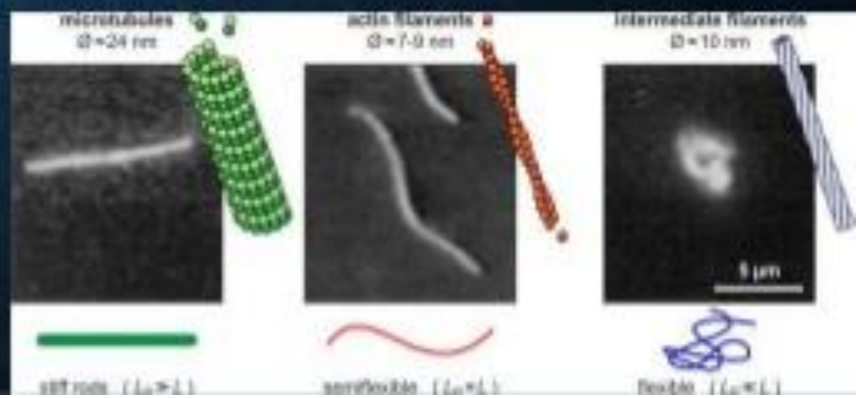
Fig. 14.63 Cross-linking mechanism by transpeptidase enzyme.

Source: Google Images

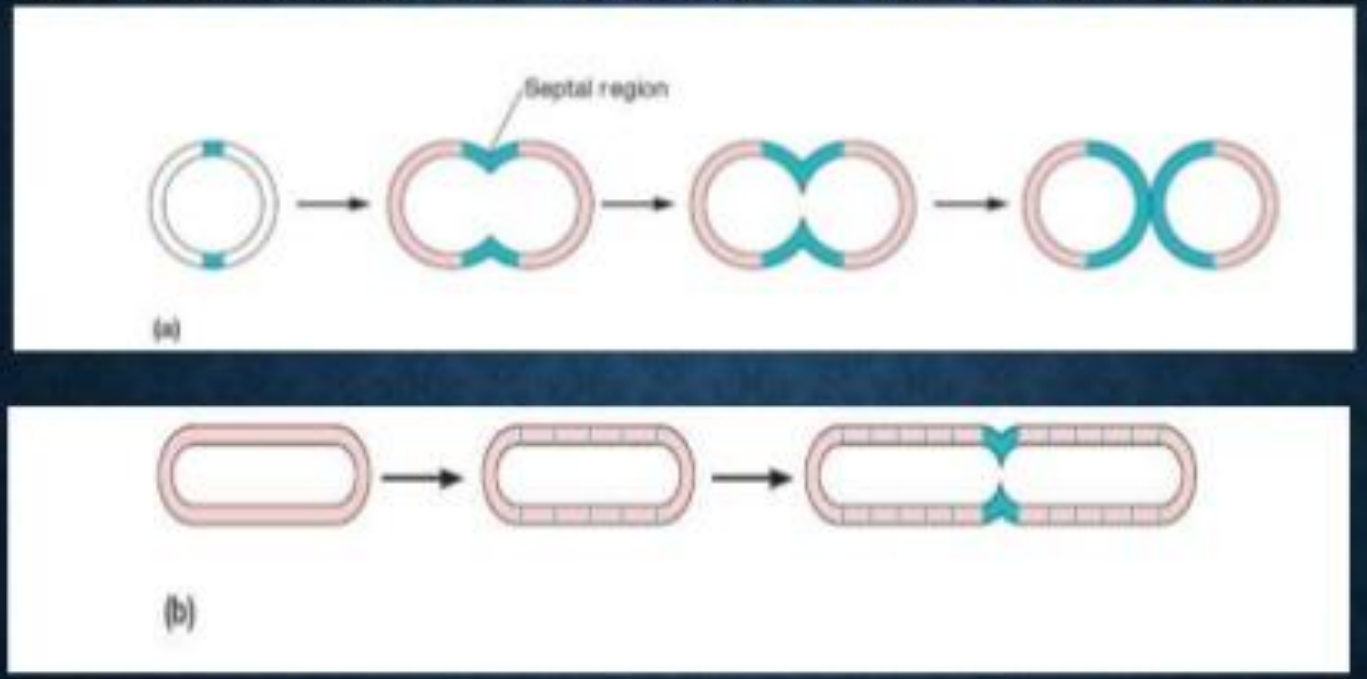

Gram negative cell wall
peptidoglycan

ROLE OF CYTOSKELETON IN CELL WALL SYNTHESIS

- Cytoskeletal structures formed by MreBCD proteins control cell shape by controlling the cell wall synthesis.
- Any mutations that lead to the defects in bacterial cell shape are directly associated with a defect in cell wall synthesis.
- Multiple mutations in *pbp* genes can convert rod shaped *E.coli* and *B.subtilis* into round or branched cells.(Nelson *et al.*,2000)
- Similarly mutation in TagF (enzyme involved in teichoic acid synthesis) converts *B.subtilis* to round cells. (Henriques *et al.*, 1998)

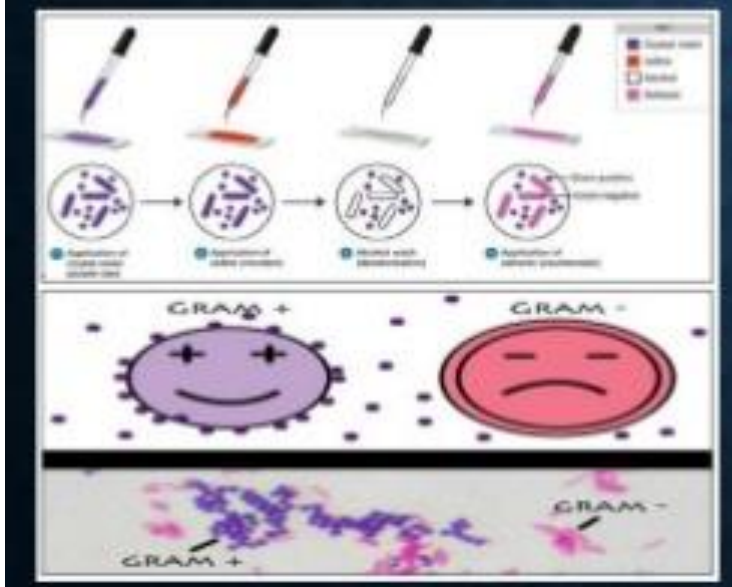


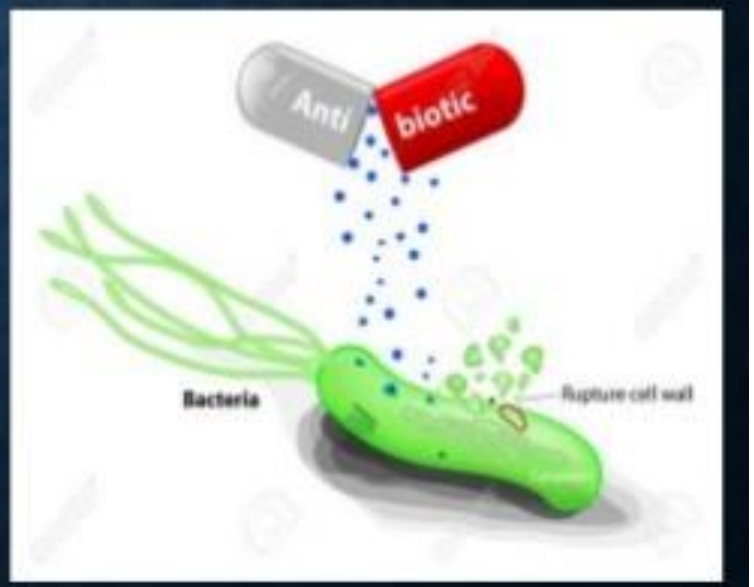
PATTERNS OF CELL WALL SYNTHESIS



Wall Synthesis Patterns. Patterns of new cell wall synthesis in growing and dividing bacteria.
(a) Streptococci and some other gram-positive cocci.
(b) Synthesis in rod-shaped bacteria (E. coli, Salmonella, Bacillus). The zones of growth are in turquoise. The actual situation is more complex than indicated because cells can begin to divide again before the first division is completed

SIGNIFICANCE OF PEPTIDOGLYCAN





CONCLUSION

- Peptidoglycan wall is crucial for the bacterial growth, protection and maintenance of the cell shape.
- Cytoskeletons play a crucial role in cell shape determination but the specific effectors of cell wall receptors of cell wall morphogenesis controlled by cytoskeleton is unknown (Scheffers and Pinho, 2005)
- All the factors, responsible for the cell wall synthesis, if studied it would be effective in designing drugs and antibiotics.

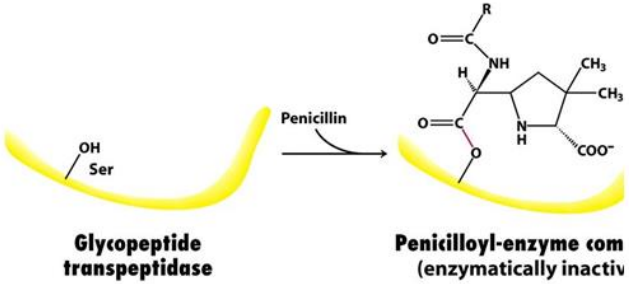
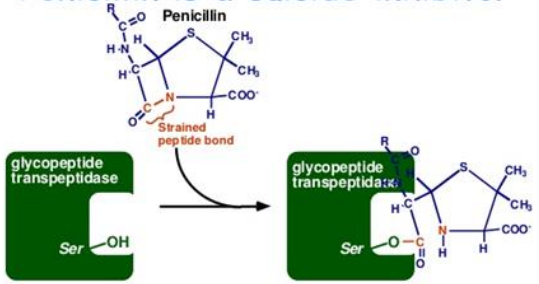


Figure 8-35

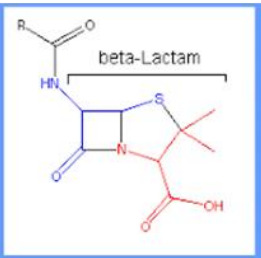
-On binding to the transpeptidase, the serine residue a
the active site attacks the carbonyl carbon atom of the
lactom ring of the penicillin to from the penicilloyl-seri
derivative.
-Penicillin acts as a suicide inhibitor.

Penicillin is a suicide inhibitor



Glycopeptide transpeptidase catalyzes the formation of cross-links between D-amino acids in the cell walls of bacteria. This enzyme also catalyzes the reverse reaction, the hydrolysis of peptide bonds. During the course of hydrolyzing the strained peptide bond in penicillin, the enzyme activates the inhibitor (penicillin), which then covalently modifies an active site serine in the enzyme. In effect, the enzyme "commits suicide" by hydrolyzing the strained peptide bond in penicillin.

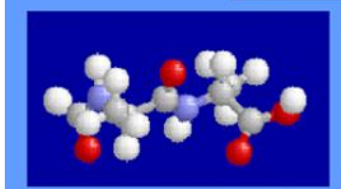
Similarity in structure of cell wall peptide and penicillin

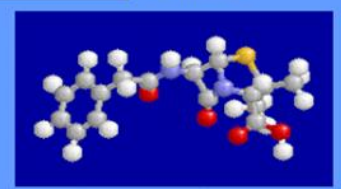


D-alanine-alanine

Trace red oxygen and blue nitrogen backbone

Penicillin





C. Ophardt, c. 2003