mutans is an inhabitant of the mouth that metabolizes sucrose to produce a polysaccharide capsule enabling the cell to adhere firmly to the teeth. This is the initial step in the formation of dental plaque, which is a complex array of microorganisms and organic matrix that adheres to the teeth and ultimately leads to decay. The substitution of sucrose by glucose prevents capsule formation and hence eliminates plaque.

A similar picture emerges with *Staph. epidermidis*. This bacterium forms part of the normal microflora of the skin and was originally thought of as non-pathogenic. With the increased usage of indwelling medical devices coagulase-negative staphylococci, in particular *Staph. epidermidis*, have emerged as the major cause of device-related infections. The normal microbial flora has developed the ability to produce extracellular polysaccharide, which enables the cells to form resistant biofilms attached to the devices. These biofilms are very difficult to eradicate and have profound resistance to antibiotics and disinfectants. It is now apparent that the dominant mode of growth for aquatic bacteria is not planktonic (free swimming) but sessile, i.e. attached to surfaces and covered with protective extracellular polysaccharide or glycocalyx.

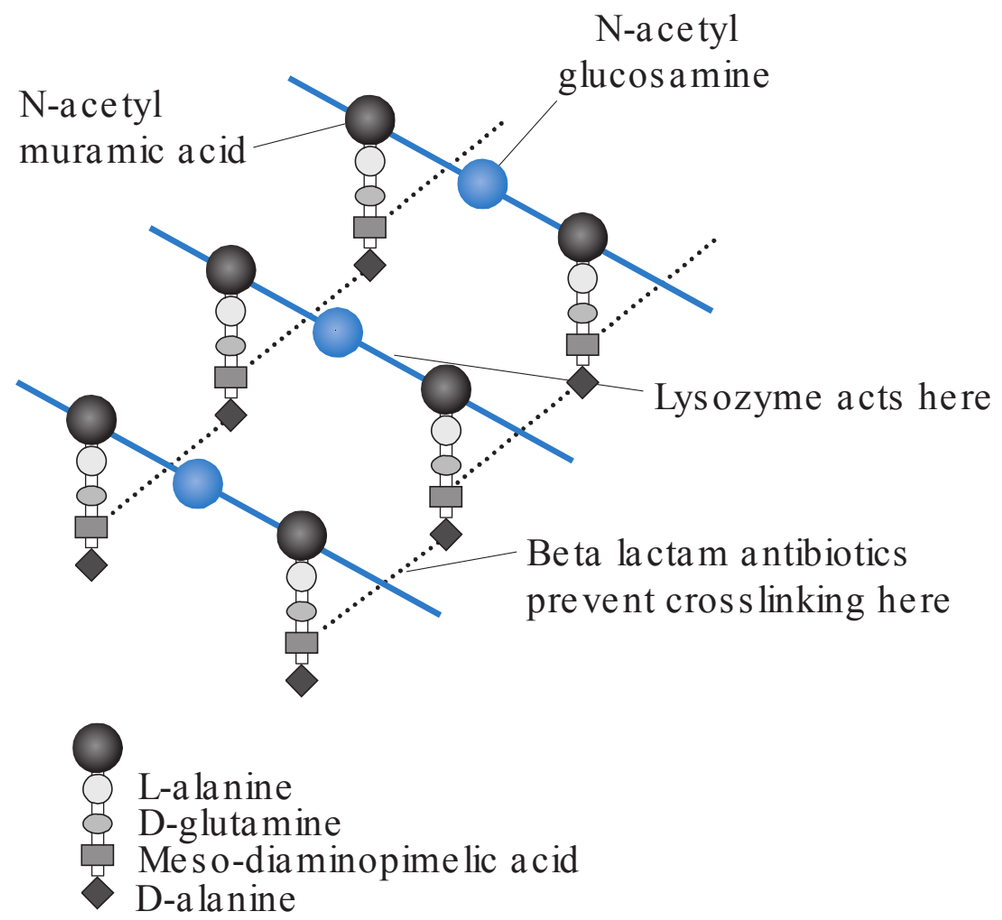

Fig. 13.3 • Peptidoglycan.

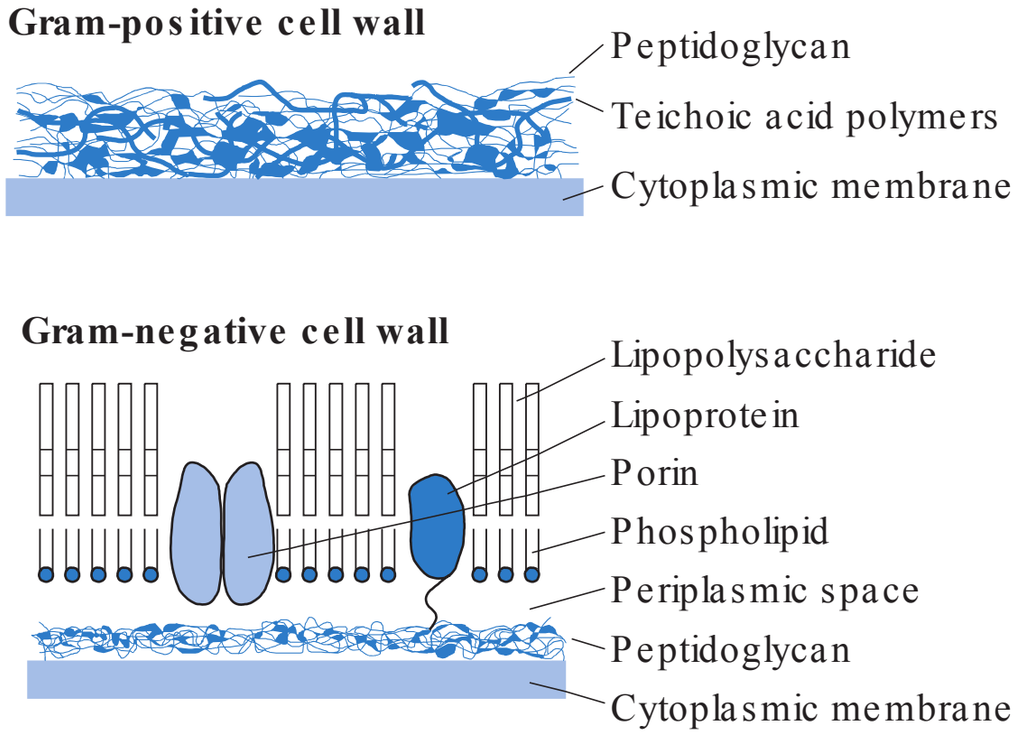

Fig. 13.4 • Structural components of bacterial cell walls.

Cell wall. Bacteria can be divided into two broad groups by the use of the Gram-staining procedure (see later in this chapter for details), which reflects differences in cell wall structure. The classification is based upon the ability of the cells to retain the dye methyl violet after washing with a decolourizing agent such as absolute alcohol. Gram-positive cells retain the stain whereas Gram-negative cells do not. As a *very rough* guide, the majority of small rod-shaped cells are Gram negative. Most large rods, such as the Bacillaceae, lactobacilli and actinomycetes, are Gram positive. Similarly, most cocci are Gram positive, although there are notable exceptions, such as the Neisseriaceae.

Bacteria are unique in that they possess peptidoglycan in their cell walls. This is a complex molecule with repeating units of *N*-acetylmuramic acid and *N*-acetylglucosamine (Fig. 13.3). This extremely long molecule is wound around the cell and crosslinked by polypeptide bridges to form a structure of great rigidity. The degree and nature of crosslinking vary between bacterial species. Crosslinking imparts to the cell its characteristic shape and has principally a protective function. Peptidoglycan (also called murein or mucopeptide) is the site of action of a number of antibiotics, such as penicillin, bacitracin, vancomycin and cycloserine. The enzyme lysozyme is also capable of hydrolysing the β–1–4 linkages between *N*-acetylmuramic acid and *N*-acelylglucosamine.

Figure 13.4 shows simplified diagrams of a Gram-positive and a Gram-negative cell wall. The Gram-positive cell wall is much simpler in layout, containing peptidoglycan interspersed with teichoic acid polymers. These latter are highly antigenic but do not provide structural support. Functions attributed to teichoic acids include the regulation of enzyme activity in cell wall synthesis, sequestration of essential cations, cellular adhesion and mediation