

4.8. REPRODUCTION IN BACTERIA

Reproduction in bacteria (almost in all monerans or prokaryotes) is *asexual*, taking place by means of binary fission, arthrospore formation, conidia formation and budding (see Section 4.7 for arthrospore and conidia formation). Some of the bacteria produce dormant structures (endospores, cysts) to survive adverse conditions; these structures germinate producing vegetative cells when favourable conditions return.

4.8.1. Binary Fission

Binary fission is the most common method of reproduction in bacteria. It is a process in which a parent cell divides to produce two equal-sized daughter (progeny) cells. In binary fission (Fig. 4.8), the parent cell first enlarges and then its cell wall and plasma membrane begin to grow inward in the middle region. Simultaneously, the circular bacterial chromosome replicates in characteristic prokaryotic manner (Chapter 28) resulting in two daughter bacterial chromosomes (Fig. 4.9). The inward growth of the cell wall and plasma membrane proceeds forming a transverse septum in the middle in such a way that it divides the parent cell into two equal-sized

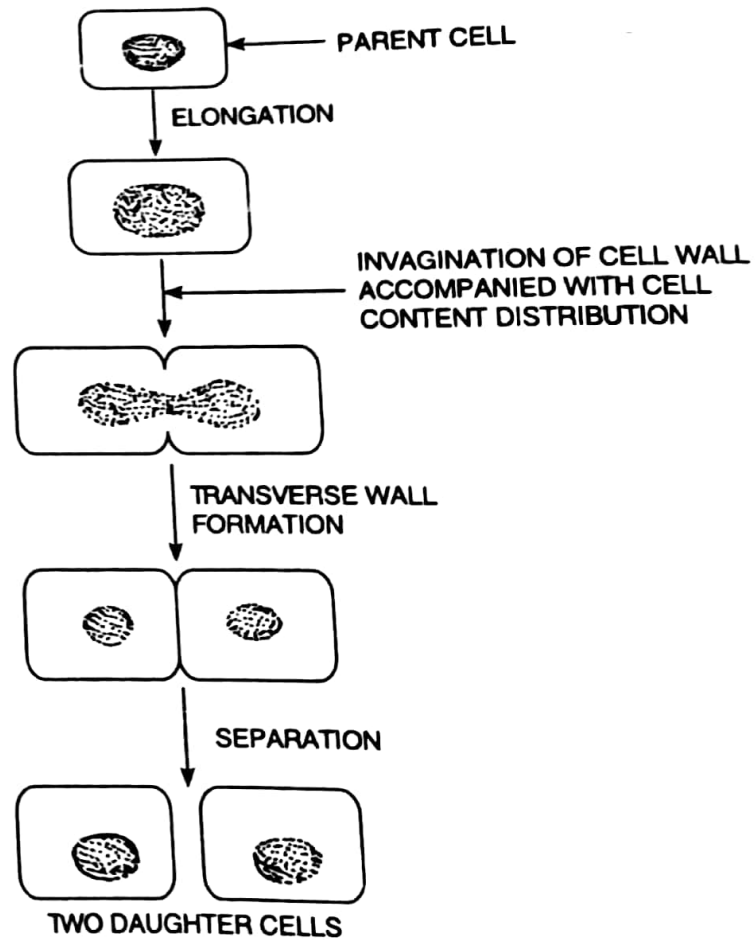


FIG. 4.8. Binary fission in bacteria.

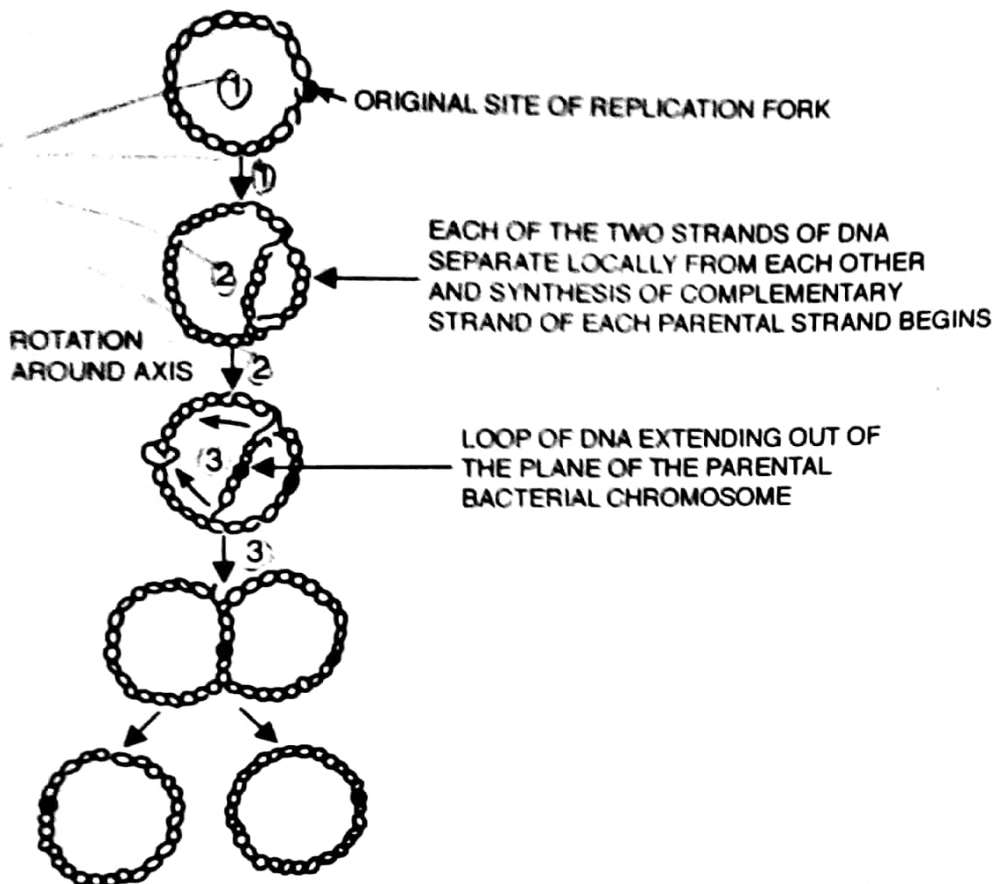


FIG. 4.9. The replication of a bacterial chromosome showing sequence of synthesis of a new circular loop of DNA.

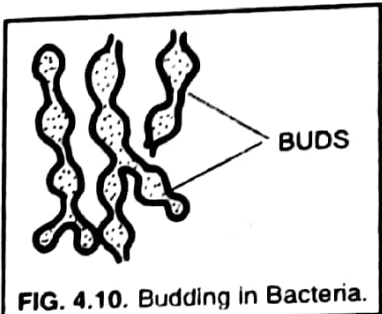


FIG. 4.10. Budding in Bacteria.

daughter (progeny) cells each with a complete bacterial chromosome. Finally, the daughter cells separate from each other and become independent. Repeating the process results in multiplication of the bacterial population.

Binary fission is a quick process. Although the time required to complete a binary fission (called generation time or doubling time) varies considerably among different bacteria, some like *E. coli* needing only 20 min under optimal conditions. At this rate, one cell of *E. coli* will multiply by binary fission to yield 512 cells in three hours, 3,2768 cells in five hours, and so on.

4.8.2. Budding

Budding (Fig. 4.10), a type of division characterized by an unequal division of cellular material, takes place in some rod-shaped bacteria which develop small outgrowths generally at one end. These outgrowths, finally, bud off from the parent cells as daughter cells and mature into bacterial cells. *Rhodospirillum rubrum* is a budding bacterium.

4.8.3. Sexual Reproduction

No true *sexual reproduction* is known to occur in bacteria (almost in all monerans or prokaryotes). As normally defined, a true sexual reproduction represents a method of propagation of new individuals involving union of two compatible nuclei accompanied with plasmogamy, karyogamy, and meiosis occurring in a regular sequence at specified points in the life of an organism. The two compatible nuclei contain a complete set of genetic material. Contrary to it, only incomplete sets of genetic material are transferred from one prokaryotic cell to the other, no karyogamy and meiosis is reported. Thus the bacteria in particular and all prokaryotes in general lack true sexual reproduction, and their requirements of sexuality are met by different processes of *genetic recombination* (Section 29.1).

Although sexual reproduction with the formation of a zygote (karyogamy) and subsequent meiosis does not occur in bacteria (in all prokaryotes), genetic recombination takes place following *horizontal gene transfer*. In horizontal gene transfer, genes are transferred from one independent, mature bacterium (donor) to another (recipient). This process is quite different from transfer of genes from parents to offspring (*vertical gene transfer*; in sexual reproduction) in eukaryotes. In eukaryotes, the recombination is reciprocal, i.e., all of the DNA is conserved in gametes that eventually arise from meiosis and recombination. Recombination in bacteria is a one-way DNA transfer from donor to recipient. Transfer of DNA from a donor bacterium to the recipient bacterium takes place in three different ways : direct transfer between two bacteria temporarily in physical contact (*conjugation*; Section 29.1.1), transfer of a naked DNA fragment (*transformation*; Section 29.1.2), and bacteriophage-mediated transfer of DNA (*transduction*; Section 29.1.3).