

8.3 Prokaryotic Cell Division

Learning objectives

By the end of this section, you will be able to:

- *Describe the process of binary fission in prokaryotes*
- *Be able to define and explain all bolded terms*

For unicellular organisms, cell division is the only method to produce new individual cells. In both prokaryotic and eukaryotic cells, cell reproduction should produce two daughter cells that are genetically identical to the parent cell.

To produce identical daughter cells, the following steps are essential. First, the genomic DNA must be replicated and then divided into each of the new daughter cells. Next, the cytoplasmic materials must be divided equally to give both new cells the machinery necessary to sustain life. These steps are required for both eukaryotic and prokaryotic cells.

Prokaryotic Cell Division

Prokaryotic cells have genomes that consist of a single, circular DNA chromosome located in a region called the nucleoid. The process of cell division, called **binary fission**, is simplified. First, DNA can be replicated at a faster rate given bacteria only have one chromosome to replicate. Second, the steps of mitosis are unnecessary because there is no nucleus that needs to be broken down nor multiple chromosomes that need to be divided.

Binary Fission

Before dividing, a prokaryotic cell must first grow and increase the number of its cellular components (Figure 8.15). Next, DNA replication starts at a location on the circular chromosome called the origin of replication. The chromosome is attached to the cell membrane, and replication continues in opposite directions along the chromosome. Next, the cell elongates, and the duplicated chromosomes separate and move to opposite poles of the cell.

Finally, the cell begins cytokinesis. Cytokinesis is directed by proteins that result in the formation of a **septum**. The septum consists of the bacterial cell wall and outer cell membranes. Once the septum is complete, the cell pinches apart, forming two new independent cells.

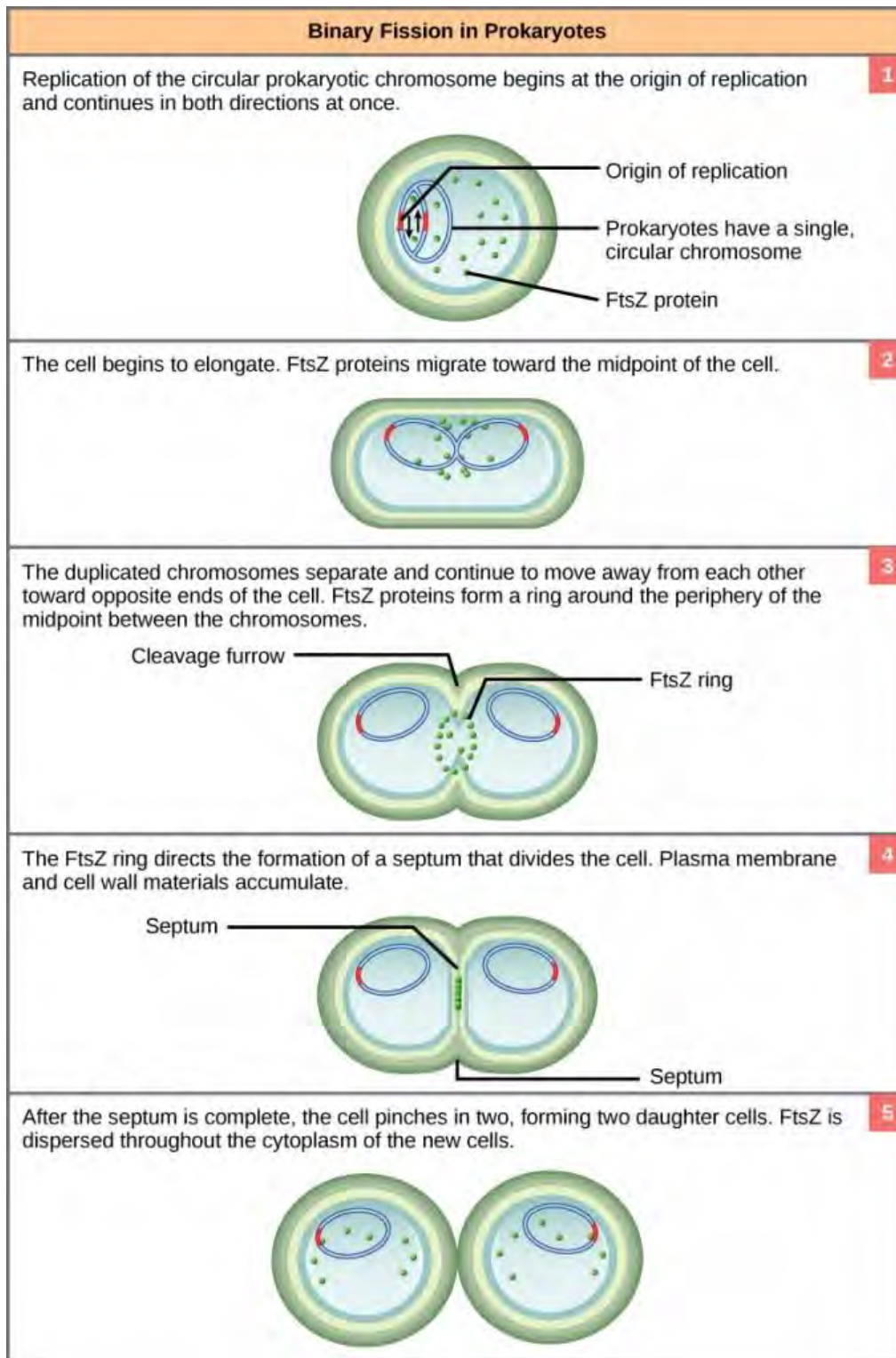
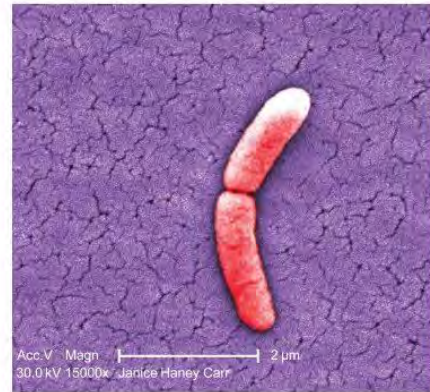


Figure 8.15 The binary fission of a bacterium is outlined in five steps. Note the image provides the name of a protein, FtsZ, which assembles into a ring structure, which directs the formation of the septum. (credit: modification of work by “Mcstrother”/Wikimedia Commons)

Binary fission is a less complicated and a much quicker process than cell division performed by eukaryotic cells. As a result, some bacteria like *E. coli* can divide in as little as twenty minutes. *Salmonella typhimurium*, one of the species of bacteria that causes food poisoning, can divide in 40 minutes allowing for their population to grow rapidly (Figure 8.16). Most people infected with *Salmonella* show signs of the illness 12-72 hours after being exposed to the bacteria.

Figure 8.16 The electron micrograph depicts two cells of *Salmonella typhimurium* after a binary fission event. (credit: Parker et al. / [Microbiology OpenStax](#))



Check your knowledge

Which of the following will complete binary fission?

- a. *Staphylococcus aureus* (a bacteria)
- b. *Trichophyton rubrum* (a fungus)
- c. *Rhytidiadelphus squarrosus* (a moss)
- d. *Apis mellifera* (an insect)

Answer: a, the Staphylococcus aureus is the only prokaryote in this list.