Section Summary

In both prokaryotic and eukaryotic cell division, the genomic DNA is replicated, and each copy is allocated into a daughter cell. The cytoplasmic contents are also divided evenly into the new cells. However, there are many differences between prokaryotic and eukaryotic cell division. Bacteria have a single, circular DNA chromosome and no nucleus. Therefore, mitosis is not necessary for bacterial cell division. Bacterial cytokinesis is directed by a ring composed of a protein called FtsZ. During cytokinesis, a septum consisting of the outer cell membrane and cell-wall forms, and eventually, the cell pinches apart, forming two new cells.

Exercises

1. Which eukaryotic cell-cycle event is missing in binary fission?
    a. cell growth
    b. DNA duplication
    c. mitosis
    d. cytokinesis
2. FtsZ proteins direct the formation of a _____ that will eventually form the new cell walls of the daughter cells.
    a. plasma membrane
    b. cell plate
    c. cytoskeleton
    d. septum
3. Name the common components of eukaryotic cell division and binary fission.

Answers

1. (c)
2. (d)
3. The common components of eukaryotic cell division and binary fission are DNA duplication, separation of the duplicated chromosomes, and the division of the cytoplasmic materials.

Glossary

binary fission: the process of prokaryotic cell division

septum: a wall formed between bacterial daughter cells as a precursor to cell separation

8.4 Sexual Reproduction

Learning objectives

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

- *Explain the differences between asexual and sexual reproduction*
- *Discuss the advantages and disadvantages of asexual and sexual reproduction*
- *Be able to define and explain all bolded terms*

Many unicellular organisms, such as yeast, and some multicellular organisms, including strawberry plants, can produce genetically identical clones through a process called **asexual reproduction**. Other single-celled organisms and most multicellular organisms, including the Commander butterfly, reproduce sexually (Figure 8.17). Recall, **sexual reproduction** requires two different reproductive cells to fuse and form a single, genetically unique cell called a zygote.

Figure 8.17 Different life cycle stages of the Commander butterfly. (credit: Rajeeshraghav / Wikimedia Commons)

Sexual reproduction was an early evolutionary innovation. The process is thought to have started shortly after the appearance of the first eukaryotic cells. In many animals, it is the only mode of reproduction. However, scientists recognize that there are disadvantages when it comes to the process of sexual reproduction.

For example, although an individual may be successful in their given environment, it does not guarantee the offspring will be equally as successful. One or both parents may pass on non-functional or mutated genetic material to their offspring. Cystic fibrosis is one such example. With this condition, healthy parents pass on faulty DNA to their offspring. The faulty DNA leads to the production of abnormally thick mucus in the lungs, often resulting in respiratory failure. If an organism that reproduces asexually is successful in their environment, their offspring should also be equally successful because they have the same identical traits as the parent.

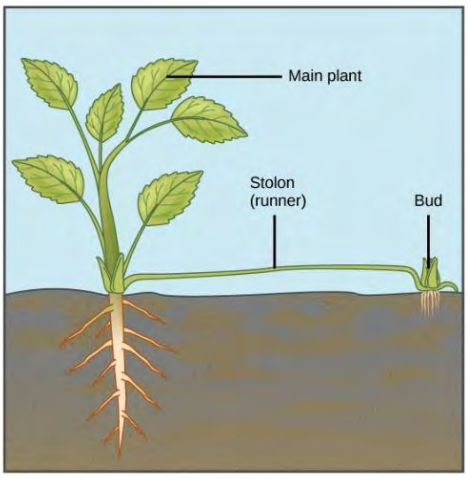

Figure 8. 18 shows a plant reproducing asexually through a process called budding. (credit: Biology OpenStax / Wikimedia Commons)

An organism that can produce offspring by asexual budding, fragmentation, or asexual eggs also has an advantage in that they do not require another organism of the opposite sex to reproduce (Figure 8.18). There is no need to expend energy finding or attracting a mate. That energy can be spent on producing more offspring. The opposite is true for organisms that reproduce through sexual reproduction.

On the surface, organisms that perform asexual reproduction may appear to be more advantageous. However, multicellular organisms that exclusively depend on asexual reproduction are exceedingly rare.

Why is sexual reproduction so common? A likely explanation is that sexual reproduction creates variation amongst individuals (Figure 8.19). Variation is very important to the survival and reproduction of the population. As the habitat or the environment around the organism changes, variation allows different individuals within the population to be successful. In asexual organisms, if the environment changes and an individual is negatively impacted, then all individuals would be negatively impacted due in part to the lack of genetic variation.

The only source of variation in asexual organisms is a mutation. This is also a source of variation in sexual organisms; however, it is not the only source of variation. Also, different mutations are continually reshuffled from one generation to the next when different parents combine their unique reproductive cells. Other sources of genetic variation occur when reproductive cells are produced during meiosis. Meiosis will be discussed in the next section.

Figure 8.19 shows human skin color genetic diversity. (credit: truthseeker08/ Pixabay)