

5.4

Asexual Reproduction

KEY CONCEPT Many organisms reproduce by cell division.

▶ MAIN IDEAS

- Binary fission is similar in function to mitosis.
- Some eukaryotes reproduce through mitosis.

VOCABULARY

asexual reproduction, p. 148

binary fission, p. 148



REVIEW AT
CLASSZONE.COM

Connect In this flashy world of ours, you may think that the humble bacterium would have little chance of finding a mate. No dazzling smile, no fancy hair products, no shiny car, and—if we are brutally honest—not even a brain. With all of these limitations, it may seem that our bacteria friends would be destined to die out. And yet, bacteria are found in abundance and live just about everywhere on Earth. How can there be so many bacteria?

▶ MAIN IDEA

Binary fission is similar in function to mitosis.

Reproduction is a process that makes new organisms from one or more parent organisms. It happens in two ways—sexually and asexually. Sexual reproduction involves the joining of two specialized cells called gametes (eggs and sperm cells), one from each of two parents. The offspring that result are genetically unique; they have a mixture of genes from both parents. In contrast, **asexual reproduction** is the creation of offspring from a single parent and does not involve the joining of gametes. The offspring that result are, for the most part, genetically identical to each other and to the single parent.

Connecting CONCEPTS

Cell Structure Recall from Chapter 3 that many scientists hypothesize that mitochondria and chloroplasts were originally free-living prokaryotes. One piece of evidence that supports this hypothesis is the fact that these two organelles replicate much as bacteria do, through fission.

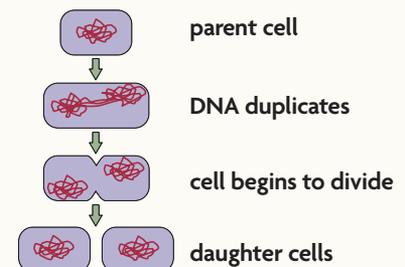
Binary Fission and Mitosis

Most prokaryotes reproduce through binary fission. **Binary fission** (BY-nuh-ree FIHSH-uhn) is the asexual reproduction of a single-celled organism by division into two roughly equal parts. Binary fission and mitosis have similar results. That is, both processes form two daughter cells that are genetically identical to the parent cell. However, the actual processes are different in several important ways.

As you already learned, prokaryotes such as bacteria do not have nuclei. And although they do have DNA, they have much less of it than do most eukaryotes. Also, most of a bacterium's DNA is in the form of one circular chromosome, and bacteria have no spindle fibers.

VISUAL VOCAB

Binary fission is the asexual reproduction of a single-celled organism by division into two roughly equal parts.



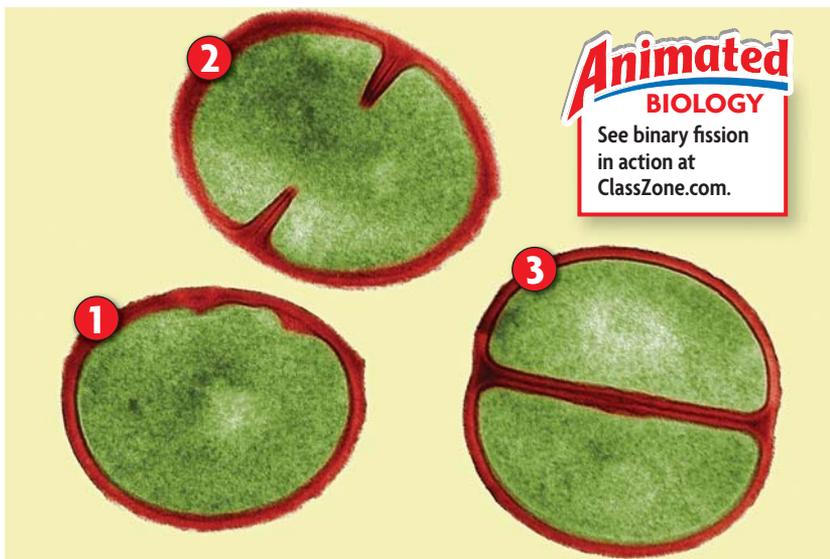


FIGURE 5.13 Binary fission is shown in this micrograph of three individual bacteria, each at a different stage of binary fission. First, a cell elongates (1), and the DNA is replicated. Next, the cell membrane pinches inward (2). Finally, the membrane meets, and a new cell wall is laid down, forming two separate cells (3). (colored TEM; magnification 60,000 \times)

Binary fission, shown in **FIGURE 5.13**, starts when the bacterial chromosome is copied. The two chromosomes are both attached to the cell membrane. As the cell grows and gets longer, the chromosomes move away from each other. When the cell is about twice its original size, it undergoes cytokinesis. The membrane pinches inward, and a new cell wall is laid down between the two chromosomes, which completes the separation into two daughter cells.

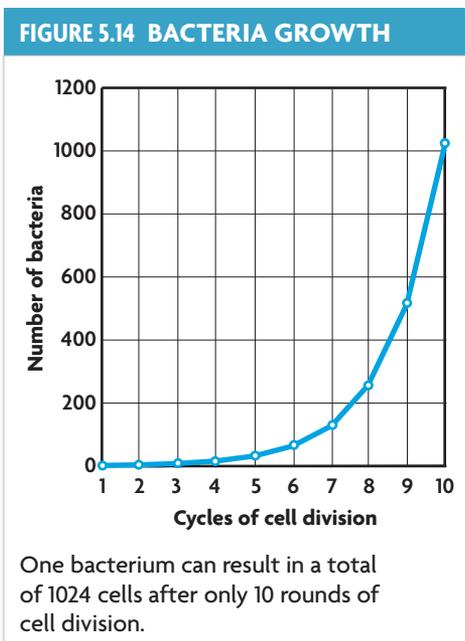
Advantages and Disadvantages of Asexual Reproduction

Very often, whether something is helpful or harmful depends on the situation. In favorable environments that do not change much, asexual reproduction can be more efficient than sexual reproduction. Recall that asexual reproduction results in genetically identical offspring. If they are well suited to the environment, genetic variation could be more harmful than helpful. In other words, if it ain't broke, don't fix it.

However, asexual reproduction may be a disadvantage in changing conditions. Genetically identical offspring will respond to the environment in the same way. If population members lack traits that enable them to reproduce, the entire population could die off. In contrast, sexual reproduction increases genetic diversity, which raises the chance that at least a few individuals will survive or even thrive in changing conditions.

Keep in mind, however, that the act of asexual reproduction itself is not more efficient; rather, the associated costs of sexual reproduction are greater. For example, all asexually reproducing organisms can potentially reproduce. Suppose two organisms each have ten offspring. If one organism reproduces asexually, all ten offspring can have offspring of their own. If the other organism reproduces sexually, having five females and five males, only the five females can bear offspring. In addition, sexually reproducing organisms must attract a mate. This effort involves not only the time and energy needed to find a mate but also many structures, signals, and behaviors that have evolved to attract mates. Organisms that reproduce asexually do not have these costs.

Summarize How is asexual reproduction an advantage in some conditions?



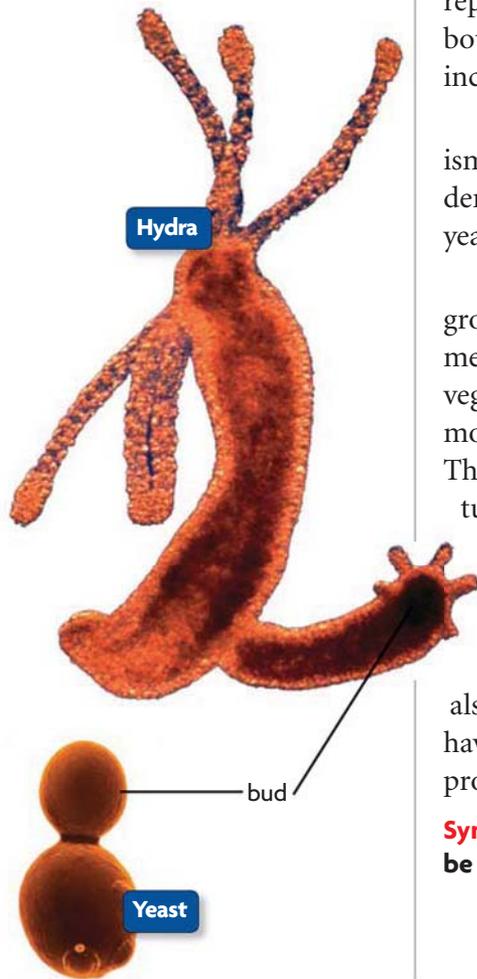
Connecting CONCEPTS

Evolution As you will learn in **Chapter 18**, the misuse of antibiotics has resulted in multidrug-resistant bacteria. The bacteria not killed by antibiotics can reproduce quickly, passing the genes for antibiotic resistance on to their offspring.

▶ MAIN IDEA

Some eukaryotes reproduce through mitosis.

FIGURE 5.15 Yeast and hydras can reproduce by budding. (hydra: LM, magnification 12×; yeast: colored SEM, magnification 3,200×)



Some eukaryotes also reproduce asexually, through mitosis. Have you ever grown a new plant from a stem cutting? Or seen a new sea star growing from the arm of another one? These new organisms are the result of mitotic reproduction and are therefore genetically the same as the parent organism. Mitotic reproduction is especially common in simpler plants and animals. It occurs in both multicellular and unicellular eukaryotes. It can take several forms, including budding, fragmentation, and vegetative reproduction.

In budding, a small projection grows on the surface of the parent organism, forming a separate new individual. The new organism may live independently or attached as part of a colony. For instance, hydras and some types of yeast reproduce by budding. Examples are shown in **FIGURE 5.15**.

In fragmentation, a parent organism splits into pieces, each of which can grow into a new organism. Flatworms and sea stars both reproduce by fragmentation. Many plants, including strawberries and potatoes, reproduce via vegetative reproduction. In general, vegetative reproduction involves the modification of a stem or underground structures of the parent organism. The offspring often stay connected to the original organism, through structures called runners, for example.

Many organisms can reproduce both asexually and sexually. The form of reproduction may depend on the current conditions. The sea anemone can reproduce in many ways. It can reproduce asexually by dividing in half, by breaking off small pieces from its base, or by budding. It can also reproduce sexually by making eggs and sperm. Some species of anemone have males and females. In other anemone species, the same organism can produce both eggs and sperm cells.

Synthesize How might the asexual reproduction of genetically identical plants be useful to humans? How could it prove harmful to our food supply?

5.4 ASSESSMENT



REVIEWING ▶ MAIN IDEAS

1. Explain how mitosis differs from **binary fission**.
2. Briefly explain why cutting a flatworm into pieces would not kill it.

CRITICAL THINKING

3. **Infer** How does an organism benefit by being able to reproduce both sexually and asexually?
4. **Apply** Yeasts are growing in two dishes. You treat one dish with a chemical that blocks DNA replication but forget to label it. How can you identify the treated dish?

Connecting CONCEPTS

5. **Ecology** Two populations live in the same habitat and compete for food. The first group is larger and uses **asexual reproduction**; the second reproduces sexually. What could happen to cause the second group to outnumber the first?