

Cell Division and Asexual Reproduction

As you have learned, cell division plays a vital role in the life of all living things. All living things reproduce, and some use cell division as their method of reproduction.

There are two types of reproduction: sexual and asexual. In **sexual reproduction**, two separate organisms (parents) contribute genetic information, usually in specialized sex cells (an egg cell and a sperm cell). The sex cells combine to produce a **zygote**, the first cell of the new organism. **Asexual reproduction** involves only one parent. All the offspring that are produced by asexual reproduction are identical to the parent. Figure 1 compares sexual and asexual reproduction at the cellular level.

LEARNING TIP

Check your understanding of sexual and asexual reproduction. In your own words, explain to a partner how they are different.

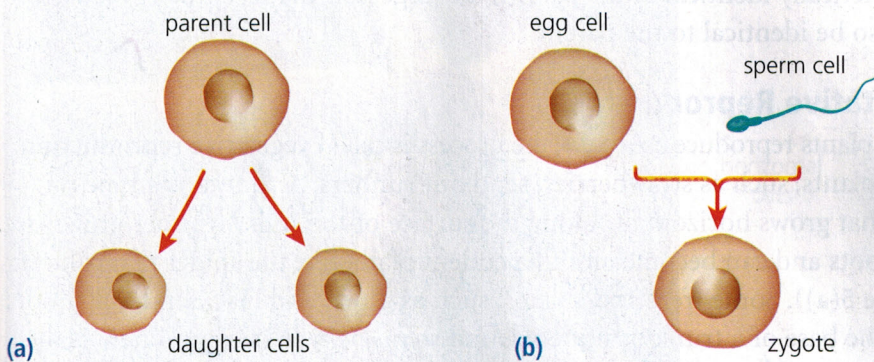


Figure 1 In asexual reproduction, (a), one parent cell divides into two identical daughter cells. In sexual reproduction (b), two cells, one cell from each parent, join to form one cell, called a zygote, which has the genetic material from both parent cells.

Types of Asexual Reproduction

From a simple bacterium to a daffodil plant, many different species use many different types of asexual reproduction to produce offspring. The offspring are clones. **Clones** contain DNA that is identical to the DNA of the parent and are therefore genetically identical. Usually, the parent chromosomes and DNA are replicated in interphase. Cell division divides the genetic material and the cytoplasm between the two daughter cells.

Binary Fission

In **binary fission**, the parent undergoes cell division to produce two genetically identical daughter cells, or offspring (Figure 2). The offspring are smaller than the parent cell, but all the necessary structures are present. Only single-celled organisms (such as bacteria), some protists (such as amoebas), and some algae use binary fission to reproduce.

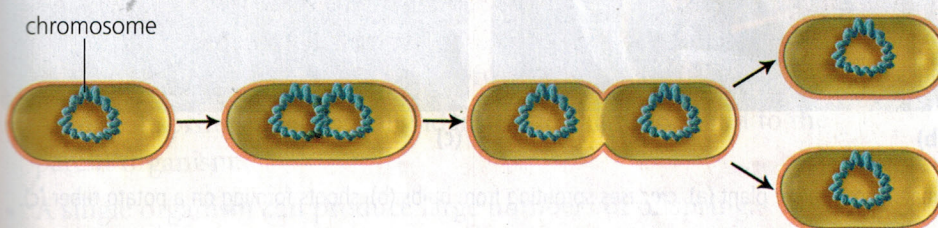


Figure 2 Binary fission in a bacterium



Figure 3 A population explosion of a protist called a dinoflagellate causes a red tide.

Binary fission allows for rapid population growth under ideal conditions. Bacteria can double their population every 20 minutes. If the bacterium is one that causes a disease, this increase in numbers can produce an infection. Certain protists, called dinoflagellates, take advantage of good conditions in the ocean. The resulting population explosion is called a red tide (Figure 3). The dinoflagellates produce toxins that can kill fish, as well as humans, if the fish or humans consume clams or mussels that have eaten the dinoflagellates.

Budding

In **budding**, the offspring begins as a small growth on the parent, called a bud. The bud continues to undergo cell division and grow in size before breaking off from the parent. Budding occurs in single-celled organisms, such as yeast, as well as in multicellular organisms, such as the hydra (Figure 4), which is related to jellyfish and anemones. Since the initial daughter cells of the bud are genetically identical to the parent, the large bud that eventually breaks off will also be identical to the parent.

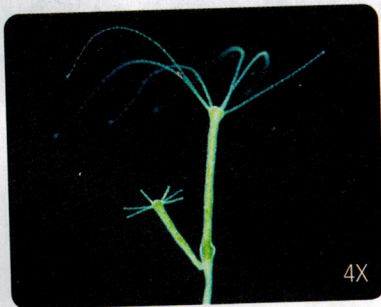


Figure 4 Budding in a hydra

Vegetative Reproduction

When plants reproduce asexually, the process is called **vegetative reproduction**. Some plants, such as strawberries, send out runners. A runner is a type of stem that grows horizontally along the surface of the soil. A runner grows its own roots and can become an independent plant, like the spider plant shown (Figure 5(a)). Some trees and shrubs, such as aspen and lilac, send out shoots from the base of a trunk or underground stems, which grow into new plants. Cuttings from some plants can also grow their own roots and become new plants. Bulbs, from which daffodils and crocuses develop (Figure 5(b)), and tubers, such as potatoes (Figure 5(c)), are other forms of vegetative reproduction. The new plant clones are genetically identical to the parent plant.



(a)



(b)



(c)

Figure 5 Vegetative reproduction in plants: runners on a spider plant (a), crocuses sprouting from bulbs (b), shoots forming on a potato tuber (c).

Fragmentation

In **fragmentation**, a small part of an animal breaks off and grows into a new organism. A fragment can grow into a complete animal. Whether an entire new animal grows from the fragment depends on how much of the original parent is contained in the fragment. The fragment of a sea star (Figure 6(a)), for example, must contain part of the central disk in order to produce a new organism. The original parent animal can regrow the lost fragment.

Reproduction after fragmentation cannot happen without regeneration. Regeneration is the ability to regrow a body part, a tissue, or an organ. Some flatworms, such as planaria (Figure 6(b)), can regenerate an entire organism from a small fragment. The genetic material of the new offspring is identical to the genetic material to the parent.



(a)

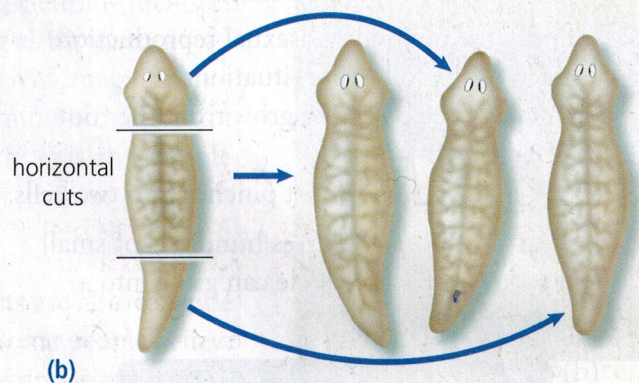


Figure 6 Fragmentation in a sea star (a) and a planarian (b). The sea star is growing three new legs from a fragment. Each section of the planarian will grow into a complete organism.

Spore Formation

Many fungi (such as moulds, puffballs, and mushrooms), algae, and non-flowering plants (such as ferns) reproduce by forming large numbers of spores (Figure 7). **Spores** are cells with thick cell walls. They are similar to seeds, but they are produced by cell division and grow into organisms that are genetically identical to the parent organism. Organisms that form spores may also reproduce sexually.

Characteristics of Asexual Reproduction

Even though there are different types of asexual reproduction, all of them have characteristics in common:

- Only one organism is needed to reproduce.
- All the offspring are genetically identical to each other and to the parent organism.
- A single organism can produce large numbers of offspring.

LEARNING TIP

Headings and subheadings act as a guide for your reading. To check your understanding as you read, turn each heading into a question and then answer it.



Figure 7 A magnified view of spore-bearing parts in the fungus *Penicillium*.

Fragmentation

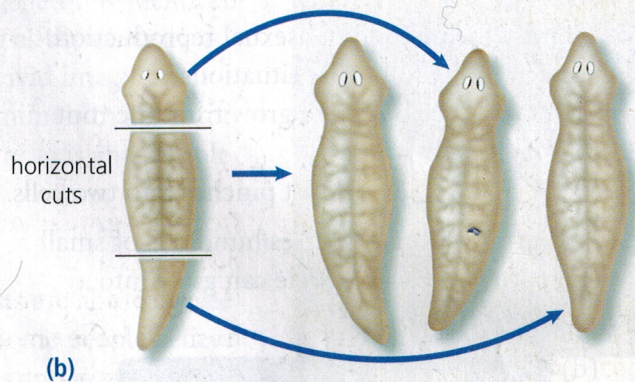
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(a)

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(b)

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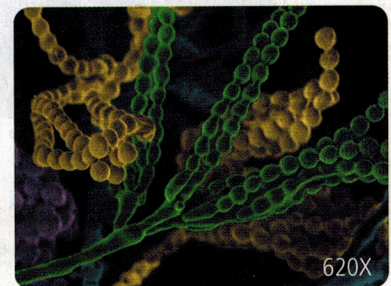


Figure 7 A magnified view of spore-bearing parts in the fungus *Penicillium*.


- At the cellular level, how is asexual reproduction different from sexual reproduction?
- What is cloning? Why are all the offspring of asexual reproduction called clones?
- What process must occur before asexual reproduction begins?
- Explain why the population of an asexually reproducing organism can increase rapidly.
- Use a Venn diagram to compare asexual reproduction with cell division.
- Identify the method of asexual reproduction in each of the following situations.
 - A new tree begins to grow from the root of a nearby tree.
 - A single-celled protist pinches into two cells.
 - A mushroom disperses hundreds of small particles. Each particle can grow into a new mushroom.
 - 
- Use a dictionary to define “binary” and “fission.” How do these definitions explain this type of asexual reproduction?
- How are budding and vegetative reproduction similar?
- What is the difference between binary fission and budding?
 - How are these two types of asexual reproduction similar?
- Describe two types of vegetative reproduction.
- How is spore formation different than the other types of asexual reproduction?
- Explain the difference between fragmentation and regeneration.
 - Give an example of an animal that can do both.
- Many organisms that reproduce asexually also reproduce sexually. What are some advantages of asexual reproduction?
- Why is having only one parent both an advantage and a disadvantage of asexual reproduction?
- Under certain conditions, bacteria can reproduce every 20 minutes. If a population started off with a single bacterium, calculate how many bacteria would be present in six hours.
- Oysters are a major part of the diet of sea stars. Oyster harvesters used to try to kill sea stars by cutting them up and throwing them back into the ocean. Why did this practice not reduce the number of sea stars?
- Some lizards easily lose pieces of their tails, which they can later regenerate. Explain how this process benefits the lizard.

Figure 8