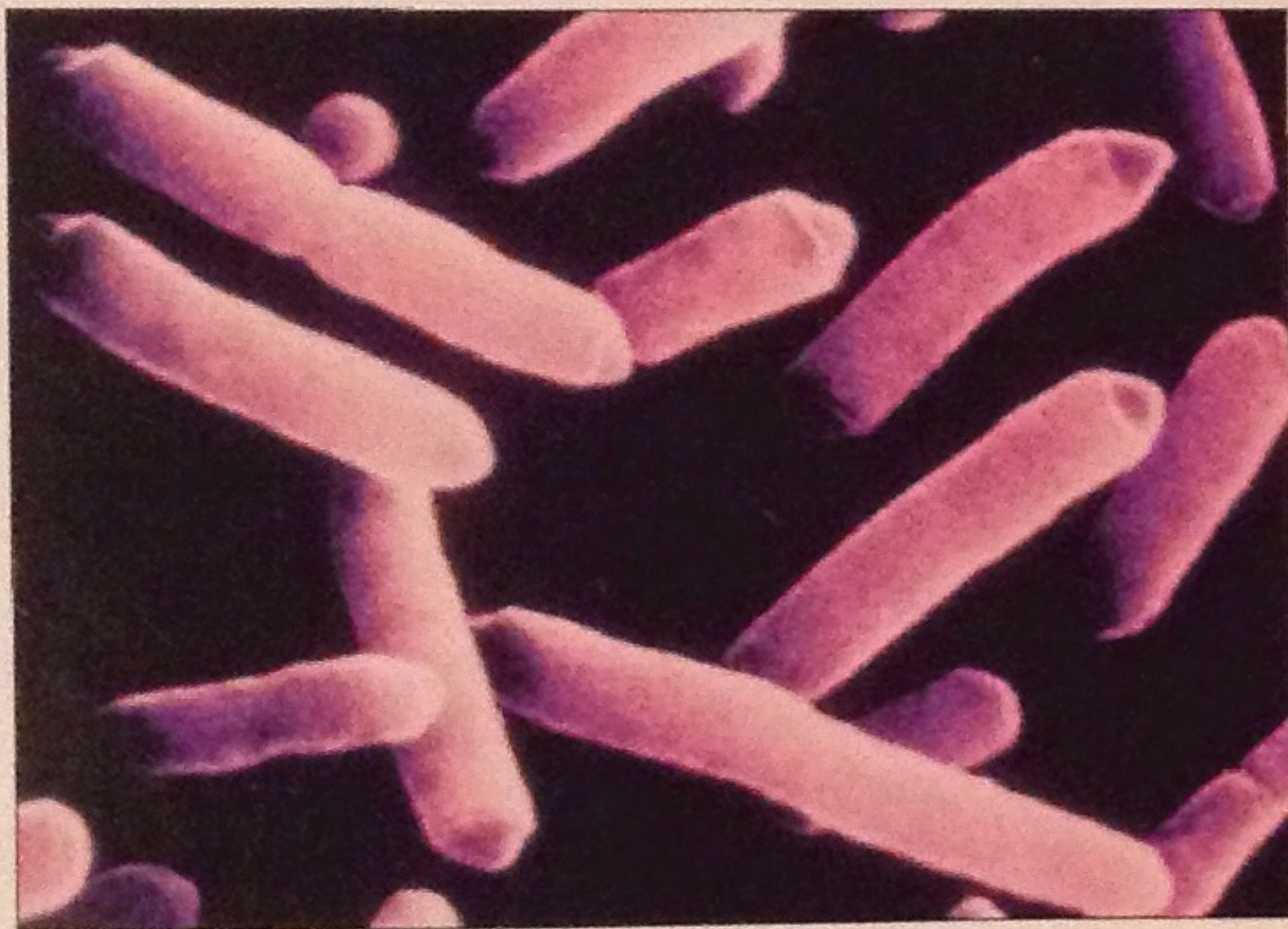


## 1.4 Asexual Reproduction in Bacteria, Protists, Fungi, and Animals

In the last section, you learned how important the cell cycle is to human growth and tissue repair. Mitosis and cell division are important for another reason. They are the basis for the asexual reproduction of many organisms. **Asexual reproduction** is the formation of a new individual that has identical genetic information to its parent. In this section, you will explore the ways in which bacteria, protists, fungi, and some animals reproduce asexually. Before you begin reading this section, refresh your knowledge of the five-kingdom classification system by studying Appendix A.

### Asexual Reproduction in Bacteria

Members of the kingdom Monera, such as bacteria shown in Figure 1.21, are unicellular organisms that do not contain a true nucleus. Bacteria reproduce asexually through a process called **binary fission**. In this process, a parent cell divides so that each new cell contains a single chromosome carrying a complete set of DNA identical to that of the parent (see Figure 1.22 on page 30.)



**Figure 1.21** All the organisms shown here are bacteria. Bacteria have a single chromosome that is not surrounded by a nuclear membrane. How is this different from the cells you have already investigated in this chapter?

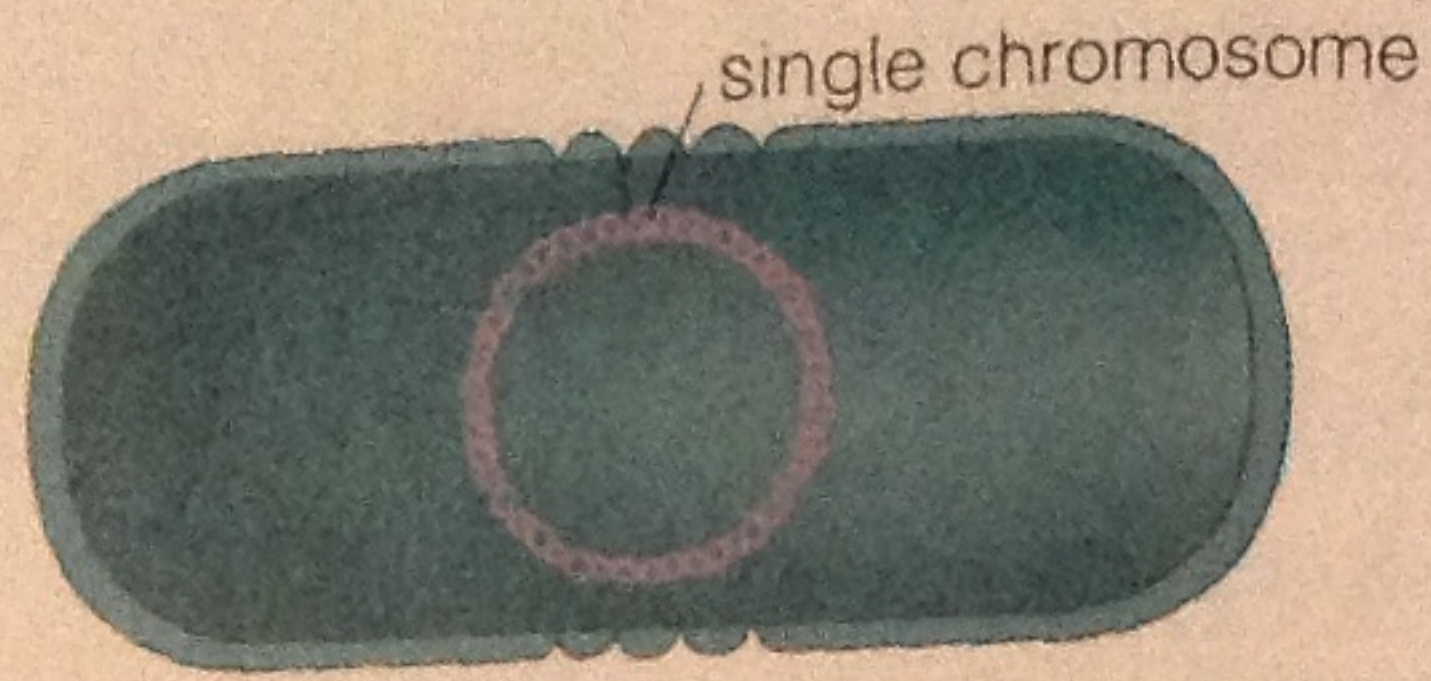
### DidYouKnow?

Cells that lack a true nucleus, such as bacteria, are known as *prokaryotes*. All other cells — those of animals, plants, fungi, and protists — have a nucleus and other membrane-bound organelles and are known as *eukaryotes*.

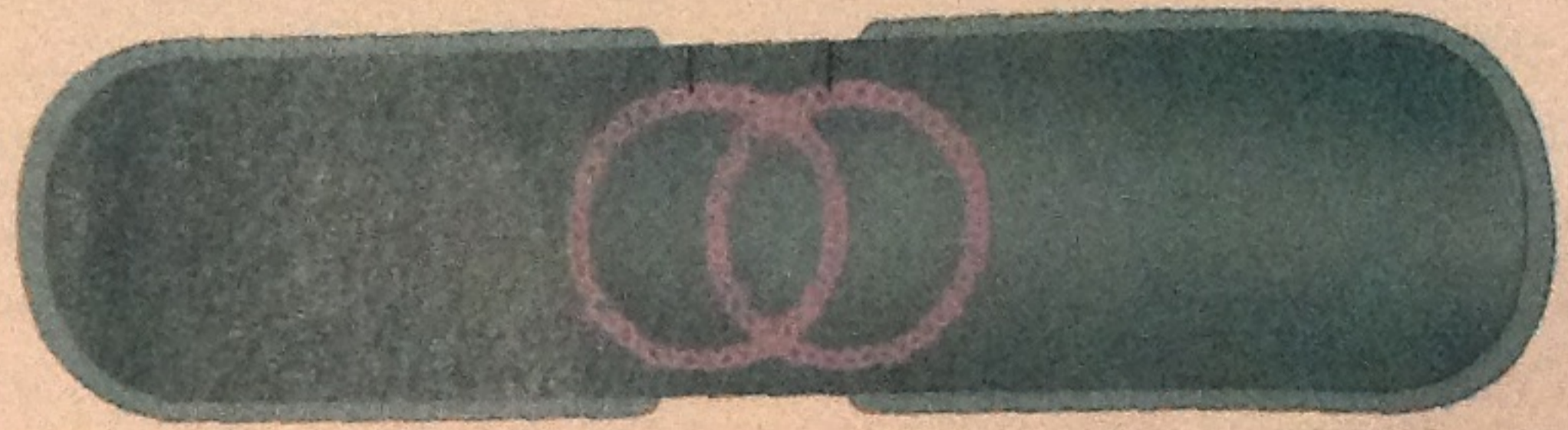
### Pause & Reflect

Bacteria, such as *Clostridium botulinum*, can cause a serious form of food poisoning. Other bacteria, such as *Lactobacillus acidophilus* help digest food and destroy other harmful bacteria in your intestinal tract. In your Science Log, write a one-page essay explaining why bacteria can be both harmful and beneficial to humans. Search the Internet for information about "useful" bacteria, such as those that are used to break down toxins in the environment.

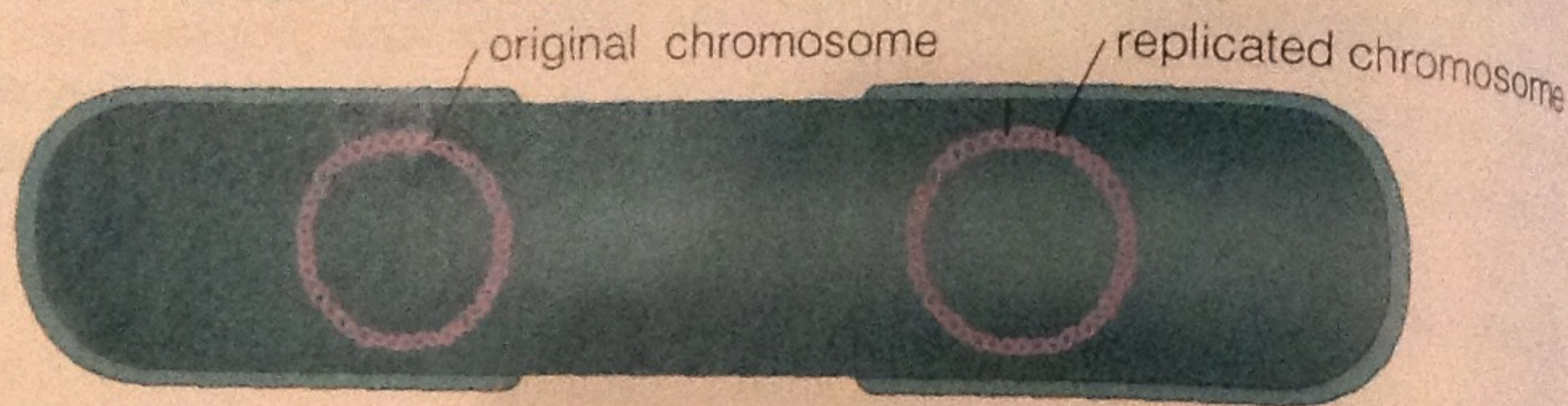
A. The cell prepares for replication. Do you see where the cell wall has ruptured?



B. The cell makes a copy of its single chromosome. Do you see the new membrane that has formed? Why do you think it is needed?



C. The original chromosome and its copy soon separate as the cell grows larger, each moving to opposite ends of the cell.



D. The cell membrane begins to pinch inward near the middle of the cell, creating two smaller parts, each with a single chromosome carrying identical genetic information.



E. A new cell wall forms around each of the two new cells.



**Figure 1.22** Binary fission is one method of asexual reproduction used by bacteria. Under ideal conditions, the entire process takes about 20 minutes. Why might such a short cell cycle be an advantage?

**STRETCH**  
Your Mind

Suppose you get on a bus to go to school. At 8:20 A.M., you yawn, and a single *Streptococcus* bacterium drifts into your open mouth and settles in your throat. Under ideal conditions, a single bacterium can reproduce in 20 min. So, by the time the bus drops you off at school at 8:40 A.M., there are two bacteria in your throat. When your homeroom period starts at 9:00 A.M., there are four.

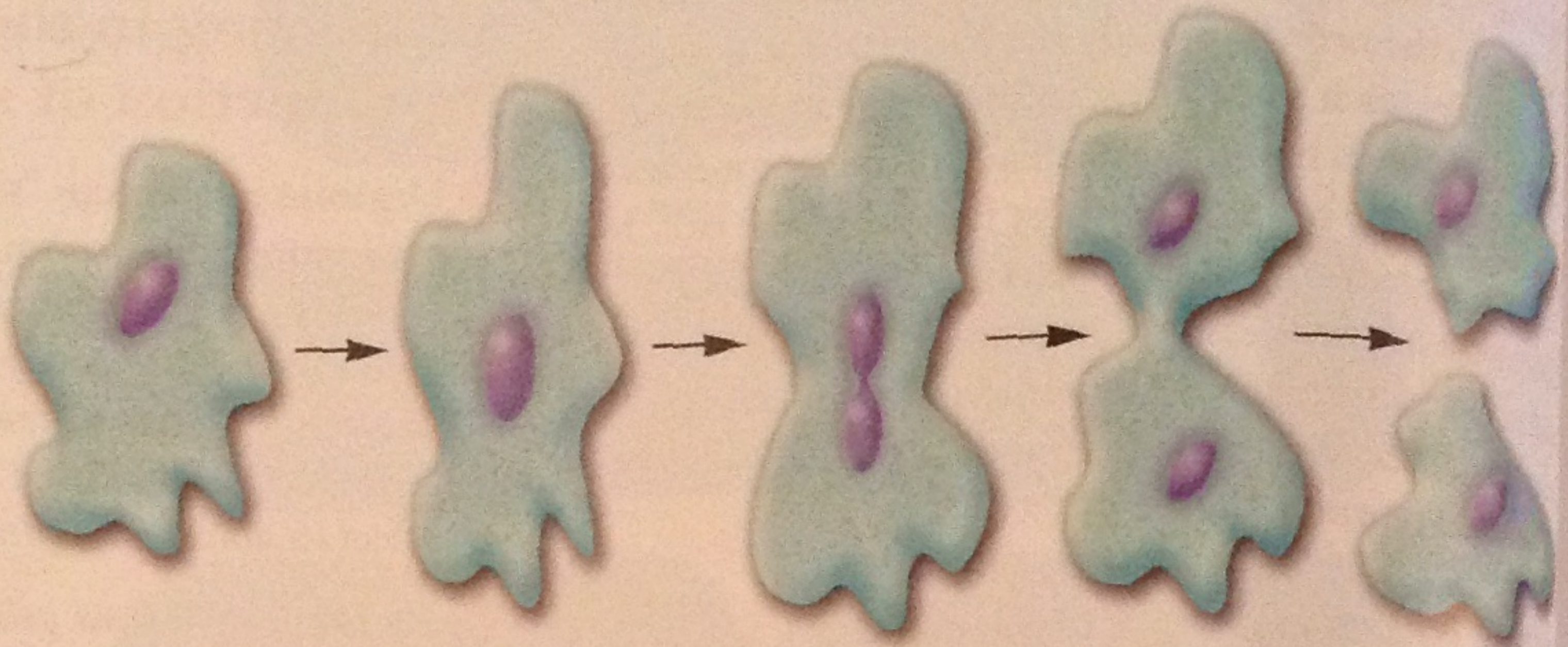
1. Assume that the bacteria continue to reproduce asexually every 20 min. How many bacteria will be in your throat by: (a) lunchtime (12:00 noon); (b) by the time you get the bus in the afternoon (3:20 P.M.); (c) suppertime (6:00 P.M.); (d) bedtime (10:00 P.M.)?
2. Make a graph showing the growth of the *Streptococcus* population in your throat.
3. Do you think the bacteria can keep multiplying in this way indefinitely? Explain.
4. At what time do you think your throat may feel sore? How many bacteria will be present in your throat?

## Asexual Reproduction in Protists

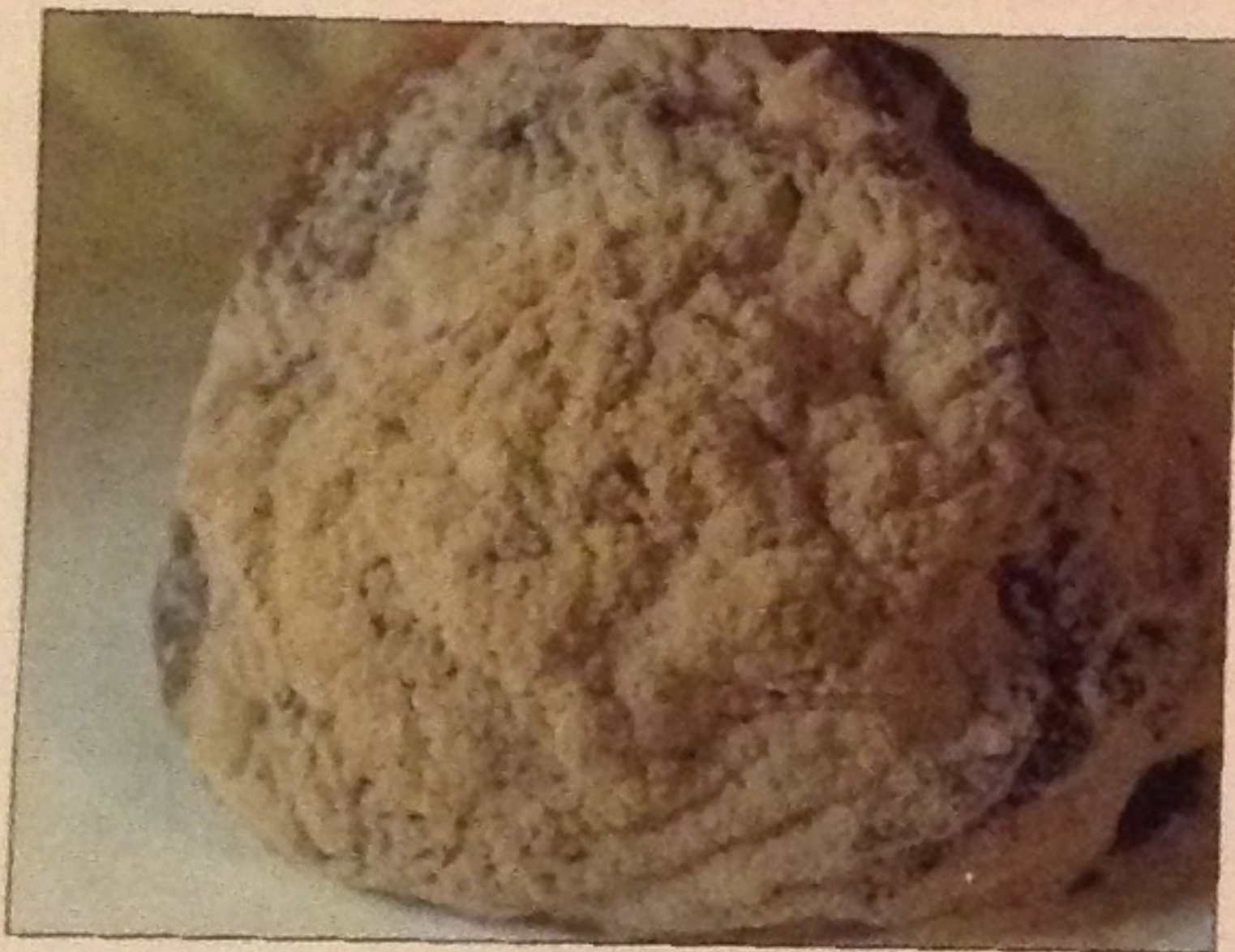


Unicellular organisms in the kingdom Protista, such as the amoeba, also rely mainly on asexual reproduction to increase their numbers. Unlike bacteria, the DNA of protists is contained within a true nucleus. Mitotic cell division in these unicellular organisms results in the formation of two identical offspring. Protists are important because they form the basis of many food chains and because they are responsible for many diseases that affect humans.

**Figure 1.23** *Entamoeba histolytica* is a famous amoeba that has its own disease named after it—amoebic dysentery. This disease causes diarrhea, fever, and abdominal cramps. Find out how *E. histolytica* is transmitted.



**Figure 1.24** This simple sketch shows mitosis and cell division in an amoeba. How does this process differ from binary fission in bacteria?



**Figure 1.25** This fungus grows by obtaining nutrients from a peach.

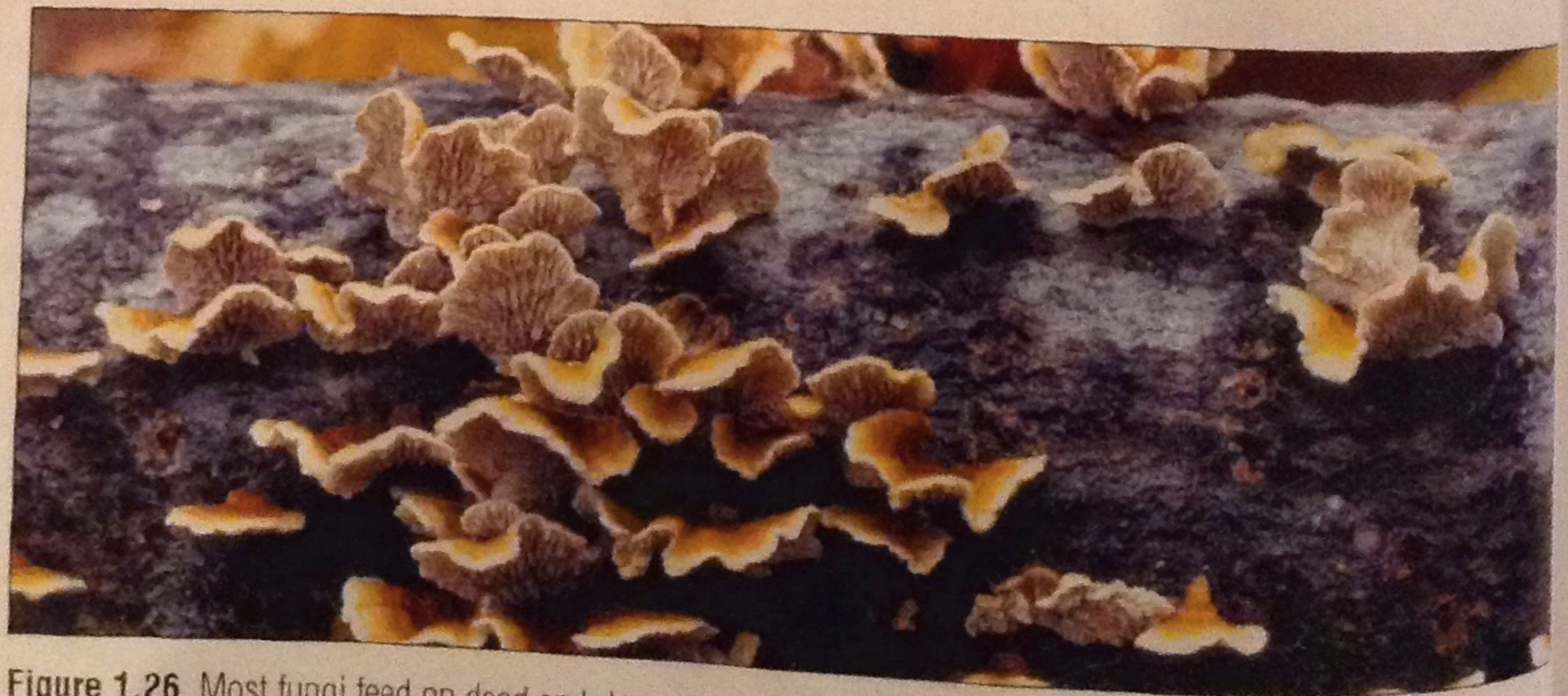
## Asexual Reproduction in Fungi

Moulds, yeast, and mushrooms are members of the Fungi kingdom. The bodies of these organisms are composed of many thin filaments called hyphae. The hyphae grow over the surface of and into the bodies of other organisms to obtain food (see Figure 1.25). Three methods that fungi use to reproduce asexually are fragmentation, budding, and spores.

Fungi can reproduce asexually by **fragmentation**. A small piece, or fragment, breaks away from the main mass of hyphae and grows into a new individual. What must the fragment contain to enable it to develop into a new organism identical to its parent?

### Word CONNECT

The word "hyphae" is descended from the Greek word "hyphos," meaning web. (The singular form of hyphae is hypha.) Why is hyphae a good word to describe the filaments that make up the body of a fungus?



**Figure 1.26** Most fungi feed on dead and decaying organisms. How is this of benefit to the environment?

Yeast are unicellular fungi often used to make bread or alcohol products. When conditions are favourable for growth, yeast reproduce asexually by **budding**. First, a copy of the nucleus is made. Can you explain why is this necessary? Next, a tiny bud begins to form on the cell wall. This bud, containing the new nucleus, continues to grow larger. It eventually breaks away to become a single, independent cell. Look carefully at the micrograph in Figure 1.27. What are the small circles at the lower left of the parent cell?

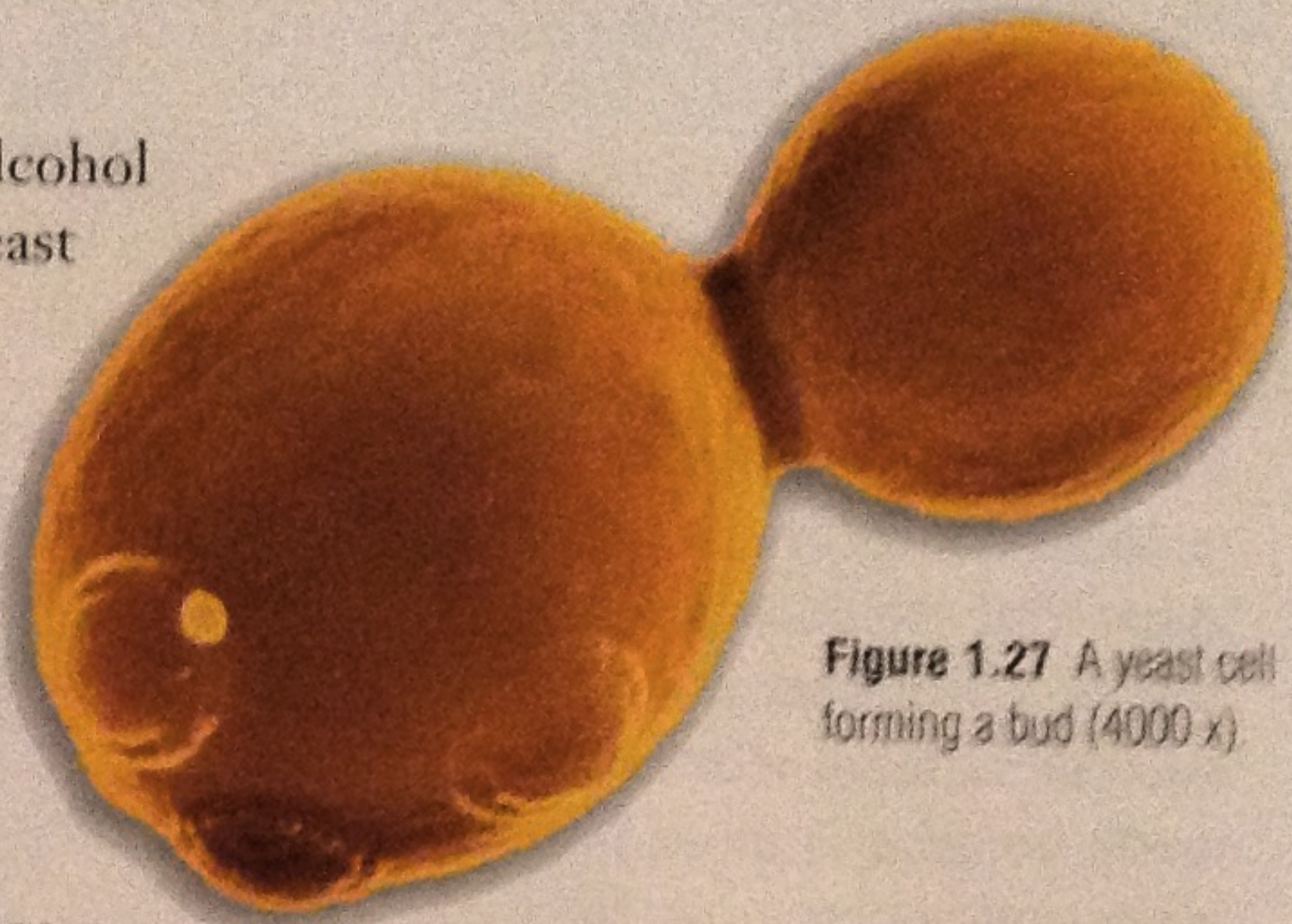


Figure 1.27 A yeast cell forming a bud (4000 x)

To reproduce asexually, moulds, such as *Rhizopus*, produce spores. A **spore** is a reproductive cell that can grow into a new individual through mitotic cell division. Spores are stored in a case called a *sporangium*. When spores are mature, they take on a characteristic colour, such as black, yellow, blue, or red. Think of some places where you have seen mould recently. Was the place moist or dry? Hot or cold? You can test which conditions favour mould growth in the next activity.



Figure 1.28 This bread is covered by the common mould *Rhizopus*.

### Off the Wall

When each sporangium splits open, it releases spores that float about on air currents. Airborne spores have been found in the atmosphere at altitudes of more than 160 km.

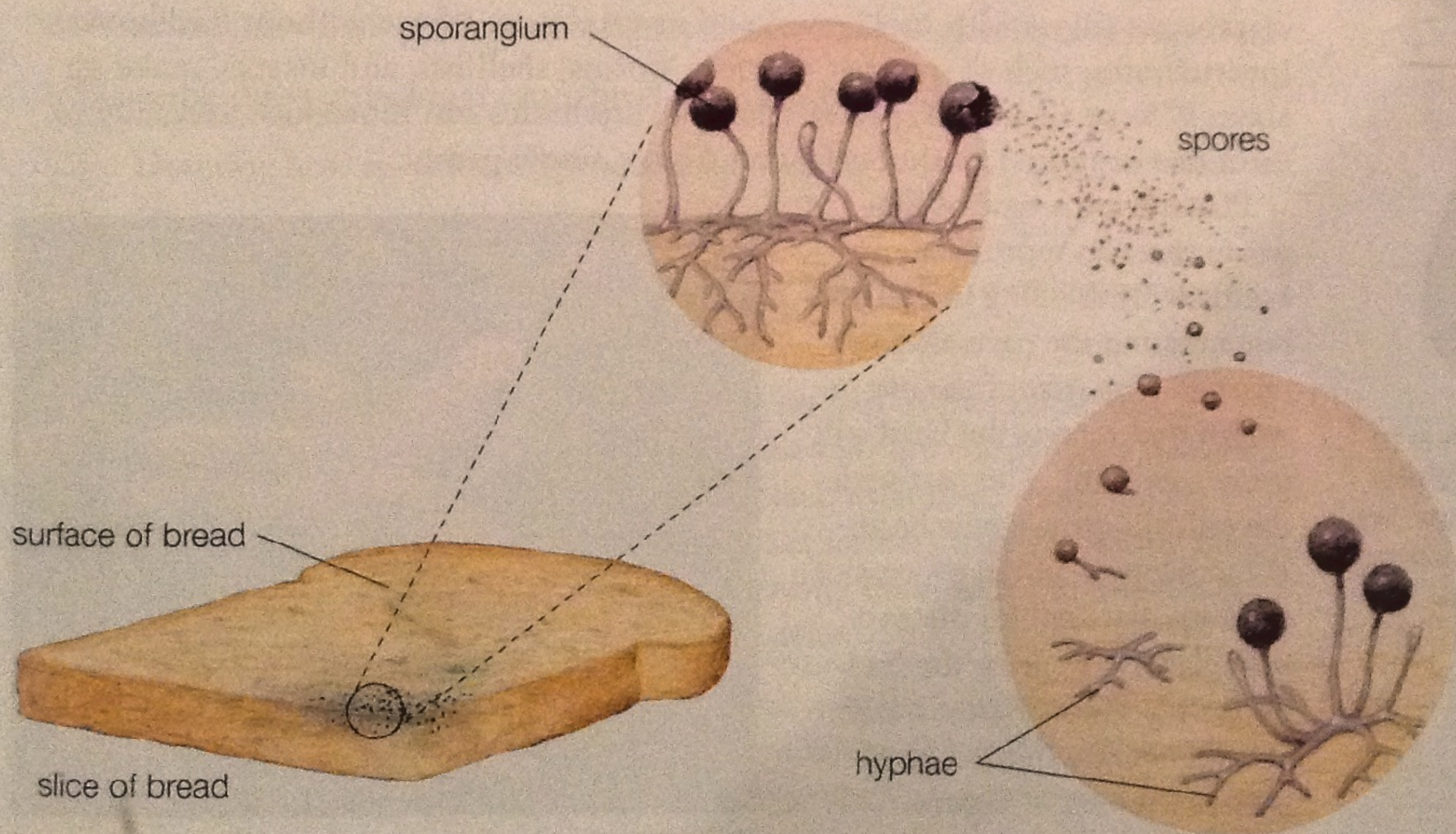


Figure 1.29 Sporangia form on the tips of hyphae that have grown up from the surface of the bread. In each sporangium, hundreds of spores develop by mitotic cell division. Why do you think each spore is capable of starting a new colony of mould?

## Making a Mould

Like all living organisms, bread mould requires suitable conditions in which to reproduce. You know that mould will grow on bread, but does any kind of bread provide the right food source? Is there a difference between home-made bread and store-bought bread? What other conditions must be present for bread mould to grow?

### What To Do



1. Propose a hypothesis about the growth of bread mould that you would like to explore.
2. Design an experiment to test your hypothesis. In your design proposal, be sure to include your hypothesis, the materials you will need, and the steps you will follow to conduct your research. You should include the use of a low-power microscope or dissection scope to examine the bread for results. Be sure to

include steps to dispose of materials properly at the end of the experiment. **Note:** For tips on how experiments are designed, turn to page IS-2.

3. When you have received approval from your teacher, conduct your experiment.

### What Did You Discover?

1. Describe your results. Use charts, diagrams, or photographs. Write brief descriptions to accompany your illustrations.
2. Did your results support your hypothesis? Why or why not?
3. What additional research or experiments could you carry out, based on your results?
4. Suggest how the spread of harmful moulds could be controlled.

## Asexual Reproduction in Animals

In the kingdom Animalia, animals can be divided into two main groups — vertebrates (those with backbones) and invertebrates (those without backbones). Invertebrates, such as sponges, jellyfish, worms, shellfish, and insects, make up about 97% of all animal species. Many invertebrates can reproduce asexually to form one or more identical offspring from a single parent.

Planaria are a type of flat-worm that can reproduce asexually by dividing in two and regenerating the parts they are missing. The part of the planarian that retains the head will grow a new tail. The part with the tail will grow a new head. What happens in the process of dividing that enables the two new planaria to grow the body parts they need? Planaria can also regenerate injured body parts, as shown in Figure 1.30.



**Figure 1.30** An injury to the head of this planarian divided its head into two sections. Two complete heads are forming as a result of regeneration.



**Figure 1.31** Sea stars reproduce asexually and can grow new body parts through the process of regeneration.

Some animals, such as sponges and hydras, reproduce asexually by budding. A cell, usually near the base of these organisms, undergoes mitosis and cell division repeatedly to produce a group of new cells, or a bud. Eventually, when the bud completes its development, it detaches and becomes independent.



**Figure 1.32** Sponge buds may remain attached to the parent, which result in a colony. What advantage does the bud have by being attached to its parent?



**Figure 1.33** Hydras are very small organisms that live in water. Based on what you have learned about budding, describe what is happening in this picture.

## Check Your Understanding

1. What is binary fission? How does binary fission differ from mitotic cell division?
2. Describe three ways fungi can reproduce asexually.
3. (a) Describe how an animal reproduces by budding.  
(b) What is one advantage of this type of reproduction?
4. **Apply** Explain why covering and refrigerating food helps to reduce spoilage from moulds.
5. **Thinking Critically** One arm of a sea star with part of the central disk attached can grow into a complete sea star. Sea stars are considered a nuisance by people who raise oysters. A sea star can attach itself to an oyster's shell, open it, and eat the contents. In the past, oyster farmers tried to destroy the sea stars by cutting them into pieces and throwing them back into the ocean. What do you think was the outcome of this action?
6. **Thinking Critically** Some invertebrates, such as crabs, have the ability to regrow body parts that have been lost through injury. What cell part do you think scientists study to learn more about the process of regeneration in these animals?