13.2 Asexual Reproduction in Seed Plants

Figure 1 Many of these grass plants growing in the dunes of Pinery Provincial Park are produced by asexual reproduction.

If you have ever walked along a beach, you may have noticed large clumps of grass growing in the sand. Grasses are often pioneer species on newly formed sand dunes. Once a single grass seed germinates and grows in the sand, it can quickly give rise to a large population (**Figure 1**). The swift increase in individual grass plants is accomplished by asexual reproduction, in which a single parent produces offspring by cell division. In plants, asexual reproduction is also called vegetative reproduction. Grass species can reproduce asexually by producing rhizomes, underground stems from which new plants arise (**Figure 2**).

Figure 2 A grass plant dug up to show a rhizome.

Structures Involved in Asexual Reproduction

Plants use a number of structures to reproduce asexually. Some, like rhizomes, are modified stems. These include corms, stolons, and the "eyes" on tubers (**Figure 3(a)**). Other plant structures are modified leaves, such as in the kalanchoe plant (**Figure 3(b)**). Suckers are new shoots that grow from a plant's roots and can form new plants (**Figure 3(c)**).

Sometimes new plants can grow from fragments of roots or shoots. For example, if a gardener breaks off a small portion of a dandelion's taproot when pulling out the plant, a new dandelion will grow from the fragment left in the soil.

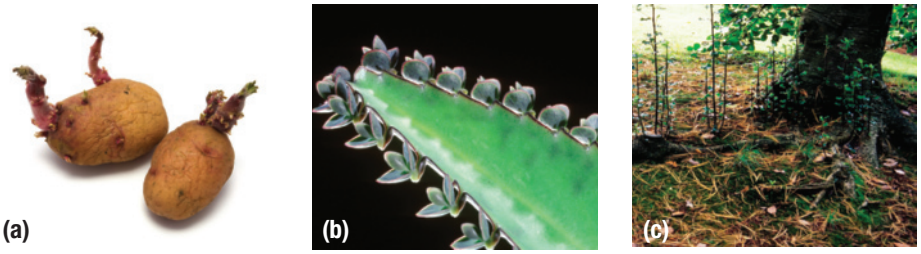

Figure 3 New plants can arise from (a) tubers, (b) leaves, and (c) roots.

LEARNING **TIP**

Modified Plant Structures
The anatomy of the modified structures that are involved in asexual reproduction was discussed in Chapter 12.

Investigation **13.2.1**

Methods of Asexual Reproduction (page 619)
After reading about plant structures involved in asexual reproduction, you can complete Investigation 13.2.1.

In this observational study you will take cuttings from two different plant species and observe the effects of light exposure and lack of light on root formation in each species.

Costs and Benefits of Asexual Reproduction

Asexual reproduction in plants usually occurs by mitosis of diploid cells. As a result, asexual reproduction produces genetically identical individuals (clones). Why do plants reproduce asexually? Asexual reproduction has several benefits:

- If a plant has traits that allow it to survive in a particular environment, all of its offspring will have these traits, and they can all take advantage of the resources in the environment.
- The plant does not have to produce specialized reproductive structures, such as flowers or cones, so reproduction takes less energy and produces new individuals more quickly.
- Only one plant is needed. The plant does not depend on the presence of another individual in order to reproduce.
- Plantlets formed by asexual reproduction are generally more robust than young seedlings produced by sexual reproduction, so plantlets have a higher survival rate.

There is one big cost to reproducing asexually. As you learned from the Evolution unit (Unit 3), the environment selects only those individuals with traits that allow them to survive and reproduce in that environment. A population created by asexual reproduction is genetically identical. This lack of variation can have serious consequences. If the environment changes significantly, all of the individuals could die if their traits no longer help them survive and reproduce. For example, if the dune grass population were susceptible to a deadly plant virus, the virus could wipe out the whole population. To get around this problem, species reproduce sexually as well. For example, the grass plants produced by asexual reproduction will eventually reproduce sexually by producing flowers and forming seeds.

LEARNING **TIP**

Mitosis
Mitosis is the division of cells after duplication of their DNA. The daughter cells of mitosis have identical genetic material.

Human Uses of Asexual Plant Reproduction

Early in human history, people recognized that they could take advantage of plants' ability to reproduce asexually. They realized that they could use the various plant structures to grow more plants. Early farmers also found that they could use asexual reproduction to produce copies of those plants that had desirable characteristics.

Today, gardeners, farmers, and commercial nurseries still use asexual reproduction to clone desirable plants. One of the simplest methods is to take a stem cutting and place it in water. Some species quickly grow new roots at the cut edge (**Figure 4(a)**). Once roots form, the cutting can be transferred to soil (**Figure 4(b)**).

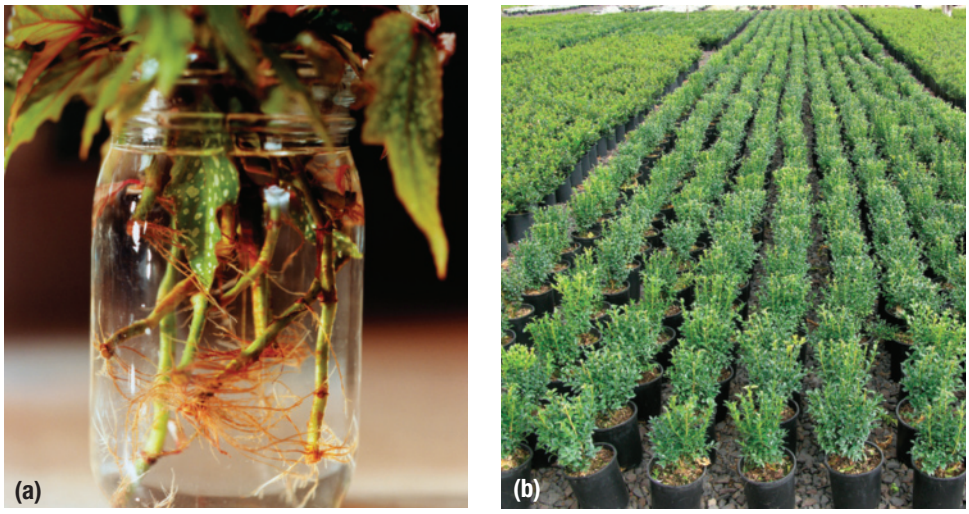

Figure 4 (a) Roots form on a cutting. (b) Commercial nurseries produce genetically identical plants grown from cuttings.

grafting attaching a young branch from one plant to the stem and root of another plant

scion the detached young branch from a plant

stock the plant onto which a scion is grafted

Figure 5 Scions of grape plants that produce desirable fruit are often grafted onto the stock of individuals with hardy disease- and insect-resistant roots.

Some growers use specific techniques to induce asexual reproduction in ways that do not occur naturally. One common example is grafting. **Grafting** involves cutting a young branch from a plant that has desirable characteristics and attaching it to the stem of another plant. Usually both plants are of the same or closely related species. The branch is called the **scion** and the plant that provides the stem and root system is called the **stock** (**Figure 5**). In a successful graft, the cambium of the scion and the cambium of the stock grow together, so that the vascular tissue of the stock eventually fuses with the vascular tissue of the scion. Plants in orchards and vineyards are maintained primarily by grafting. Often scions from a single tree that produced desirable fruit are grafted onto all the plants in the orchard or vineyard. For example, if an orchard has trees that produce McIntosh apples, all the branches that produce the apples are grafts of scions from a single apple tree. Grafting allows growers to produce multiple copies of a desirable tree or vine, but it does have a disadvantage. If most scions are from only a few individuals, the genetic diversity of the orchard or vineyard can be very low. This can make the plants vulnerable to disease, pests, or changes in environmental conditions.

Some plants cannot reproduce asexually. Others reproduce asexually only with difficulty. To overcome this, scientists have developed ways of producing clones by culturing particular tissues (**Figure 6**). Scientists grow these clones by placing a piece of a plant into a series of culture media where the plant tissue can grow into a complete plant. You will learn more about tissue culture in Section 13.6.

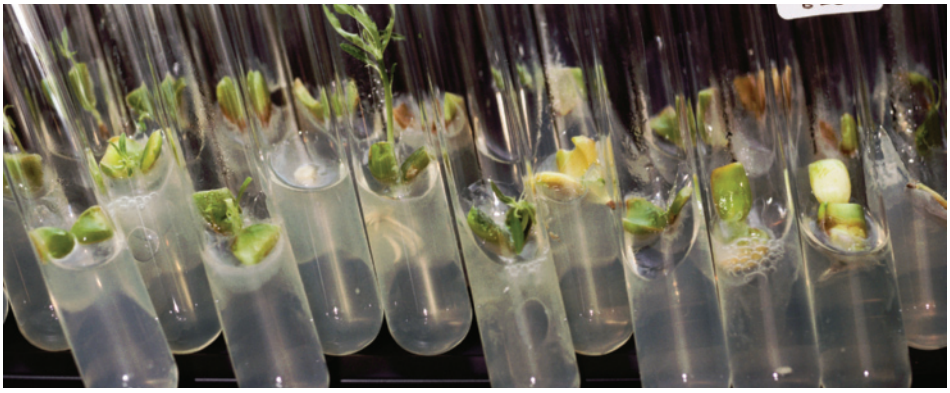

Figure 6 Apricot plants being grown in culture media in test tubes

13.2 Summary

- Asexual reproduction, also known as vegetative reproduction, produces genetically identical copies (clones) of an individual plant.
- Structures used in asexual reproduction include bulbs, rhizomes, and scions.
- Benefits of asexual reproduction include the ability to reproduce rapidly.
- Asexual reproduction techniques are used in agriculture to produce copies of plants with desirable traits.

13.2 Questions

1. Give two examples of plants that can reproduce asexually and the structures that they use. K/U
2. How might the ability to reproduce asexually be of particular benefit to pioneer plant species? K/U A
3. How does the use of asexual reproduction help fruit growers produce a consistently high-quality harvest? K/U A
4. List the advantages of asexual reproduction. K/U
5. Would you expect a changing environment to benefit plants that reproduce asexually or sexually? Explain your reasoning. T/I A
6. Describe the process of grafting. K/U
7. You hear a scientist comment to an orchard grower, "By producing all your new trees by grafting, you will never be able to improve the flavour of your fruit." Explain the scientist's reasoning. Do you think this is a significant concern? K/U T/I A