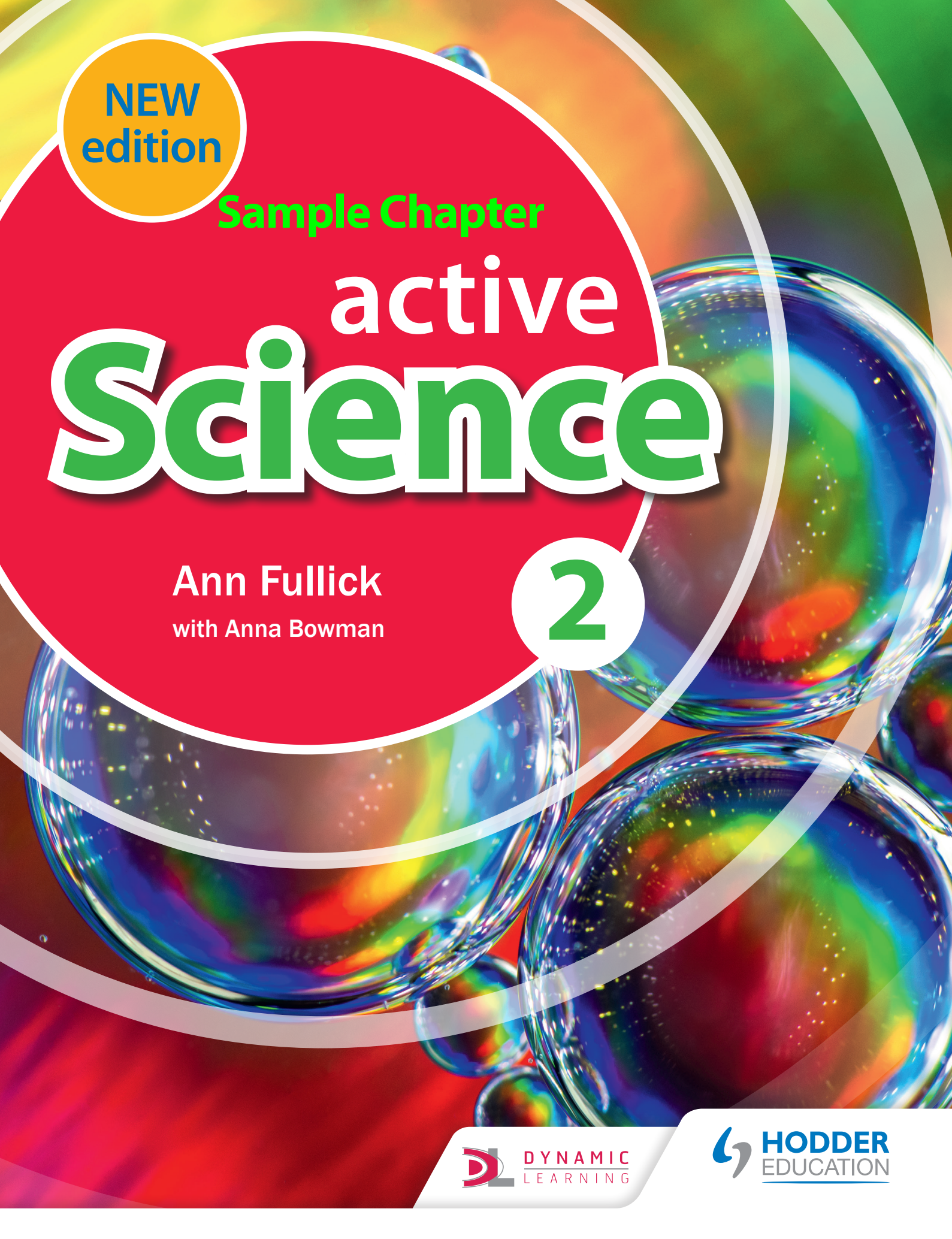

NEW edition
Sample Chapter
active
Science
2
Ann Fullick
with Anna Bowman
DYNAMIC LEARNING
HODDER EDUCATION

Active Science 2

New edition

Ann Fullick

with Anna Bowman

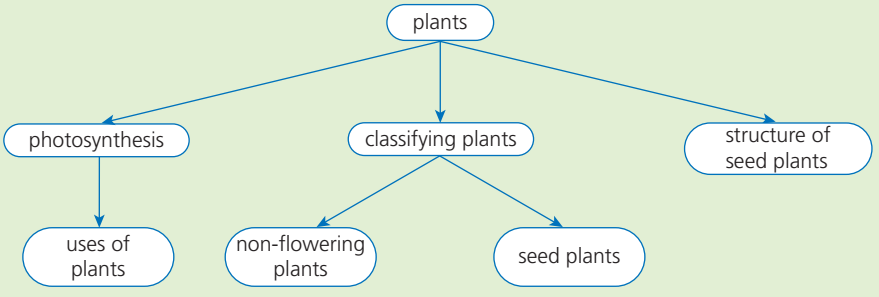
Contents

1 Plants: Classification and photosynthesis

Learning outcomes

After studying this chapter, you will be able to:

- **define plants**
- **define photosynthesis**
- **give a summary of photosynthesis**
- **list some of the uses of plants**
- **classify plants**
- **describe the characteristics of different groups of plants**
- **identify the main parts of a plant**
- **describe some of the modifications of plant parts for different functions.**



What are plants?

Plants are multicellular living organisms. They may grow in soil, in water, on rocks or on other plants. They can respond to their surroundings by moving part of their body, but they move very slowly. They do NOT move their whole bodies around.

Give a plant sun, air, soil and water and you usually have a healthy plant. Do the same for an animal and it will soon die. A big difference between plants and animals is that animals need to eat other organisms, but plants do not. Many plants have green parts and make their own food using light, air and water. Plants are living things like us – and we depend on them for our survival.

1 **What are the seven characteristics of living things? The acronym MRS GREN may help you remember!**

Photosynthesis

Plants make their own food and oxygen through a process called **photosynthesis**. In photosynthesis, green plants use energy from the Sun to join water from the soil with carbon dioxide from the air to produce sugar and oxygen.

Figure 1.1 The photosynthesis carried out by plants is vital for life on Earth.

Key term

Photosynthesis – The process that happens in the chloroplasts in which plants and algae use light, carbon dioxide and water to make sugar and oxygen.

You can summarise photosynthesis like this:

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{light energy}} \text{glucose (sugar)} + \text{oxygen}$$

The structure of a plant, especially the leaves, is adapted for photosynthesis. When you look at the structure of a plant in more detail, remember that the cells of the leaves need a good supply of light, water and carbon dioxide so that they can make food for the plant.

The importance of plants

We humans, along with all the animals on the Earth, need plants to keep us alive. They provide all the oxygen we breathe and, directly or indirectly, all the food we eat. We also use plants in many different ways, including as medicines, in the homes we live in, the clothes we wear and even the paper on which this book is written (see Figure 1.2).

Figure 1.2 We use plants in lots of different ways, for example, we use different parts of a coconut palm for food, drink, cosmetics, roofing, matting, soil substitutes…

2 **Think about some of the ways we use plants. Make a list of five different plants and discuss how they are important to humans.**

Plant groups

In Active Science Book 1, Chapter 3, you learned how living things can be classified. This means putting them into groups according to their characteristics. That work focused mainly on animals. Plants are vitally important to life on Earth, as you are learning in this chapter, and they can be classified too.

Figure 1.3 Plants come in all sorts of shapes and sizes – but they all have certain features in common.

When we classify animals, we divide them into vertebrates and invertebrates. In the same way, we can divide plants into **seed plants (flowering plants)** and **non-flowering plants**. Almost all plants have green parts where they make their own food by photosynthesis. Some plants are quite simple and do not produce flowers. Others are generally larger and produce the flowers we see around us all the time. One problem when we come to classify plants is that even flowering plants don't have flowers all the time, so we have to look for other clues!

Activity 1.1

Looking at plants

Scientific skills: Observation, recording and inferring

Method

A Go out into your local environment and observe as many plants as you can in their natural habitats.

B Make a sketch of the main features you see on each plant OR take a photo using a mobile phone or tablet.

C Make notes about the physical characteristics of each plant.

D Make a judgement about whether they are seed plants or non-flowering plants. Some plants that you may observe in your environment are:

- torch ginger
- coconut palm
- mango tree
- breadfruit
- tree fern
- moss
- bougainvillea
- prickly pear cactus
- soursop tree
- calabas
- hot lips
- lobster claws (*Heliconia*)
- maidenhair fern
- flamboyant tree
- papaya

E Group these plants, and any others that you have observed, into seed plants and non-flowering plants.

Key terms

Seed plants (flowering plants) – Plants that produce flowers and seeds – they are divided into the conifers and the true flowering plants and are also called flowering plants.

Non-flowering plants – Plants that do not produce flowers and seeds – they reproduce using spores.

Links

Use your skills from **visual arts** and **English** to help you here.

Key term

Spores – The means of reproduction in mosses, liverworts and ferns – the equivalent of seeds in flowering plants.

Classifying plants

Non-flowering plants

There are many non-flowering plants. They have been on Earth for millions of years. They are often found in shady, wet areas. Many of them are relatively small, but some of them can grow very large indeed, for example, the wonderful tree ferns found on many Caribbean islands. They do not produce flowers. They reproduce using **spores**, which are their equivalent of seeds and grow into new plants. Here are two of the main groups of non-flowering plants:

1 Liverworts and mosses

- no true roots, stems or leaves
- no water-carrying vessels
- produce no flowers – they reproduce using spores

These simple plants don't have true roots, stems or leaves. They don't have any transport vessels to carry water around the plant. Their 'leaves' are often very thin, only one or two cells thick, so they can absorb all the water they need from their environment. This is why mosses and liverworts are almost always found in damp, shady places.

Figure 1.4 Sphagnum moss grows in damp, shady places and never has any flowers.

2 Ferns

- have roots, stems and leaf-like fronds
- range in size from tiny to the tree ferns of our high Caribbean rainforests
- reproduce by spores that develop under the fronds



Figure 1.5 Different types of Caribbean ferns, and the reproductive spores underneath a fern frond.

Seed plants

Seed plants are found all over the world. They all produce seeds, but only the true flowering plants produce the bright flowers and fruits we all love. Both conifers and the true flowering plants have roots, stems and leaves, and they all have specialised water transport tissues. This means that seed plants can grow very big indeed! Here are the two main groups of seed plants:

1 Gymnosperms (conifers)

- have true roots, stems and leaves
- have water-carrying vessels
- produce simple flowers and seeds
- the seeds are naked – they are found in cones

Gymnosperms have leaves that are often very narrow and needle-like, and they do not lose a lot of water through these leaves. They can grow in very harsh, cold conditions, and where conditions are good, they can get very large. The tallest plants in the world are conifers – the giant redwoods that can grow to over 100 m tall!

Figure 1.6 Gymnosperms are relatively primitive flowering plants but they can survive in many difficult conditions.

2 Angiosperms (flowering plants)

- have true roots, stems and leaves
- have water-carrying vessels
- reproduce using flowers pollinated by the wind or by animals such as insects
- produce fruits and seeds

Flowering plants range in size from very tiny to very large. The smallest whole plant is watermeal, a bright green, oval plant that floats on water and is about the size of a grain of rice. The biggest flower belongs to *Rafflesia arnoldii* – it is over 1 metre across and 11 kg in mass! Many of the plants in our gardens and in our fields are true flowering plants. We enjoy the beautiful flowers they often produce. More importantly, we eat the fruits and seeds they produce, from maize and mangoes to breadfruit, rice and cashews.



Figure 1.7 Frangipani, plantains and barley are just three examples of the hundreds of thousands of species of true flowering plants.

Activity 1.2

Classifying plants

Scientific skills: Observation, recording, reporting and classifying

You will need:

- a container for collecting plants

Method

A Go around the school yard or your home and collect plants to classify. You can collect all or part of a plant, or photograph it.

B Look at each plant you have collected carefully and make a pencil drawing, (see Figure 1.8 for an example). Make sure your drawing shows all the most important features of your plant, for example, number of petals, leaves, roots if you can see them, any flowers, fruits or spores, and so on.

C Answer the following questions after you have drawn the plants. Use the lists and photographs above to help in your classification.

Questions

1. Is the plant a seed plant or a non-flowering plant?
2. Does it have roots, stems and leaves?
3. Does it have leaves with veins or fronds without spreading veins?
4. Does the plant have any sign of flowers, fruits, cones or spores?

D Try to classify the plant as in the example below.

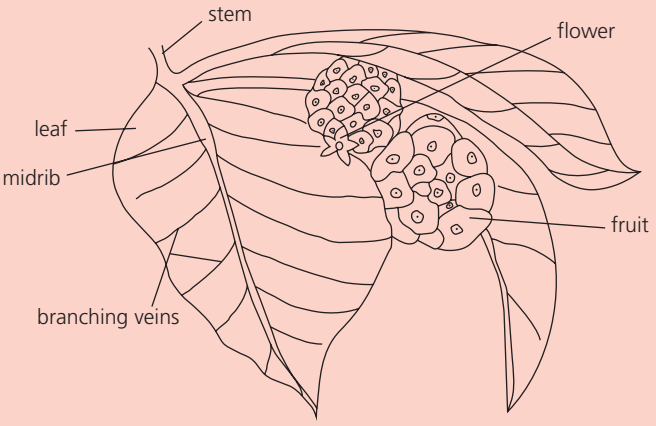


Figure 1.8 Draw and label your specimen carefully to show the main features.

Observations:

a It has true leaves.

b There are transport vessels visible in the leaves.

c It has a stem.

d It has flowers.

e It has a fruit.

This is a true flowering plant – an angiosperm. It is a noni tree showing both the flower and the fruit.

Links

Use your skills from **visual arts** and **English** to help you here.

Research project

Choose a plant from one of the non-flowering plant groups and one from the flowering plants. It can be a local plant or one from anywhere else in the world. Make a poster on each of the plants you have chosen, include as much detail as you can about the plant itself, the group it belongs to and the bigger classification of non-flowering or flowering plants. Make your poster colourful, clear and interesting for your classmates to enjoy.

Links

Use your skills from **IT**, **visual arts** and **English** to help you here.

Key terms

Angiosperms – The scientific name for the true flowering plants.

Monocotyledonous plants (monocots) – Plants where the seeds contain only one cotyledon (seed leaf), and the narrow leaves have parallel veins.

Classifying angiosperms

All **angiosperms**, the flowering plants, have true roots, stems and leaves, have water-carrying vessels, and reproduce using flowers, fruits and seeds. This is a very big group of plants, and scientists classify them into other, smaller groups. For example, angiosperms are divided into **monocotyledonous plants (monocots)** and **dicotyledonous plants (dicots)**. The main differences between them are summarised in Table 1.1.

Table 1.1 The main differences between monocotyledonous and dicotyledonous plants

Monocots	Dicots
Have seeds with only one **cotyledon** (seed leaf)	Have seeds with two cotyledons (seed leaves) (see Figure 1.9c)
Have long, thin leaves	Have variable-shaped leaves
Have parallel veins in the leaves (see Figure 1.9a)	The leaves have a main vein or **midrib** up the centre with smaller veins forming a network (see Figure 1.9b)
Examples include grasses, sugar cane and maize	Examples include breadfruit, mangoes and pigeon peas

a

b

c

Figure 1.9 a) Monocot leaves showing the typical narrow shape and parallel veins; b) A dicot leaf showing the typical broader shape with a midrib and a network of branching veins; and c) A dicot seed from a mangrove tree showing the two seed leaves with the embryo plant between them.

Key terms

Dicotyledonous plants (dicots) – Plants where the seeds contain two cotyledons (seed leaves), and the variable-shaped leaves have veins that branch out into a network from the midrib.

Cotyledon – Seed leaf.

Midrib – The main vein up the centre of a dicot leaf.

Activity 1.3

Classifying angiosperms

Scientific skills: Observation, recording, reporting and classifying

You will need:

- a container for collecting plants

Method

A Go around the school yard or your home and collect leaves to classify from as many plants as possible. You can collect a leaf from each plant, or photograph them.

B Look at each leaf you have collected carefully and decide whether it is from a monocot or a dicot. Where possible, identify the plant.

C Make a pencil drawing of the leaves you have collected, under the headings 'Monocot leaves' and 'Dicot leaves'. Make sure your drawing shows all the most important features of the leaves you have collected.

D What percentage of the leaves you have collected are monocots and what percentage are dicots?

Links

Use your skills from **mathematics** and **visual arts** to help you here.

The structure of angiosperms

The basic structure of flowering plants seems simple – see Figure 1.10. The different parts are adapted for the jobs they do for the plant. The roots anchor the plant in the soil. They also absorb the water and minerals that the plant needs from the soil. The stem supports the leaves and flowers. It transports water and minerals from the soil to the leaves, and food from the leaves to the rest of the plant. The leaves carry out photosynthesis, and the flowers are important for reproduction, as you will see in Chapter 3 of this book.

Modification to plant parts

Even when you know the basic structure of plants, it can be hard to recognise the different parts. Plants have many modifications that help them to live in very different environments. These modifications can change the appearance of the plant body, so you need to look for the key characteristics to classify the different parts. Below are some examples of how the parts of a flowering plant can be modified, and what you need to look for.

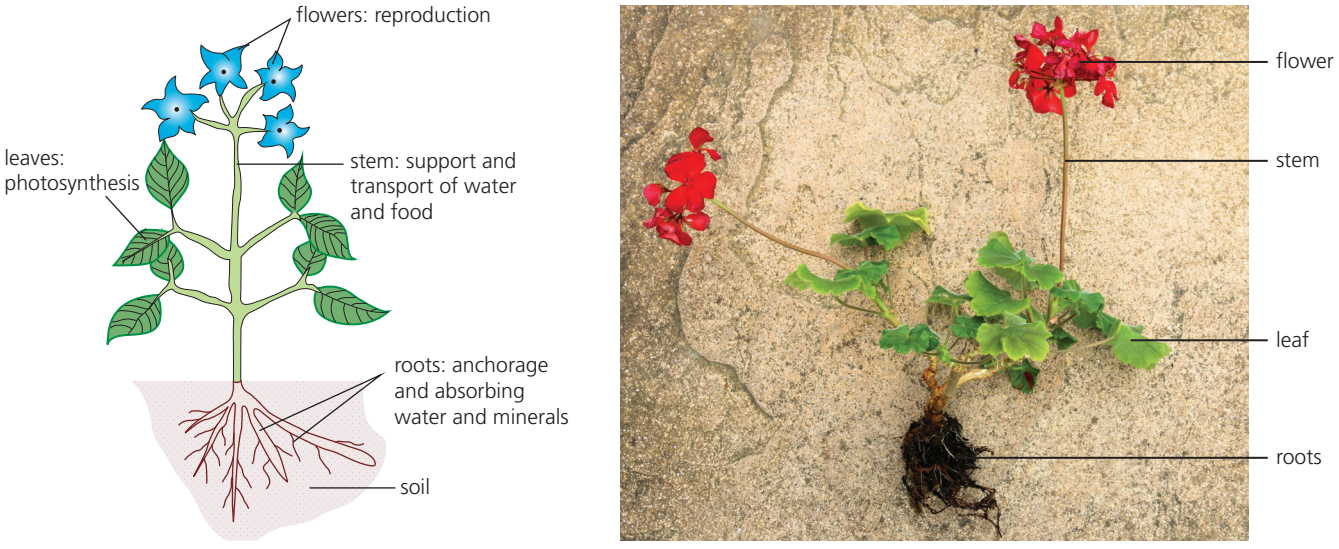


Figure 1.10 The main features of a flowering plant.

Key terms

Simple leaf – A leaf made up of a single blade.

Compound leaf – A leaf made up of a number of leaflets.

1 Leaves

Leaves can be found in many different shapes and sizes. As you have already seen, the leaves of dicots are broad, usually with serrated margins and a network of veins. Monocots have long, thin leaves with parallel veins.

A leaf that has a single blade is called a **simple leaf**. If it is divided into lots of smaller leaflets, it is called a **compound leaf**. A bud that will grow to form new stems or flowers (the axillary bud) is found at the place where the leaf stalk or petiole joins the main stem. The presence of these buds can help you decide if your leaf is a simple one or just the leaflet of a compound leaf.

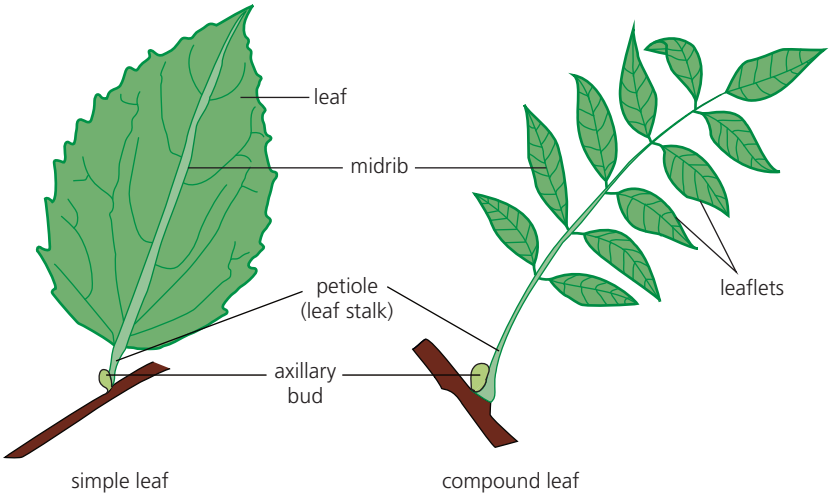


Figure 1.11 The main features of simple and compound leaves.

Leaves can have many other modifications. They can be thick and fleshy to store water, or they can be spines (see Figure 1.12 of a cactus), which protect the plant and save water but carry out little photosynthesis. Some leaves even look very like flowers!

2 Stems

Plant stems can be modified in many different ways, but they are still stems. The most easily recognised adaptation is the woody appearance of the stems of trees, which become tree trunks! Stems may grow thorns or spines to protect the plant from herbivores. They may become thickened and full of food, and be used for types of reproduction. Some stems coil around to hold a plant up as it grows, or become very thick and store water – but they still support the plant and they are still stems.

Figure 1.12 The water-filled green stem of a cactus carries out most of the photosynthesis for the plant (the leaves have become protective spines), while the stems of some climbing plants spiral round to support the plant as it grows up towards the light.

3 Roots

Plant roots are usually found underground, so we can't always see what they look like. But just like every other part of a plant, they can be modified to carry out different functions, as well as anchoring the plant and absorbing water and minerals from the soil. The roots of plants such as sweet potatoes, yams and beets are swollen with starch to act as a food store. We make use of these **tubers** and eat them ourselves! The buttress roots of some of the biggest rainforest trees give extra support, while the aerial roots of some types of mangroves allow the cells to get the oxygen they need from the air.

Key term

Tubers – Modified roots swollen with starch as a store of food against difficult conditions.

Figure 1.13 The buttress roots of rainforest trees and the delicious flesh of sweet potato tubers are just two examples of root modifications.

Activity 1.4

Plant modifications

Scientific skills: Observation, recording, reporting and classifying

You will need:

- a container for collecting plants

Method

A Go around the school yard or your home and find examples of plant modifications. You can collect examples, or photograph them.

B Go online or use books to find more examples of the ways that different parts of plants can be modified for different functions.

C Make a booklet about plant modifications and why they are so important. Make sure your explanations are clear, and use lots of illustrations to make your booklet as interesting as possible.

Links

Use your skills from **visual arts** and **English** to help you here.

End of chapter questions

For questions 1–5, choose the correct answer from A–D.

1 **Plants make their own food by:**
- A respiration
- B excretion
- C photosynthesis
- D sensation

2 **Which one of the following is a non-flowering plant?**
- A a breadfruit tree
- B a mango tree
- C a soursop tree
- D a tree fern

3 **A torch ginger (Figure 1.14) is an example of:**
- A a liverwort
- B an angiosperm
- C a gymnosperm
- D a fern

Figure 1.14 Torch ginger

4 **Which of the following plants has naked seeds carried in cones?**

A a giant redwood
B a mahogany tree
C sphagnum moss
D a noni tree

5 **A potato is a modified**

A stem
B root
C leaf
D fruit

6 **Give a summary of photosynthesis.**

7 **Draw a table to compare non-flowering and flowering plants.**

8 **'Without plants, human beings could not survive on Earth.'**

Write a short essay explaining this statement.

Summary

- Plants are multicellular organisms that can respond to their surroundings by moving parts of their body very slowly.
- Plants have green parts where they capture light energy and use it to combine carbon dioxide and water to make sugar (glucose) and oxygen in a process called photosynthesis.
- People need plants for food and oxygen, and also use plants in a variety of other ways.
- Plants are divided into two main groups: non-flowering plants and seed plants (flowering plants).
- Non-flowering plants do not produce flowers – they reproduce using spores. They include the liverworts, mosses and ferns.
- Seed plants reproduce using flowers and they produce seeds. They include the gymnosperms (conifers), which produce flowers followed by naked seeds in cones, and the angiosperms (true flowering plants), which produce flowers, fruits and seeds.
- Angiosperms can be classified as monocotyledonous plants (monocots) or dicotyledonous plants (dicots). Monocots have one seed leaf (cotyledon) in their seeds and narrow leaves with parallel veins. Dicots have two seed leaves in their seeds, and different dicots have different shaped leaves, with a midrib up the centre of each and a network of smaller veins.
- The basic structure of the angiosperms includes roots for anchorage and to absorb water and minerals, stems for support and transport, leaves for photosynthesis and flowers for reproduction. All of these parts may be modified to carry out different or extra functions to help the plant survive.

If you continue to study biology you will:

Find out more about the process of photosynthesis…

…and investigate how different conditions affect it.

Figure 1.15 Students can investigate the factors that affect the rate of photosynthesis.

You will find out more about the way plants make sugar and oxygen from carbon dioxide and water. What conditions affect the rate at which this amazing reaction takes place? Is chlorophyll really green? Why is light so important in photosynthesis? To find out the answers, you will carry out your own experiments (see Figure 1.15), changing the conditions for the plants you are studying and finding out what happens to them as a result.

Discover the importance of plant life in local and global ecosystems

Figure 1.16 The plants of the Caribbean play an important role in both local and global ecosystems.

In CSEC Biology, you will build up an understanding of the role of plants in ecosystems. You will discover the way resources cycle through the natural world, and why plants are needed to absorb and store carbon dioxide to maintain the balance of nature. You will study ecosystems out in the field (see Figure 1.16), identifying different species of plants and animals and working out the factors that affect their abundance.

Plants are the basis of almost all feeding relationships on land. When plant diversity is lost through farming, hundreds of other species are affected too. You will discover more about this network of life and how to monitor the changes that result from human actions. You will also learn how we can farm sustainably and encourage both plant and animal life on our islands.

Questions

1 The rate of photosynthesis is affected by a number of factors, including:

a) carbon dioxide concentration in the air

b) light levels

c) temperature.

Do some research and write a brief report explaining how these three factors change the rate at which plants make their own food.

2 Plants play a very important role in balancing ecosystems. They remove carbon dioxide from the air during photosynthesis and store the carbon in their tissues. Investigate what is happening to the natural forests and other ecosystems of your country. Are they disappearing to make way for agriculture, or are they being conserved? Write a news article or a blog about the health of the natural ecosystems on your island.

Links

Use your skills from **IT**, **mathematics** and **English** to help you here.

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