Chapter 1

Classification

Learning outcomes

By the end of this chapter you should understand:

- ☐ The characteristics of living organisms
- ☐ How to use the binomial system for naming organisms
- ☐ How living organisms are classified
- ☐ The characteristics of some vertebrates
- ☐ The characteristics of some invertebrates
- ☐ Viruses, prokaryotes (bacteria), protoctists and fungi
- ☐ The construction and use of a dichotomous key

1.01 Characteristics of living organisms

All living organisms possess the 'characteristics of life'. The one group of organisms that does not show all the characteristics of life is the viruses. Thus they are considered to be on the border between living and non-living.

All truly living organisms display the following characteristics:

- **Movement.** This may be the movement of a part of an organism in relation to the rest of its body (such as the movement of an arm or of a shoot tip), or it may involve the movement of the whole organism from one place to another – when it is called locomotion. It commonly involves the contraction of muscles (as in the arm) or cells growing at different rates (as in the shoot tip).

  It is thus defined as **an action by an organism (or part of an organism) causing a change of position or place**.

- Respiration. This is a chemical reaction that takes place in living cells. It involves the breakdown of large, nutrient organic molecules (usually carbohydrates, such as glucose) to release (not to 'make', 'manufacture' or 'produce') the energy contained within the molecule. The glucose molecule contains energy in the form of chemical energy, which is converted into other forms for use in doing work – such as electrical energy in nerve impulses.

  Respiration is defined **as the chemical reactions in cells that break down nutrient molecules and release energy (for metabolism)**.

TIP

Breathing and respiration are not the same thing. When we take air into and expel air from our lungs, we are breathing. This process is to supply oxygen to the blood that takes it to the cells where respiration occurs.

- Sensitivity. This is the ability to detect and respond to changes in the environment (known as **stimuli**). The stimuli may be from the internal environment – for example, the effect of hormones on a cell or tissue, or from the external environment – for example, light. The internal environment is a term that refers to the conditions inside an organism. Sensitivity is also the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses.
- **Growth.** It is customary for organisms to start life small in size and gradually become larger with time. Some organisms grow to a certain size then stop, while others grows continuously throughout their lives. Growth is defined as **a permanent increase in size**.

  Growth involves an increase in dry mass by an increase in cell number or cell size or both. Dry mass is the mass of all the components within an object except any water present.
- **Reproduction.** In order to maintain (or increase) their numbers, all organisms have the ability to make more of the same kind.

- **Excretion.** This is the removal from organisms of toxic materials and substances in excess of requirements.

  The material removed includes the waste products of metabolism – chemical reactions in cells including respiration.

> **TIP** Remember that excretion does NOT include the removal of undigested waste from the intestines since it has never taken part is a chemical reaction within the body's cells.

- **Nutrition.** In order to provide the raw materials and the energy for all the other characteristics of life listed previously, organisms must take in energy-containing materials that are required for growth and development.

  Nutrition is thus defined as **the taking in of materials for energy, growth and development**.

  Plants require light, carbon dioxide, water and ions; animals need organic compounds and ions and usually need water.

> **TIP** The first letters of each of the characteristics together spell the name of 'MRS GREN' – a lady well known to students trying to remember the characteristics of living organisms!

1.02 The concept and use of a system of classification

The living universe comprises well over 10 million different types of organism, which are sorted into groups based on common features. This is called **classification** (or **taxonomy**). Those organisms that share many similar features are placed in the same group. Those that share few features are placed in separate groups. The number of shared features between different groups gives an indication of how closely related the groups may be.

The largest groups are called **kingdoms**, of which there are five:

- Prokaryote (Bacteria)
- Protoctist
- Fungus
- Plant
- Animal.

Each kingdom is divided into sub-groups and each sub-group is divided into smaller groups. The last two groups in this succession are the **genus** and finally, the species. (The plural of genus is genera.)

A **species** is defined as **a group of organisms that can interbreed (reproduce) and produce fertile offspring**. A species is therefore said to be 'reproductively isolated'.

Organisms within a species are not identical and the differences between them are called **variations**.

The binomial system of classification

'bi' = two and 'nomial' from the Latin *nomen* = name

All living organisms are usually known by the binomial system, an internationally agreed system using two names.

These two names indicate the **genus** and the **species** to which the organism belongs.

The genus is always written with an upper-case first letter and the species is written with all lower-case letters. Both names are always underlined when hand-written and appear in italics in print. Both names often have a Latin or Greek origin. Thus, the lion is

Panthera leo (hand-written) and
Panthera leo (in print).

The binomial system is useful because:

- Sometimes, different species in different parts of the world share the same name. When different countries work together on schemes to conserve endangered species, it is vital that they are all considering the same organisms (e.g. there are three different species of arthropod all called 'Daddy Long-legs' in different parts of the world.)
- The same species may have different names in different languages.
- The common name may be misleading (a jellyfish is not a fish).
- All organisms placed in the same genus will share a set of features common only to that group. Knowing the genus, even without actually seeing the organism, therefore tells the biologist a great deal about organisms and about their evolutionary history and relationships (i.e. how recently they separated from one another as they have evolved).

For many years, the classification of organisms was based on studies of their morphology, that is, their outward appearance, for example, the number and type of limbs, or the shape of the flowers produced by a plant. It may include internal morphological features, such as the skeleton (useful when classifying fossils, for example). These studies were also supported by consideration of shared anatomical features, that is, internal features visible as a result of dissection of organisms.

RNA and DNA sequencing

The sequence of chemical bases in the DNA and RNA molecules found in different organisms gives a very accurate indication of how closely related those organisms are. Mutations are constantly changing this sequence and those changes are handed on to the next generation. (See Chapter 18.)

The sequence of bases in the DNA molecule determines the sequence of amino acids in the proteins made by the organism. Thus, a mutation in an organism's DNA leads to a change in its protein structure. The longer ago the two different organisms separated from a common ancestor, the larger the number of mutations will have occurred, and the greater the differences in the sequence of bases there will be in these organisms' DNA and RNA. This, in turn, leads to a greater difference in the amino acid sequence in their proteins.

Data from the analysis of DNA/RNA base sequences is now so accurate that we are able to identify human beings in the same family.

Progress check 1.1

1 Find out what you can about a DNA molecule. How many bases are there?

2 Make sure you know what each of the letters in 'Mrs Gren' stand for.

3 What describes respiration?

- A breathing in oxygen
- B breathing out carbon dioxide
- C releasing energy from nutrient molecules
- D using energy to construct nutrient molecules

1.03 Features of organisms

All living organisms share the possession of a cellular structure, that is, they are all made up of one or more living units called cells.

Cells include the following features:

- Cytoplasm – a jelly-like substance that contains smaller structures (organelles) and in which all the metabolic chemical reactions occur.
- **DNA** – the chemical that forms the genes of the cell that are responsible for the nature of the proteins made within the cell and also for handing on this information to future generations.
- Cell membrane – the living, selectively permeable structure that encloses the cell contents and is responsible for the entry of substances into and exit of substances from the cell.

Two of the most familiar kingdoms in the living universe are the animals and the plants. The distinguishing features of these two kingdoms are as follows:

Animals

- Animals take in (**ingest**) and use organic materials from other living organisms as their source of energy for growth and development.
- Animals are able to move from one place to another (movement known as **locomotion**). (Sponges are exceptions to this as they are animals that remain fixed to the surface on which they live.)
- Sexual reproduction – animals reproduce using specialized reproductive cells (gametes). The male gamete is the sperm and the female gamete the egg cell (or ovum). Few animals reproduce by asexual reproduction.
- Most animals have **diploid** nuclei. That is to say that each nucleus has **two** full sets of genetic material contained in matching chromosomes. Only the X and Y chromosomes (the sex chromosomes) do not exactly match.
- There is no rigid cell wall surrounding the cell membrane.

Plants

- Plants manufacture their own food from carbon dioxide and water, using energy from sunlight that is trapped by the green pigment called chlorophyll. The process is called photosynthesis.
- Plant cells are surrounded by a rigid cell wall made of **cellulose**. Pressure within the cell caused by the entry of water keeps the cell firm and supplies rigidity to the plant.
- Plants have a complex reproductive cycle, involving various agents to bring about the processes of pollination and, later, fruit or seed dispersal.
- Most plants have only a few, but easily identifiable organs – leaves, flowers, stems and roots.
- Asexual reproduction, where a parent plant gives rise to may offspring without the involvement of gametes, is relatively common in plants.
- Although most plants in their familiar form have diploid nuclei, very few have the non-matching XY sex chromosomes.

NB Both plants and animals are made up of many cells (they are thus both described as being multicellular).

Classification within the animal kingdom

Animals either possess or do not possess a **vertebral column**.

TIP

Avoid the word 'backbone'. It is not a very accurate term as there are many bones in the vertebral column. Those possessing a vertebral column are called **vertebrates**. (Those without are called invertebrates.)

There are five groups of vertebrates:

- Fish
- Amphibians
- Reptiles
- Birds
- Mammals.

Fish

All fish share the following characteristics (Figure 1.1):

- A **skeleton** made of **bone** or of the more pliable material, **cartilage**
- A skin covered with **scales**
- **Fins** that present a large surface area to push against the water when swimming
- **Gills** for extracting oxygen from water and supplying it to the blood.

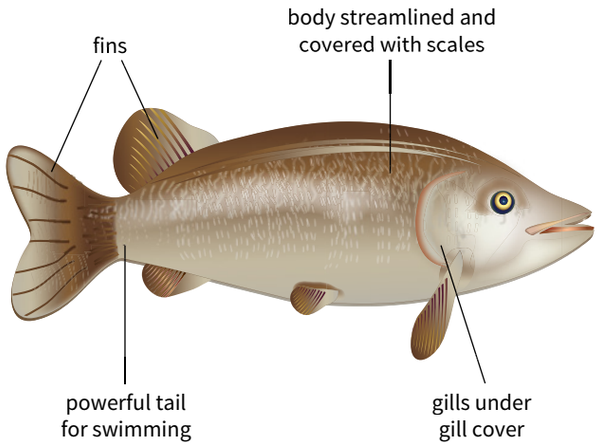

Figure 1.1 A fish

Amphibians

Frogs, toads, newts and salamanders all have the following characteristics (Figure 1.2):

- A **soft skin** with no scales
- **Live** or can survive **on land** but always **return to water to lay eggs**
- Adults have **lungs** to breathe air
- Eggs hatch into larvae called **tadpoles** that live in water
- **Tadpoles** breathe using **gills**
- Tadpoles change into adults by metamorphosis (metamorphosis = a change in form and feeding habits from larva to adult).

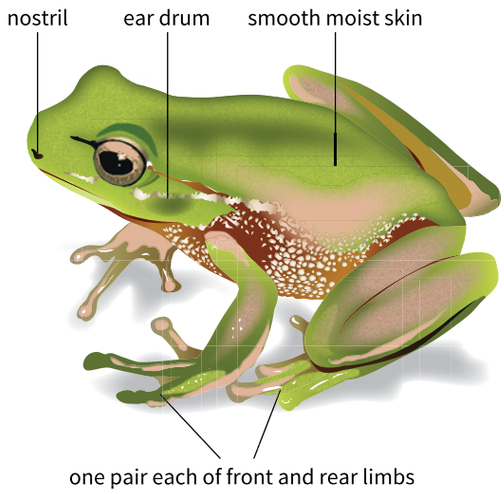

Figure 1.2 An amphibian (frog)

Reptiles

Lizards, snakes, tortoises and turtles all have the following characteristics (Figure 1.3):

- A tough, **dry**, **scaly skin**
- Lay **eggs** with leathery **shells on land**
- Have **lungs** for breathing air.

Figure 1.3 A reptile (crocodile)

Birds

Birds including the flightless birds (such as the ostrich) have the following characteristics (Figure 1.4):

- Skin covered with **feathers**
- Forelimbs modified to form **wings**
- A **beak** for feeding
- Have **scales** on their legs and toes
- **Lungs** for breathing
- Lay **hard-shelled eggs** on land
- Maintain body at a **constant temperature** – usually **above atmospheric temperature**.

TIP

Use the terms 'warm-blooded' and 'cold-blooded' with care. They are not very helpful terms, since some reptiles when basking in the sun may have a blood temperature higher than that of birds.

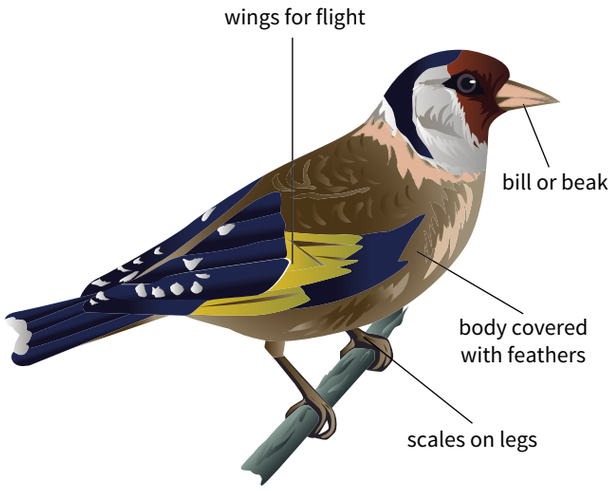

Figure 1.4 A bird

Mammals

Mammals, including kangaroos, cows, whales and human beings, have the following characteristics (Figure 1.5):

- Have **hair** on at least some part of the skin
- Internal fertilisation and **internal development** of the embryo
- Young ones fed on **milk from mammary glands**
- **Lungs** for breathing
- Maintain body at a **constant temperature** ('warm-blooded' – but sometimes not as warm as the surrounding atmosphere).

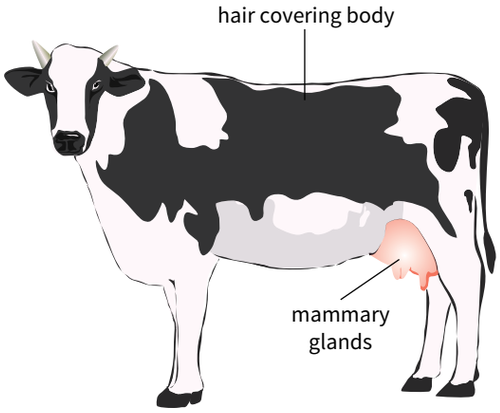

Figure 1.5 A cow

Test yourself by writing at least two characteristic features of each of the five vertebrate classes.

Worked example

a A student is told that an animal he is about to be shown is either an amphibian, a reptile or a mammal. Describe the features common these three groups.

b Describe the external features that would indicate to which group it belongs.

Answer

a Since these are all vertebrates, then the question is asking for vertebrate features shared by the three groups. All vertebrates have a vertebral column (avoid calling it a 'backbone') and a bony skeleton. They will possess eyes, a mouth, two front legs ('arms') and two rear legs. They will all have the following internal organs: lungs, heart, blood vessels, liver, kidneys and an alimentary canal.

b If it is an amphibian, it will have a soft, smooth and most probably moist skin. If it is a reptile, its skin will be tough, dry and will be covered with scales. If it is a mammal, it will have a skin covered, or partly-covered, with hair. It is likely to be warm to the touch. If it is a female, then it will have at least one pair of mammary glands on the front of its thorax (chest).

(Note that part (b) asks about external features. Mention of internal or external fertilization, laying of unprotected eggs in water that hatch into tadpoles (amphibian) or of shelled eggs on land (reptiles) are facts that are not relevant to the question.

The invertebrates

These are the animals that **do not have vertebral columns**. Like the vertebrates, they are divided into **phyla** (the plural of 'phylum'), but such is the diversity of the invertebrates that they include over **30 different phyla**. The largest group (phylum) of invertebrates, by far, is the **arthropods**.

The arthropods

These include several Classes of which the largest and better-known ones are:

- The insects
- The crustaceans (crabs and lobsters)
- The arachnids (spiders)
- The myriapods (centipedes and millipedes).

All arthropods have the following features:

- They have **segmented bodies**.
- They have limbs with clearly visible joints.
- They have an **exoskeleton** (i.e. a skeleton on the outside of the body). (Muscles are attached internally to the exoskeleton – the opposite of ourselves, where muscles are attached externally to our endoskeleton.)
- The exoskeleton is composed of the chemical **chitin**. (See fungi.)

The insects

In addition to the characteristics of arthropods listed, insects have the following features (Figure 1.6):

- The **body** is divided into **three parts** – head, thorax and abdomen. The head, thorax and abdomen are not segments.
- They have **three pairs** of (jointed) **legs** – attached to the thorax.
- They usually have **wings** – one or two pairs attached to the thorax.
- They have **one pair** of **antennae** – attached to the head.
- They have **compound eyes** – each one with hundreds of small units called ocelli.
- **Breathing** is through **small holes** (spiracles), occurring in pairs, one each side of the abdominal segments and two on the thoracic segments. The spiracles lead into branched tubes called tracheae.

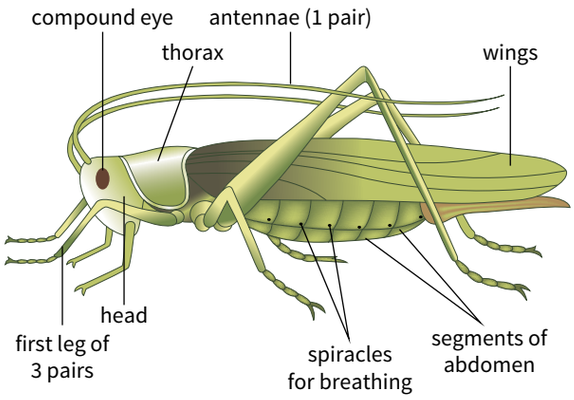

Figure 1.6 An insect

The crustaceans

These live mostly in water (e.g. a lobster) and those that live on land (e.g. some crabs) live in damp places.

As well as the characteristic of arthropods, crustaceans have other features: (Figure 1.7):

- There are **two pairs** of **antennae** that are attached to the head.
- There are **three pairs** of **mouthparts** that, with the antennae, make up the **five** pairs of appendages attached to the head.
- The **exoskeleton** is often strengthened with **calcium salts**. (This protects the animal from predators, but can make the animal very heavy. The additional mass is supported by the water in which most crustaceans live.)
- The head and thorax are often joined to form the cephalothorax.
- The abdomen often has a **pair of limbs** on **each segment**, which are modified for many purposes, but often for swimming.

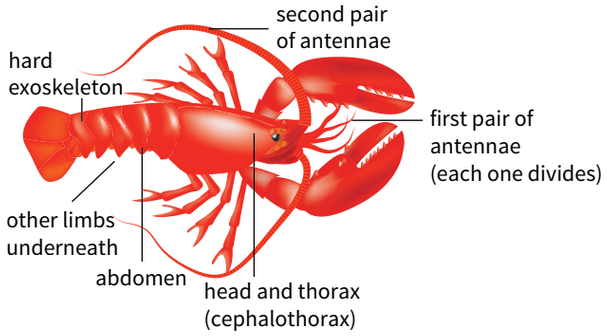

Figure 1.7 A lobster

The arachnids

This group includes the spiders and the scorpions and, as well as those features possessed by arthropods, the arachnids also have the following (Figure 1.8):

- A **body** divided into two parts (the head and thorax, called the cephalothorax, and the abdomen).
- **Four pairs** of jointed legs joined to the cephalothorax.
- **No antennae**.

Figure 1.8 A spider

The myriapods

Myriapod means 'countless legs' and includes the centipedes and millipedes. As well as possessing the features common to arthropods, they also possess (Figure 1.9):

- **One pair** of **antennae**.
- **One** or **two pairs** of **legs** attached to **every segment**.

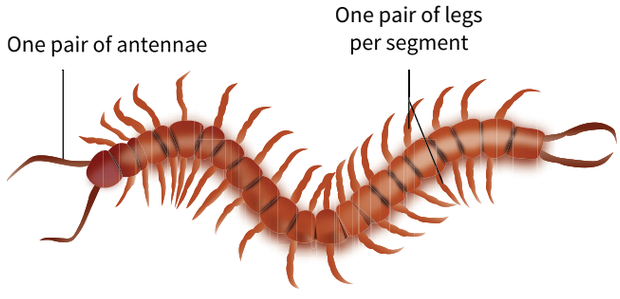

Figure 1.9 A centipede

Progress check 1.2

1 Name the chemical found in the exoskeleton of arthropods.

2 Which animals possess visible body segments?

A birds

B insects

C mammals

D reptiles

Other features present in cells

As well as cytoplasm, DNA and a cell membrane, the cells of all truly living organisms also contain within their cytoplasm structures ('organelles') called ribosomes.

Ribosomes are:

- about 20 nm in diameter (1 nm = 1 millionth of a millimetre)
- the place where amino acids are joined together to make proteins.
- made of protein and the nucleic acid RNA.

Some of the proteins made will be enzymes and amongst the enzymes will be those used in the process of anaerobic respiration. This occurs in the cytoplasm of all cells with the release of a relatively small amount of energy. If oxygen is available within the cell, then the end-products of anaerobic respiration will be further broken down (oxidised during aerobic respiration) to release greater amounts of energy.

The main features used in classifying viruses, prokaryotes (bacteria), protoctists and fungi

Since a microscope is required to study viruses and prokaryotes, protoctists and also for some fungi – such as yeast – they are referred to as microorganisms.

Occupying a position below the plants and animals in the evolutionary tree, the prokaryotes, protoctists and the fungi each form their own kingdoms (see earlier).

Viruses

Viruses are **not truly** living organisms. They have the following main characteristics (Figure 1.10):

1 They are **less than 300 nm** in size – around 50 times smaller than a bacterium. (1 nm, or nanometre, is 1 thousand millionth of a metre). They can be seen only with an **electron microscope**.

2 They contain **nucleic acid** (**DNA** or **RNA**).

3 The nucleic acid is surrounded by a **protein coat** (known as the **capsid**).

4 They can **reproduce** only inside living (**host**) cells.

5 Since they are parasites, they cause disease (i.e. they are pathogenic). Examples of diseases caused by viruses are influenza, measles and AIDS.

6 Viruses are **not** affected by antibiotics.

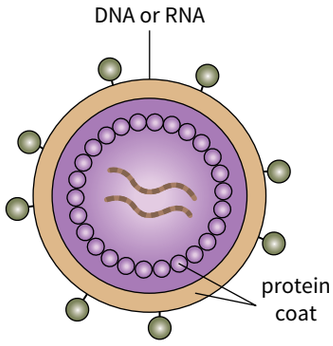

Figure 1.10 A virus

Their extremely small size allows them to be easily transmitted from host to host in very considerable numbers, both by air currents as well as by contact. The protein coat gives the nucleic acid considerable protection. Once inside a living host cell, they take over the host cell's metabolism and use it for their own reproduction. Some viruses (e.g. influenza virus) have a high mutation rate; thus a person may recover from flu, but still fall victim to the next epidemic caused by a mutated strain of the virus to which they have no immunity.

Prokaryotes (or bacteria)

Prokaryotes are truly living organisms, with the following characteristics (Figure 1.11):

1 They have a size in the range of **0.5–5 μm** (1 μm = 1/1000 mm).

2 They are unicellular (made of one cell only).

3 They have **no true nucleus** (their DNA lies 'loose' in the cytoplasm).

NB Some prokaryotes contain a loop of DNA called a plasmid – a feature sometimes employed in biotechnology.

4 They have a cell wall.

5 They may be (pathogenic) parasites or they may be saprotrophs. Some may be involved in nitrogen fixation and **denitrification**. (See the Nitrogen Cycle.)

Pathogenic = disease-causing; Saprotrophic = feeding on dead organic matter causing it to decay.

6 They are **killed** by **antibiotics**.

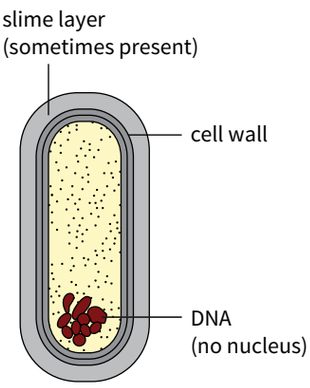

Figure 1.11 A bacterium

They can form resistant spores that are easily carried by air currents and by contact. Once within a suitable **substrate**, they reproduce quickly – dividing every half an hour.

Progress check 1.3

1 In suitable conditions, one bacterium could become how many in 5 hours?

2 What is the purpose of ribosomes?

Protoctista

These are a group of largely microscopic, truly living organisms.

1 They are mostly unicellular but some are multicellular.

2 They are either free-living or parasitic.

3 They have **aerobic** respiration involving mitochondria.

4 Unlike the prokaryotes, structures that lie in their cytoplasm are surrounded by **membranes**.

5 They have true **nuclei** (i.e. they are eukaryotes).

6 They reproduce both sexually and asexually.

7 They are grouped into **three categories**: animal-like (protozoa) that have animal-like nutrition; plant-like (algae) that feed by photosynthesis and fungus-like.

Fungi

Fungi are usually much larger organisms, mostly visible to the naked eye. For example: yeasts, moulds and mushrooms. They have the following characteristics (Figure 1.12):

- They have **no chlorophyll**. (They release enzymes to digest large molecules externally, then absorb the soluble products.) They are thus **parasites** or saprotrophs.
- They have a 'cell' wall made of **chitin**.
- They are usually made of a large number of tubular threads (**hyphae**) intertwined to form a **mycelium**.
- Hyphae are not divided into individual cells. The lining of **cytoplasm** has **many nuclei** and the central space in the hyphae is a vacuole full of (vacuolar) sap.
- If they store carbohydrate, they store glycogen.
- They reproduce by producing **spores**.

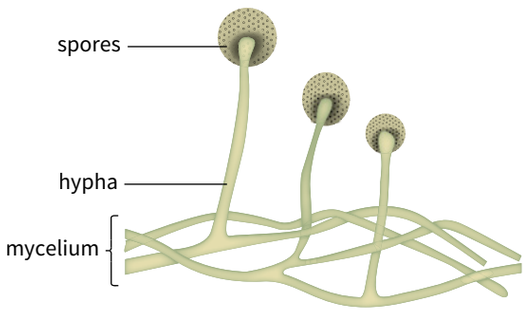

Figure 1.12 A fungus

The branching mycelium of a fungus ensures that the maximum amount of food substance (substrate) is digested as quickly as possible before it dries up, or is digested by bacteria. Fungi are important in the decay of dead, organic matter. Fungal spores are light and easily carried by air currents from one substrate or host to another.

1.04 Classification of the plant kingdom

In plant classification, the term 'division' is often used instead of phylum, but like phyla, divisions are divided into classes. Two major divisions of plants are the **ferns** and the **flowering plants**.

Characteristics of ferns

Ferns have the following characteristics (Figure 1.13):

- They are green photosynthesising plants.
- They have conducting tissue (xylem and phloem) forming veins.
- They have, often compressed, stems called **rhizomes**.
- They do **not** produce flowers.
- Instead, they produce **spores** that are light and easily carried away by the wind.
- Spores are released from **spore cases** (sporangia) that are found on the lower surfaces of fronds.
- **Frond** is the term for the leaves of ferns.

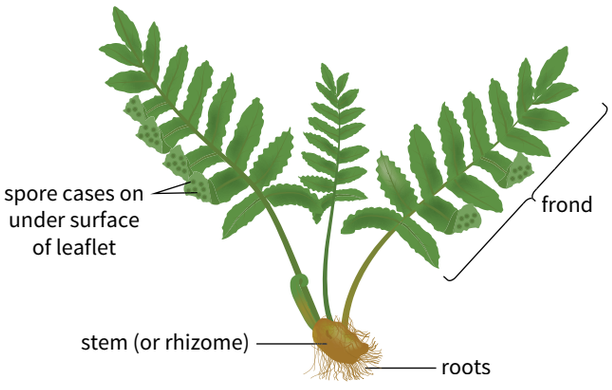

Figure 1.13 A fern plant

By far the largest division of the plant kingdom is the **flowering plants** that are sub-divided into two classes: the **monocotyledons** and the **dicotyledons** (usually shortened to 'monocots' and 'dicots').

(NB The dicots have more recently been divided into several separate smaller groups, the most important of which is called the 'eudicotyledons'.)

1.05 Classes of flowering plant

Monocotyledons

Mono = one, cotyledon = a leaf that forms part of the structure of the seed.

This class includes the grasses, cereals, lilies and orchids, all of which share the following characteristics (Figure 1.14):

- **One** cotyledon inside each seed
- Leaves that are **narrow** and **strap-like**
- Leaves that have **parallel veins**
- A mass of equally sized (**fibrous**) roots
- **Flower** parts that are usually arranged in **threes** (i.e. three petals etc.).

Figure 1.14 A monocotyledon (*Iris*) with thin strap-like leaves that have parallel veins

The (eu)dicotyledons

This class includes cabbage, hibiscus, geranium and sweet potato, all of which have features that differ from those of the monocotyledons mentioned earlier (Figure 1.15).

- **Two** cotyledons are present inside each seed. Not only do these become the first photosynthesizing leaves when the seedling emerges above ground, but generally store food used during the process of seed germination.
- The leaves are **broad**.
- The leaves have **branched veins** usually radiating from a central thicker vein called the midrib with the branches linked by a network of veins.
- **Fewer,** thicker **roots** which are often joined to one long central root called the **tap root**.
- **Flowers** have parts usually arranged in **fours** or **fives**.

Figure 1.15 Flower of a dicotyledonous plant (flax)

Progress check 1.4

1 Which chemical is found in the cell walls of fungi?

A cellulose
B chitin
C glycogen
D protein

2 An organism possesses xylem but never produces flowers. Which of the following will it be?

A a dicotyledon
B a fern
C a fungus
D a monocotyledon

3 An organism has three petals. Which of the following will it be?

A a dicotyledon
B a fern
C a fungus
D a monocotyledon

1.06 Dichotomous keys

Dichotomous means cutting (or dividing) into two.

Organisms are often identified using a book of illustrations. This is possible only if such a book is available, and this is the case only with certain organisms such as common plants, birds and butterflies. Even when such a book is available, identification will rely on the accuracy of the illustration, and it can be a time-consuming process if the organism is at the back of the book! For these reasons, biologists use dichotomous keys.

A dichotomous key consists of a series of questions. Each question has two alternative answers. Depending on which answer is chosen, the user is directed to the next question. Thus, by starting at the first question, and then by a process of elimination, a specimen may be identified.

This process is reliable because it directs the user to observe particular characteristic features. Also it is quicker since, at each question, possible alternatives are eliminated.

Dichotomous keys are usually presented in the following format. The example chosen is a key in its simplest form – namely to identify the kingdom into which an organism should be placed. More detailed keys are used when determining precisely to which species from many within the same genus an organism belongs.

1	Is it unicellular (i.e. made of only one cell)?	Yes	go to 2
		No	go to 3
2	Does it have a nucleus?	Yes	protoctist
		No	bacterium
3	Does it have hyphae?	Yes	fungus
		No	go to 4
4	Does it have cell walls?	Yes	plant
		No	animal

When identifying one organism from amongst a large number of possibilities, the most effective dichotomous key asks questions that each time divides the remaining possibilities into roughly equal halves. In this way, half the possible organisms are discarded at each step.

Progress check 1.5

1 Six different geometrical shapes, identified by the letters A to F are shown in Figure 1.16.

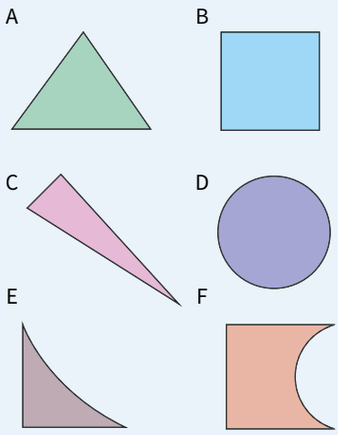

Figure 1.16

Construct a dichotomous key to identify the six shapes.

2 Now construct a key to identify the shapes using different features from those you have used already.

You should now find that several different keys may be constructed, all of which may be perfectly suitable for the purposes of identification.

Chapter summary

- ☐ You now know the characteristics of living organisms.
- ☐ You have learnt how to use the binomial system of naming organisms.
- ☐ You are able to list the five classes of vertebrate and know how to distinguish between them.
- ☐ You have learnt the differences between the microorganisms viruses and bacteria and how they differ from fungi.
- ☐ You are now able to write down the names and characteristics of the four phyla of invertebrates and the four classes of arthropods that are described.
- ☐ You have learnt the differences between the two classes of flowering plant.
- ☐ You have learnt how to use and also to construct a dichotomous key for identifying organisms.

Exam-style questions

1 Figure 1.17 shows six arthropods.

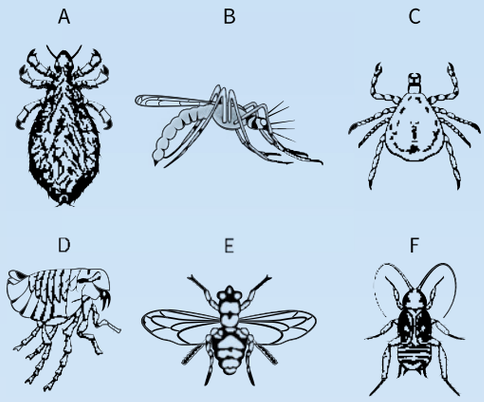

Figure 1.17

Use the key to identify each of the arthropods. Copy Table 1.1 and write the name of each arthropod in the correct box. As you work through the key, put a tick (✓) in the boxes to show how you identified each arthropod.

As an example, the appropriate boxes for arthropod A have been ticked for you.

Key

			Arthropod
1	a	segments on abdomen clearly visible	go to 3
	b	segments on abdomen not clearly visible	go to 2
2	a	3 pairs of legs	*Pediculus*
	b	4 pairs of legs	*Ornithodorus*
3	a	wings present	go to 4
	b	wings absent	*Pulex*
4	a	wings clearly longer than abdomen	*Musca*
	b	wings not clearly longer than abdomen	go to 5
5	a	antennae curved	*Periplaneta*
	b	antennae straight	*Anopheles*

	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	name of arthropod
A		✓	✓								*Pediculus*
B											
C											
D											
E											
F											

[10]

Table 1.1

2 Figure 1.18 shows a centipede.

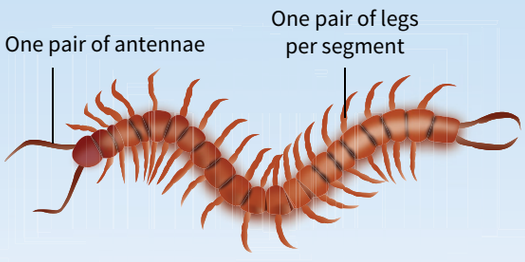

Figure 1.18

The centipede is a myriapod, one of the four groups of arthropod. It is a carnivore that lives on land and, compared with most other arthropods, its outer body covering is thin and permeable.

a Name **two** other groups of arthropod.

For each group, state one feature found only in arthropods of that group. [4]

b Suggest and explain two reasons why centipedes are often found under stones, decaying wood and leaves. [4]

3 a Explain the fact that viruses are almost always harmful to other organisms. [6]

b Describe how viruses differ structurally from bacteria. [5]