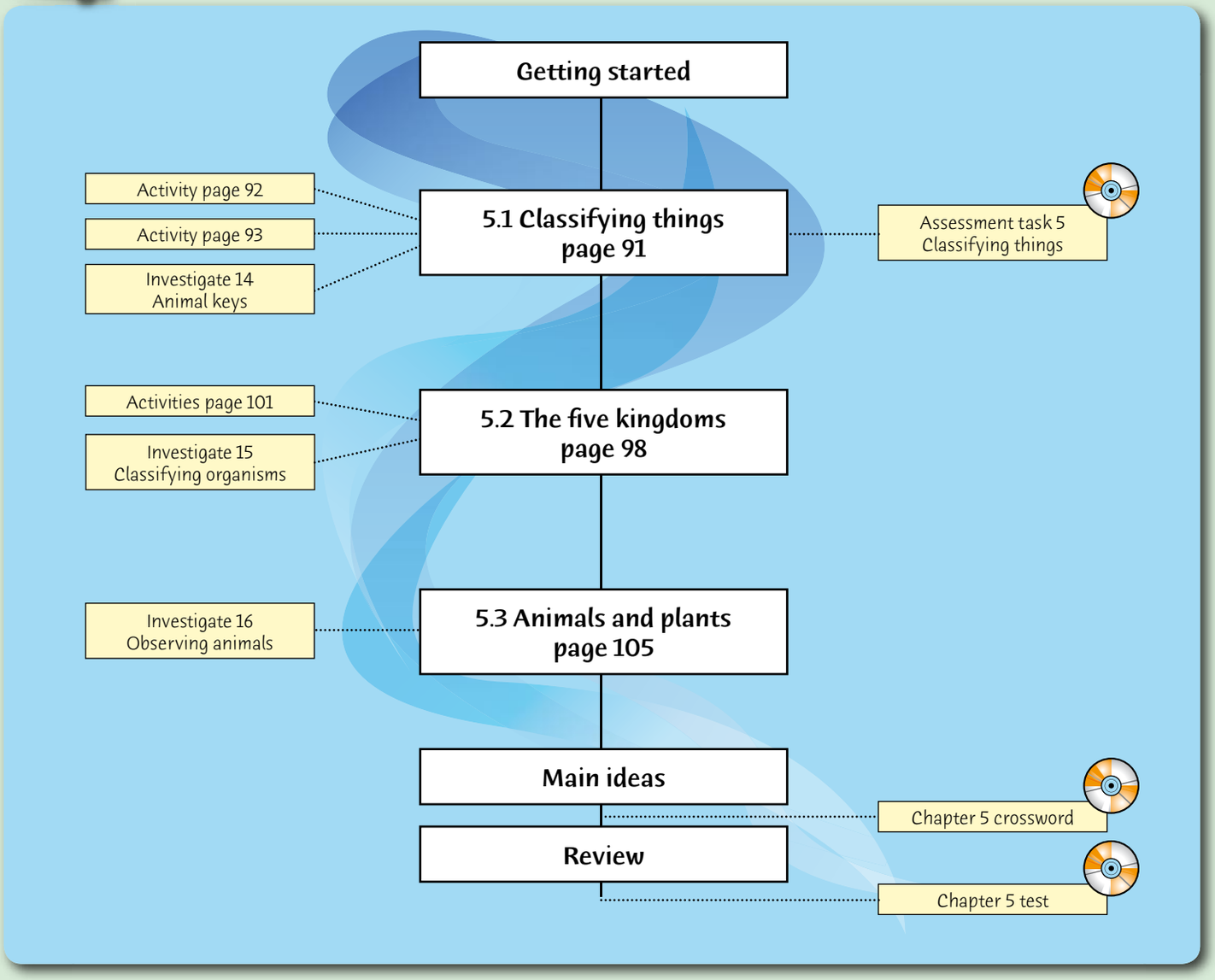
5 The living world

Planning page



Essential Learnings for Chapter 5

Essential Learnings	References		
	Student book (page number)	Workbook (page number)	Teacher Edition CD (Assessment task)
Knowledge and understanding *Life and living* Systems of scientific classification can be applied to living things (Year 7)	pages 91–111 Investigate 14 page 96 Investigate 15 page 103 Investigate 16 page 107	pages 38–41	Assessment task 5 Classification
Science as a human endeavour People from different cultures contribute to and shape the development of science	page 111		
Ways of working Communicate scientific ideas, explanations, conclusions, decisions and data, using scientific argument and terminology, in appropriate formats	pages 105–110 Investigate 15 page 103	pages 40–41	
Draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question		page 39 Exercise 5	

QSA *Science Essential Learnings by the end of Year 7*
QSA *Science Essential Learnings by the end of Year 9*

Vocabulary

arthropod
amphibian
biologists
characteristics
chlorophyll
classify
conifer
exoskeleton
function
fungi
kingdom
moneran
nutrients
parasite
photosynthesis
rhizome
structure
unicellular
vertebrate

Focus for learning

Sort organisms into groups (page 90).

Equipment (per group)

Investigate 14 page 96	about 20 different live or preserved animals, hand lens
Activities page 101	large field mushroom, bread mould, hand lens or microscope
Investigate 15 page 103	about 20 different numbered living things (representing all kingdoms if possible), hand lens
Investigate 16 page 107	fresh fish gills, leg of a cooked crab, dissecting board, scissors, probe and forceps, disposable gloves, freshly killed insect or spider, hand lens, stereomicroscope (optional), petri dish lid

5 The living world

Getting Started

Read through this list of living things:

frog, snake, pine tree, magpie, spider, fern, worm, mosquito, dolphin, bat, horse, rose, starfish, moss, gum tree, fish, lizard, chicken, seaweed, sugar glider, platypus

- Sort the organisms into three or four groups so that the organisms in each group have similar features.
- Which features did you use to group the organisms? Compare the way you grouped them with the way other people did.

Starting point

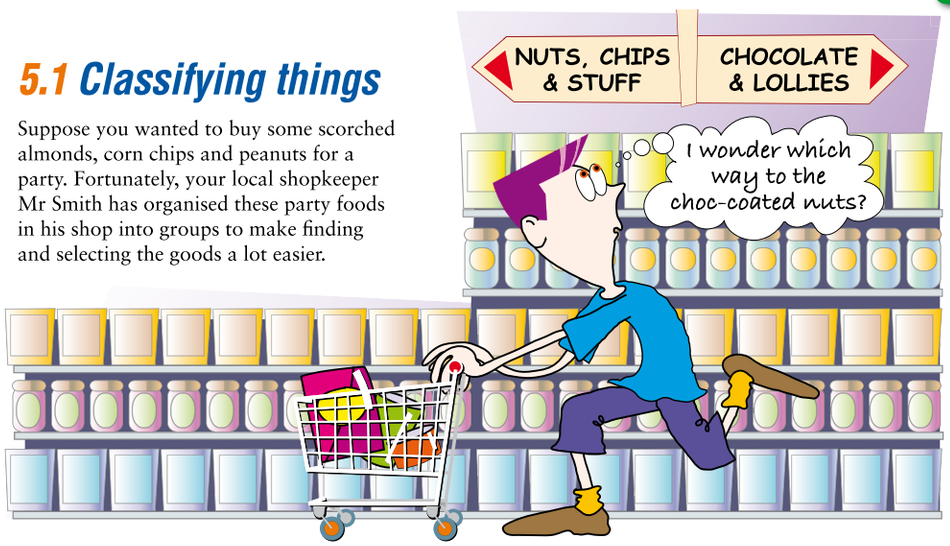
Concept maps, or mind maps, allow students to organise information into groups and subgroups, and to show the links between them. They also allow students to prepare for and understand what the chapter is about. This gives the students direction and builds their enthusiasm about what is ahead.

Design concept maps around the terms *living* and *non-living*. Ask students to describe what each term means. What characteristics determine if something is living or non-living?

Write the following question on the board: *What makes something living?* Generate a class discussion around the question. You may want to ask the class to brainstorm in small groups, giving them a time limit. Each group should then report back to the class with their definition. Collectively devise a single definition that you and the class are happy with.

5.1 Classifying things

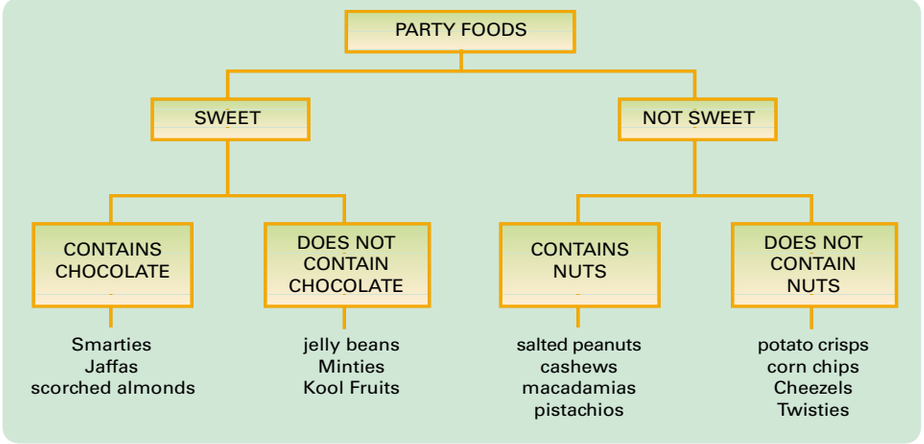
Suppose you wanted to buy some scorched almonds, corn chips and peanuts for a party. Fortunately, your local shopkeeper Mr Smith has organised these party foods in his shop into groups to make finding and selecting the goods a lot easier.



One group contains sweets that have chocolate in them—bars of plain chocolate, nut chocolate, caramel chocolate and many others. This group also contains chocolate-covered nuts and sultanas, as well as sweets that have chocolate centres, like Jaffas and Smarties.

Mr Smith uses certain *characteristics* or features of the confectionery to sort them into groups. This process is called **classification**. Each group contains items with similar features. The diagram below shows how Mr Smith classifies his party foods.

Classifying foods makes it easier to find goods in your local store or supermarket because you know that each group contains things with similar features.



Hints and tips

Classification is grouping together things with similar features. The first two groups in classifying matter are *living* and *non-living*.

Hints and tips

Using the information in the text, get the students to explain how living things can be classified. What features do they think are important? Allow students time to explore the idea fully. Can some characteristics be grouped together?

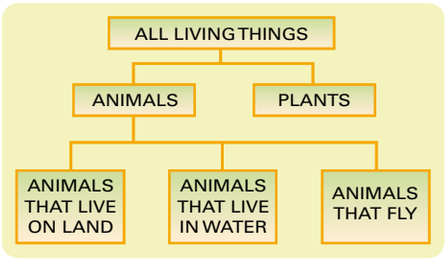
When you get to the list of characteristics of living things (page 93), the students can refer back to their work and see how many of the same characteristics they came up with.

Learning experience

In small groups, ask students to construct a list of characteristics that could be used to classify animals, foods, tools, equipment, people, countries and music.

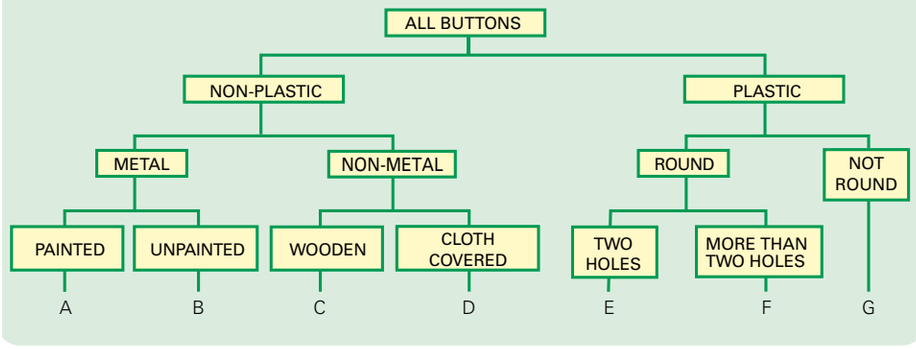
Then ask students to list reasons why these characteristics are important.

Like the items in Mr Smith's shop, the living things on this planet can be classified into groups. For example, the ancient Greeks used their observations to classify living things into two large groups—animals and plants. They further classified the animal group into three smaller groups, as shown below.



Using keys

Objects can be classified using a *key*. Mr Smith used a key to classify his party foods. The Greeks used a key to classify living things. By using a key you can easily classify objects or identify an unknown object, like the buttons in the key below. The best way to make a key is to have *two* alternatives for each characteristic. For example, in the key below, buttons are first classified into two groups—plastic and non-plastic. Each of those groups is then classified into two smaller groups, and so on.



Activity

1 Into which groups would you place the following food items using Mr Smith's method of classification.

jelly babies, Freddo Frog, Kool Mints, caramel popcorn, Burger Rings, M&Ms, butterscotch, Maltesers, jelly snakes, Mars bar, rice crackers, Crunchy bar, beer nuts, Cherry Ripe, nougat, licorice

Draw a key and add the foods to the appropriate group.

2 Use the ancient Greek method of classifying animals to place the animals in the list in Getting started on page 131 into their appropriate group.

Can you see any problems with this classification method? Explain with examples.

3 Work in a small group for this activity.

Your teacher will give you 10 or 12 assorted buttons.

Use the button key below or make up your own to classify the buttons so that each button is in a separate group.

If you have made up your own key, draw it on a large piece of paper and present it to the class.

Hints and tips

Students usually have no difficulty finding characteristics that can help separate items, but often they find the construction of the key difficult. To make this easier, ask students to write the name of the food items from Activity 1 on small cards. Students separate them into two subgroups and explain to their partners which characteristic they used to do this. They should continue to do this with each subgroup until all items have been classified. The key can then be copied into their notebooks.

Alternatively, place the cards on a large piece of butcher's paper and ask students to write the characteristics on the paper as they move the cards. Adding lines linking the cards will complete the key. Students can then transcribe the key into their books.

Students who are more visually inclined could draw symbols instead of writing the characteristics.

Learning experience

The students could collect five different leaves from outside and develop their own key. In pairs, they could test the key on their partner by giving them a leaf to identify.

Activity

Work in a group of three or four for this activity. Your task is to make a key which you can use to classify the people in your class into a number of different groups.

1 Look for characteristics where the differences are clear-cut, permanent and likely to be agreed upon by others.

2 Make sure there are two alternatives for each characteristic. For example, male and female, or can roll your tongue and cannot roll your tongue.

Here are some other characteristics that you may find useful.

- earlobe attached/unattached
- folds arms left over right/right over left
- freckles on nose/no freckles
- second toe longer/shorter than big toe
- light-coloured hair/dark hair
- blue eyes/not blue eyes

3 Make a draft copy of the key.

Compare your key with those made by other groups.

4 Test the key by classifying the people in your class. Modify your key if necessary and test it again.

What makes things living?

In Getting started you devised a way to classify about 20 living things. But how do you know something is living?

Look at the rock-like thing in the photo below. This thing is actually alive. It belongs in the same plant group as cactuses, and lives in very dry areas of Australia and other countries. This is called a *rock plant*.

There are seven characteristics used to tell whether a thing is living or not living.

Living things

- are able to move
- need oxygen
- need food or nutrients
- produce and eliminate wastes
- grow
- respond to changes
- reproduce

Biologists (scientists who study living things) know that rock plants are alive. They have all of the seven characteristics in the list above, even though some of the characteristics, such as their movement and their response to changes, are very hard to see!

Hints and tips

The *rock plant* or *living rock* in the photo belongs to the genus *Ariocarpus*. The specimen shown in the photo is native to desert areas in Texas, USA.

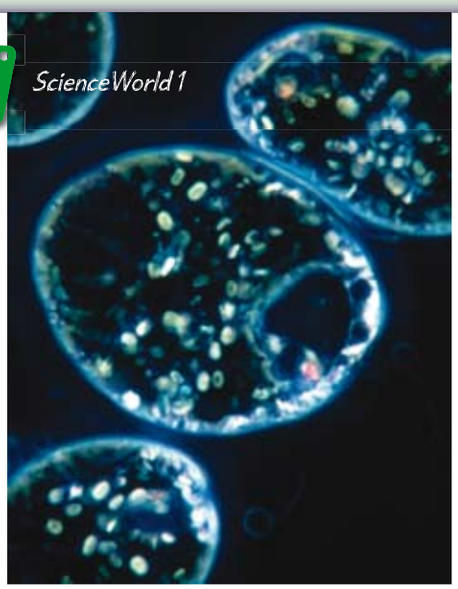
Learning experience

Hold up pictures of various living and non-living things, one at a time, and ask the class to say which group they belong to and why.

Learning experience

Play *Celebrity Head*, or in this case *Living or Non-living Head*.

Three students are selected to sit in front of their peers. The name of a living or non-living thing is written on a piece of paper and taped to a head band. The band is placed on the student's head. The three students in turn then ask yes/no questions in order to identify the object named on their band. The group may only respond with 'yes' or 'no', until ultimately the student is able to guess what is written on their headband. The first of the three students to guess correctly is the winner.



Any living thing is called an **organism**, regardless of whether it is the size of a massive blue whale that weighs 170 tonnes, or a microscopic Euglena (you-GLEEN-a) that weighs only a millionth of a gram.

The Euglena in the photo above consists of one cell. A **cell** is the basic unit of organisms, and all organisms are made of one or more cells. The Euglena is called a *unicellular* organism, while organisms made of many cells are called *multicellular* organisms.

A blue whale is made of billions of cells that have different shapes and functions. There are skin cells, liver cells, muscle cells, bone cells and so on.

Classifying living things

You may have found in the activities on the previous page that there are problems in classifying animals using the ancient Greek method. For example, animals that live in water include dolphins, starfish, fish, platypuses and frogs, but these five animals have little else in common. You could also use colour or size to classify these animals. However, there is so much variation in colour and size that this method would also prove unsatisfactory.

Over the last 200 years or so, biologists throughout the world have developed a better method of classifying living things. What characteristics do a dolphin, platypus, fish and frog have in common? One of these is the presence of bones, including a backbone. Animals that have backbones are called **vertebrates** (VER-te-brates). This is similar to the word *vertebra,* which is one of the bones in the backbone. Animals without backbones are commonly called **invertebrates**.

The presence of a backbone is part of an animal's *structure*. The use of structural characteristics is one way in which biologists classify organisms. The number of legs, the presence or absence of lungs or gills, feathers and a scaly skin are all structural characteristics.

The way an organism *functions* is also used to classify living things. For example, mammals and birds have a fairly constant body temperature, while all other animals have a body temperature that changes with the outside temperature. Body temperature is a functional characteristic.

The key on the next page can be used to classify animals.

Fig 5 A dolphin is a mammal and has a constant body temperature.

Hints and tips

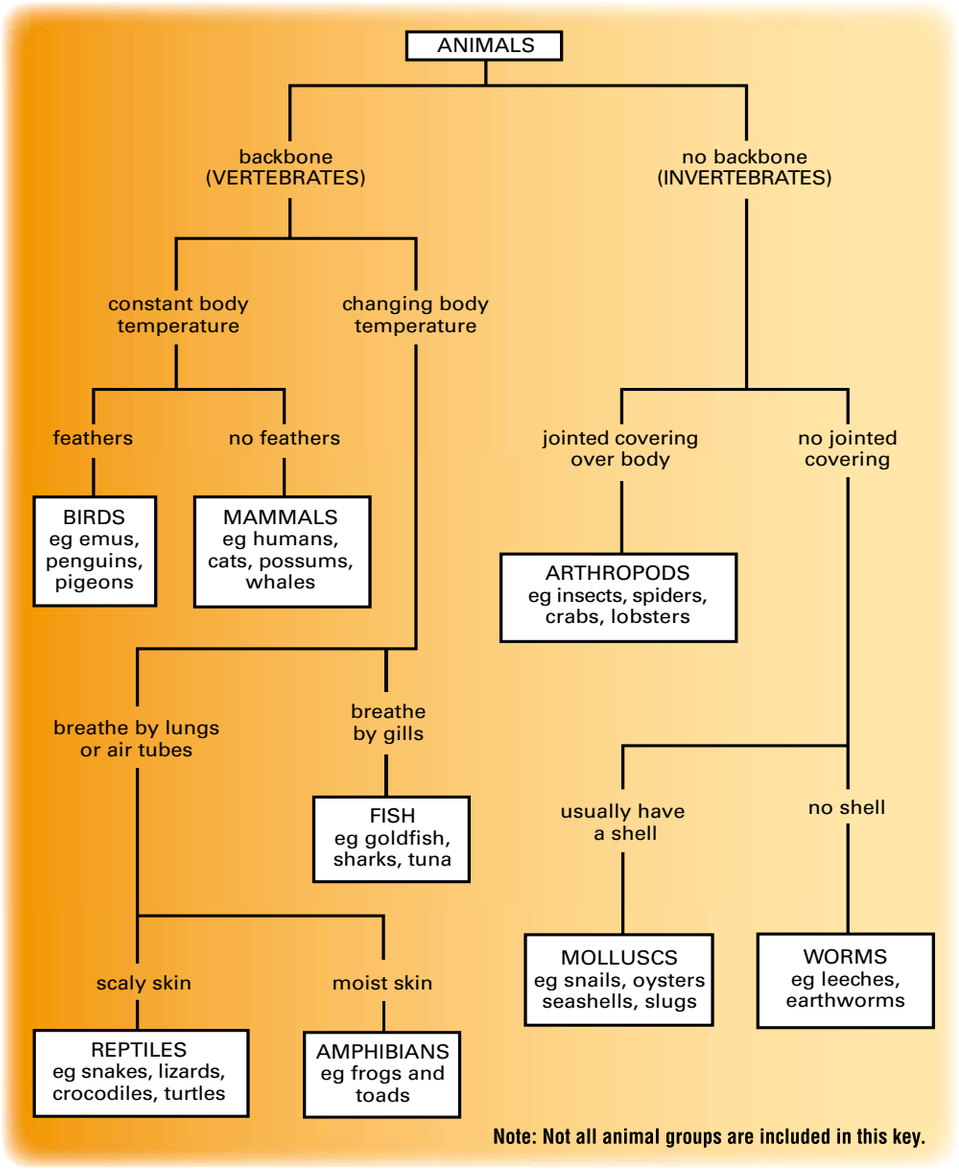
This unit contains many new words. Encourage the students to use the glossary at the end of the textbook or progressively write their own which can later be used as a revision tool.

Research

Ask students to research one animal that is an invertebrate and one that is a vertebrate, and present their findings in a poster or as a PowerPoint presentation. The student should find out why the animal is classified as it is and research its structural and behavioural features.

Learning experience

Try a '*What am I?*' quiz. Select a living thing and start reading out characteristics about 'you' and see which student is first to guess which living thing you are. The game can be further developed by asking the students to research a living thing and run their own '*What am I?*' quiz.



Note: Not all animal groups are included in this key.

Learning experience

Using old magazines, books and newspapers, have the class cut out and collect images of different animals. Working through the key on this page, classify these animals into their correct group. Allow each student to put an animal in the key and explain why they have placed it in that group.

Once this has been completed, students can work in groups to make a collage on cardboard to be displayed in the classroom.

Learning experience

Set up specimen jars around the room or on the front bench. The class can then practise using the key to identify the organisms in the jars. Students have great fun with this activity and it is very worthwhile.

Investigate 14 ANIMAL KEYS

Aim

To classify animals using a key.

Materials (per class)

- at least 20 different live or preserved animals, each with a number
- hand lens (optional)

Planning and Safety Check

- Work in pairs and read through the Method. Then design a data table for at least eight animals which you have to classify.
- Many of your animals will not be alive, so you will have to research some of the functional characteristics of these animals or rely on your general knowledge of them before you can classify them fully.

Method

1 You have to classify at least eight animals. Choose one animal and work through the animal key on the previous page.
Discuss the animal's characteristics with your partner and then classify it.
Record the name or number of the animal and the group in which you have classified it.

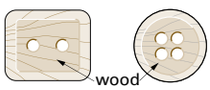
2 Use the key to describe the animal. For example, SPECIMEN 2—REPTILE (lizard) has a backbone, changing body temperature, breathes by lungs and has a scaly skin.

3 Repeat Steps 1 and 2 for each of the other animals.
Record all your observations and descriptions. Be prepared to discuss your results with other members of the class.

Check!

1 Each group below contains one item which has different characteristics from the other three. Choose the odd one out and give a reason for your choice.
- **a** iron, steel, copper, plastic
- **b** shirt, tablecloth, socks, skirt
- **c** pencil, felt pen, rubber, crayon
- **d** surfboard, skateboard, bicycle, rollerblades

2 Copy and complete the following sentences.
- **a** The process of sorting things into groups with similar characteristics is called _____.
- **b** Animals with backbones are called _____.
- **c** Animals are classified using _____ and _____ characteristics.
- **d** Living things are called _____ .
- **e** Living things can be classified using a diagram called a _____ .
- **f** There are _____ characteristics used to tell a thing is living or non-living.

3 Use the button key on page 92 to answer the following.
- **a** Describe all the buttons in group E.
- **b** Into which group would you place a painted metal button?
- **c** Into which group(s) would you place these two buttons?


How would you change the key to classify them?
- **d** Describe the differences between the buttons in groups A and D. In which ways are they similar?

4 Classify the objects in each of the lists below into two groups, and write down the characteristics you used to classify them.
- **a** apple, pear, capsicum, banana, tomato
- **b** brown snake, sea snake, turtle, tree snake, lizard, python, goanna
- **c** surfboard, sailboard, canoe, skateboard, dinghy, surf ski, catamaran

Lab notes

- For this investigation, it is better for students to work with a partner rather than in small groups.
- Number specimens, as this allows for easier identification.
- Set up the specimens around the room and allow a set time for students to record their observations about each specimen.
- At the end of the lesson, students can explain how they classified the organisms. There may be students who do not agree with the methods of classification, and this can lead to fruitful discussion.

Assessment task

This would be a good time to set Assessment task 5: Classification, found on the CD.

Check! solutions

1 These are the suggested differences. Students may be able to think of others.
- **a** **Plastic** is the only non-metallic material.
- **b** A **tablecloth** is the only article which is not normally worn as clothing.
- **c** A **rubber** is not usually used for making marks on paper, in fact quite the opposite.
- **d** A **surfboard** is the only piece of equipment which does not have wheels.

2
- **a** The process of sorting things into groups with similar characteristics is called **classification**.
- **b** Animals with backbones are called **vertebrates**.
- **c** Animals are classified using **structural** and **functional** characteristics.
- **d** Living things are called **organisms**.
- **e** Living things can be classified using a diagram called a **key**.
- **f** There are **seven** characteristics used to tell if a thing is living or non-living.

3
- **a** All the buttons in group E have two holes, are round and are made of plastic.
- **b** This button would go into group A.
- **c** These buttons would go into group C. In order to distinguish them you could make further choices about their shape, ie round or square.
- **d** The differences between buttons in groups A and D are whether they are metal or non-metal and whether they are painted or covered with cloth. Their similarity is that they are all non-plastic.

4 There will obviously be different ways of classifying, but here are some suggestions:
- **a** The capsicum and tomato may have air spaces inside, whereas the others do not.
- **b** The snakes do not have any legs, whereas the turtle, lizard and goanna do.
- **c** The sailboard, dinghy and catamaran have sails, whereas the others do not.

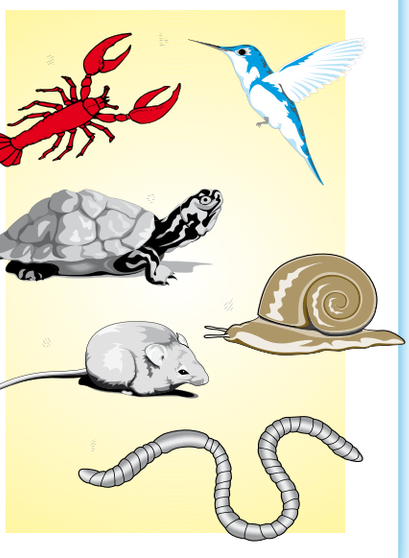
5 The list of characteristics below could be used to classify organisms.
- feeds its young with milk
- has two large eyes on the front of its head
- changes body colour and pattern with different backgrounds
- has two large canine teeth in each jaw
- squirts out black ink when disturbed
- hibernates during very cold weather

For each characteristic, decide whether it is structural or functional and make two lists. For those characteristics that you are uncertain about, list them under the heading 'uncertain'. Discuss your decisions with your partners.

6 Why do biologists use body structure and function instead of size, colour or behaviour when classifying animals?

7 List the seven characteristics used to decide whether something is living or non-living. (The order is not important.)

8 Use the key on page 95 to describe the characteristics of each of the animals below.



9 Use the animal key to name the group to which each of the following animals belong.
- **a** This animal has no backbone and has a soft body with a shell.
- **b** This animal has a backbone, a changing body temperature and gills.
- **c** This animal has a hard, jointed covering over its body and no backbone.
- **d** This animal is a vertebrate with a constant body temperature and feathers.

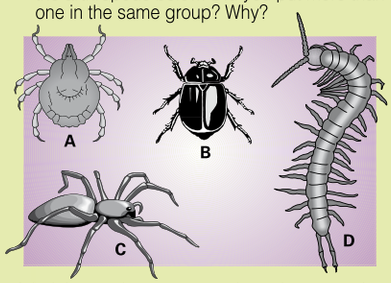
10 Write a sentence using the word 'multicellular' so that a reader will know what the word means. Give examples of multicellular organisms.

11 In which ways are birds and mammals similar? In which ways are they different?

12 How can you tell a reptile from an amphibian, and a fish from an amphibian?

challenge

1 Look at the arthropods below.
- **a** Use the animal key on page 95 to describe the features of arthropods.
- **b** Design a key that could be used to classify the arthropods below. Did you put more than one in the same group? Why?



2 A fruit bat and a parrot are about the same size, they both have wings and fly, and both eat the same sorts of foods. Suggest why biologists classify them in different groups.

3 Not all animal groups are shown in the key on page 95. For example, the groups to which starfish and jellyfish belong are not shown. Use the library or the internet to find out the names of these two groups and the characteristics of the animals in these groups.

Challenge solutions

1 **a** All arthropods have a jointed body covering and no backbone.
b Your key should use the different structures such as the number of body segments, the number of legs and the presence of feelers on the head. The spider and the mite could be in the same group.

2 Biologists classify them into different groups because the parrot has feathers and lays eggs whereas the bat has fur and gives birth to live young.

3 Starfish belong to a group called *echinoderms*, which also includes sea-eggs. Jellyfish belong to a group called *coelenterates*.

5 Structural characteristics:
- has two large eyes on the front of its head
- has two large canine teeth in each jaw.

Functional characteristics:
- feeds its young with milk
- changes body colour and pattern with different backgrounds
- squirts out black ink when disturbed
- females are fertilised internally and give birth to live young
- hibernates during very cold weather.

6 Biologists use structure and function because behaviour and other features like size and colour can change quite a bit depending on age and habitat.

7 The seven characteristics of living things are:
- being able to move
- needing oxygen
- needing food or nutrients
- producing and eliminating wastes
- growing
- responding to changes
- reproducing.

8 The lobster has a jointed covering over its body and has no backbone. The humming bird has feathers, a constant body temperature and a backbone. The tortoise has scaly skin, lungs to breathe air, a changing body temperature and a backbone. The snail has a shell, no jointed covering and no backbone. The mouse does not have feathers but does have a constant body temperature and a backbone. The worm has no shell, jointed covering or backbone.

9 Using the key on page 95:
- **a** mollusc
- **b** fish
- **c** arthropod
- **d** bird

10 'Multicellular' means 'made of many cells'. Organisms such as earthworms, trees and humans are multicellular.

11 Birds and mammals are similar because they both have a backbone and a constant body temperature. They are different because birds have feathers but mammals usually have hair.

12 The best way to tell a reptile from an amphibian is from the body covering. The best way to tell a fish from an amphibian is that fish have gills and amphibians have lungs.

5.2 The five kingdoms

Until the beginning of last century, biologists classified all living things into two groups—animals and plants. These large groups are called **kingdoms**.

When bacteria (microscopic organisms) were first observed and identified, biologists did not know which kingdom to put them in because they had features that were quite different from microscopic plants and animals. Some biologists began using a three-kingdom system of classification. Bacteria were grouped with microscopic plants and animals, and these were placed in the third kingdom.

However, with the invention of very powerful microscopes and new scientific techniques, other important differences between organisms in these three kingdoms were identified. It became obvious that the three-kingdom system was not a satisfactory method of classification. Most biologists throughout the world now recognise *five* kingdoms.

Fungi were originally placed in the plant kingdom. But fungi cannot make their own food like plants. Because of this important difference they were placed in a kingdom of their own.

The five kingdoms

Hints and tips

What makes each of the five kingdoms different? Which features are similar? Discuss these questions with the class. Have a list of some organisms which fit into each of the kingdoms. You may like to have photos of them and ask the class to help decide which kingdom they belong to.

Learning experience

The information on this page may lead to a discussion on the way ideas, hypotheses and facts in science have changed over time, and how ideas in science change with new technologies and discoveries.

An interesting 2.5 minute video clip on animal and plant classification can be found at <www.britannica.com/eb/art-83541>.

Animals

The organisms in the animal kingdom eat other organisms to obtain energy and materials for growth and movement. There are many different types of animals, but they are all multicellular organisms. Some live on land, others live in the sea or in fresh water, and others can fly.

All large land animals are vertebrates. The system of bones in these animals gives support and allows them to live on land successfully. The largest vertebrate that has ever lived on Earth is thought to be the blue whale. It can measure up to 35 metres in length and weigh 170 tonnes! The water of the ocean helps support its huge weight.

Plants

These multicellular organisms contain the green pigment **chlorophyll** (KLOR-oh-fill). This substance is able to absorb the energy from sunlight. The plants use this energy to make food, in the form of sugars, from carbon dioxide and water, and give off oxygen. This process is called **photosynthesis** (foe-toe-SIN-the-sis). The word is made up from the words *photo*, meaning 'light', and *synthesis*, meaning to 'make'.

PHOTOSYNTHESIS

carbon dioxide + water $\xrightarrow{\text{energy}}$ sugars + oxygen

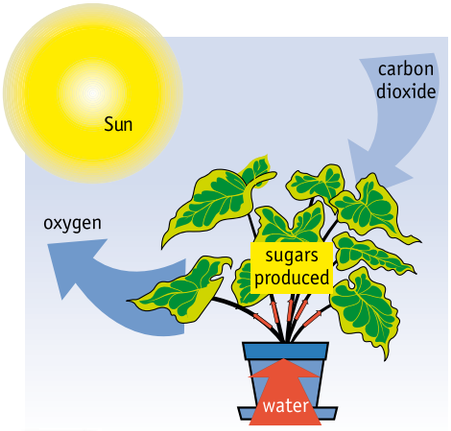


Fig 12 Photosynthesis occurs when sunlight is absorbed by the green chlorophyll in plants.

Plants cover much of the surface of the Earth. They vary in size from very small mosses a few millimetres wide to the largest living thing—the mountain ash of southern Australia, which grows to over 100 metres in height. The plant kingdom also contains the *oldest* living organism—King's Iomatia, which is found in the rainforests of Tasmania and is thought to be 43 000 years old.

The plant kingdom is divided into four groups —mosses, ferns, conifers and flowering plants.

Fig 13 King's Iomatia

Learning experience: test for starch

Starch is a complex sugar found mainly in the roots or bulbs of plants. Via photosynthesis, plants make sugar. This sugar moves to the roots and is stored as starch until needed. Hence, vegetables that tend to grow under the ground, such as potatoes and onions, tend to be rich in starch. Iodine solution turns from golden brown to blue–black in the presence of starch.

Test various fruits and vegetables for the presence of starch by cutting up small pieces and adding a few drops of iodine to each. Observe the colour change.

Fungi

The organisms in this kingdom include mushrooms, toadstools, bread mould and yeasts. They are similar to plants in that they are generally fixed to the ground and do not move around.

Fungi do not contain chlorophyll, so they cannot make their own food. Therefore, they have to obtain nutrients from other sources. They do this by growing on things they can use as a source of nutrients, such as dead plants or animals. Chemicals released from fungi break down the remains of the plant or animal into simpler substances that can easily be absorbed by the fungi.

Fungi reproduce by **spores**. These are made in caps or bulbs that stick up from the rest of the fungus. For example, in a mushroom, the dark-coloured gills under the cap are the organs that make spores. The rest of the mushroom grows on or under the ground (see Fig 14 below).

Spores are tiny cells with a hard coat around them to stop them from drying out. They are very light and are easily carried on the wind. A single mushroom can produce up to 2000 million spores!

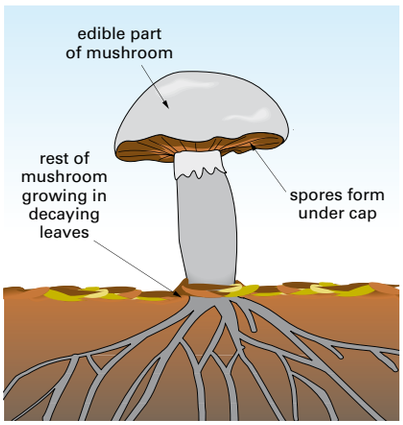


Fig 14 The edible part of a mushroom is where the spores are made. The rest of the fungus grows in the material it breaks down for food.

Helpful and harmful fungi

Fungi are very important organisms because many of them break down or decompose dead organisms. These fungi are called decomposers.

Fungi such as mushrooms can be eaten, and yeasts are used for making bread, beer and wines. Other fungi are used to make medicines such as antibiotics.

Some fungi grow on living things and are called *parasites*. They obtain all their nutrients for growth from the organism they grow on. For example, ringworm is a fungus that grows on human skin. It takes its food from the cells in the skin and makes the skin itchy, inflamed and sore. Powdery mildew is a fungus that grows on leaves, and it may eventually kill the plant.

Fig 15 The fungi growing on these oranges will decompose them until very little remains.

Fig 16 Powdery mildew is a parasitic fungus that grows on the leaves of some plants.

Learning experience

Allow some fruit (citrus fruits are good) or a slice of bread to become mouldy. Get the students to observe the mould under a microscope. Students should wash their hands afterwards if they touch the mould.

Slice some mushrooms in half and ask the students to draw a diagram labelling each part.

Learning experience: growing mushrooms

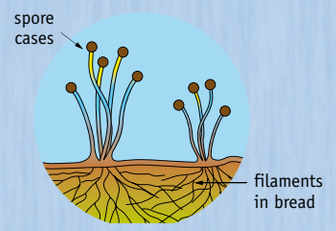
Mushrooms are cheap and very hardy, making them very easy to grow. Mushroom kits can be obtained from nurseries or hardware stores that have a plant nursery section. Allow groups to be responsible for the growth of their mushrooms. Once the mushrooms have grown, students can observe them under the microscope.

Activities

For these activities you will need a large, flat, field mushroom, some bread mould and a hand lens or microscope.

1 To grow bread mould, moisten some stale bread and leave it in an open container for a day. Then cover the container and leave it in a warm place for a few days.

Place a small piece of bread mould on a slide. Use a hand lens or microscope to observe the thread-like filaments of the mould and the round spore cases.



2 Observe the dark gills on the underside of the mushroom cap. To collect the spores, tap the cap over a piece of white paper. You may need a hand lens or microscope to observe the spores.

WEBwatch

Go to www.scienceworld.net.au and follow the links to the websites below.

Fun facts about fungi

Interesting and easy-to-read site with information on types of fungi, examples and photos.

Fungi of Australia

A very informative site that covers types of Australian fungi, uses of fungi including Aboriginal uses, and information about interesting examples of fungi.

Protists

The **Protist** kingdom includes organisms that have a very simple structure. Most of them are unicellular and most live in water—either fresh water or sea water. Algae (singular: *alga*) are included in this group. Many types of algae are unicellular, but some, like the seaweeds you see at the beach, are multicellular.

Like plants, algae contain chlorophyll and can photosynthesise. However, algae are classified as protists because they have a much simpler structure than plants—they have no roots, stems or leaves.

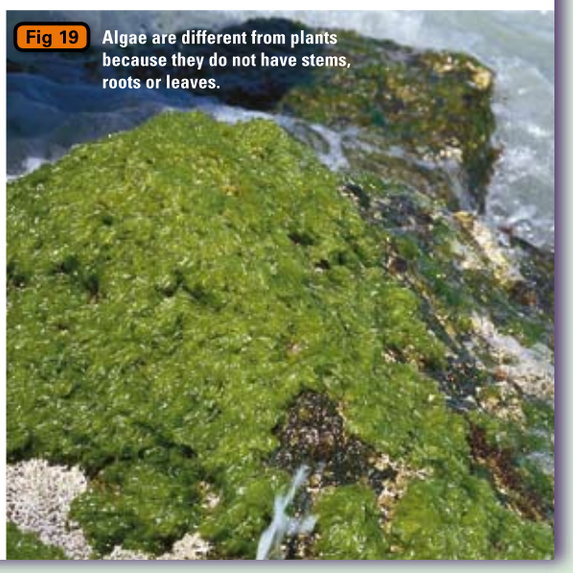


Fig 19 Algae are different from plants because they do not have stems, roots or leaves.

Hints and tips

Bring in some articles on environmental issues concerning algae (eg blue–green algae in our waterways). Make sure the articles contain information about why the algae are harmful, how they reproduce, what environments they live in and how they are treated.

Hints and tips

There are many commercial videos or DVDs that can interest students and give them a visual stimulus for this section (Protist and Monera kingdoms). Check your school library for resources.

Learning experience

Examine algae and other protists under the microscope.

Monerans

The organisms in the kingdom **Monera** (MON-er-a) have the simplest cell structure of all living things. They are all microscopic, unicellular and have a very simple cell structure. They include bacteria and blue-green algae. Organisms in this kingdom are called *monerans*. (Note: Blue-green algae are different from green algae which belong to the Protist kingdom.)

Bacteria are very important because many of them break down dead animals and plants. Some bacteria cause diseases in animals and plants; for example, tetanus and tuberculosis. Other bacteria are used to make cheese, yoghurt and antibiotics. Many of the differences between the organisms in the five kingdoms can be seen in the structure of their cells.

Fig 20 These rod-shaped bacteria, magnified 20 000 times, are found in the wastes of animals including humans.

science bits

All cells are held together by a structure called a cell membrane. Plant cells have a firm cell wall around the cell membrane, whereas animals have no cell wall. These cell walls are made from *cellulose*. Fungi also have cellulose cell walls, but the cells do not contain chlorophyll as plant cells do.

The table below shows the characteristics of the cells in each of the five kingdoms.

- Use the information in the table to design a key that can be used to classify the cells of organisms from the five kingdoms.
- You observe a unicellular organism that has chlorophyll and no cellulose in its cell wall. What problems would you have in classifying it?

Animals	Plants	Fungi	Protists	Monerans
Multicellular	Multicellular	Multicellular	Mostly unicellular	Unicellular
No cell wall	Cellulose cell wall	Cellulose cell wall	Some have a cellulose cell wall	No cellulose in cell wall
No chlorophyll	Have chlorophyll	No chlorophyll	Some have chlorophyll	Some have chlorophyll

Hints and tips

It is useful to explain to the class how bacteria can be spread. Discourage students from sharing drink bottles and discuss personal hygiene.

Homework

Ask students to list products in the house that are used to kill bacteria. Ask them to list the things their family does to prevent the spread of bacteria around the home. Determine the places in the house and at school where bacteria would be found in greatest numbers.

Learning experience

Have some prepared agar plates for the students to grow bacteria. Group members should touch a plate after wiping their fingers on different surfaces around the room. The covered plates should be carefully labelled and placed in a safe, warm position. Check on the plates in a few days. You may be horrified to see what is growing!

One very effective way to stop students sharing drinking bottles or lip gloss is for a class member to kiss a clean plate. When they see what can be passed on from one person to another it soon deters them from sharing. Take care, however, to dispose of the plates safely.

science bits

Viruses—are they alive?

Viruses are extremely small (much smaller than bacteria) and are not made of cells. Viruses have features of both living and non-living things. For example, they can form crystals like non-living matter, but they reproduce like other living things.

Viruses are completely parasitic because they rely on another organism (called the host) for all their requirements. They can reproduce only inside another organism, where they invade the organism's cells and use the cell materials to make new viruses. In this process, some of the cells are often destroyed, making the organism sick or causing its death. Human diseases caused by viruses include influenza, mumps and AIDS (HIV).

WEBwatch

To find out more about the virus that causes AIDS go to www.scienceworld.net.au and follow the links to **The AIDS virus**.

Investigate

15 CLASSIFYING ORGANISMS

Aim

To classify various organisms into kingdoms.

Materials (per class)

- about 20 stations around the laboratory each containing a numbered specimen or photo
- hand lenses or stereomicroscope

Planning and Safety Check

- Do not remove from its container any specimen that has been preserved in formalin. This substance is harmful to the skin and has harmful vapours.
- Read through the Method and draw up a data table for your results.
- To observe some of the specimens you will need a hand lens or stereomicroscope.

Method

1 There will be a living or preserved organism, or a photo of one at each station. For each one, record its number and observations about its structure, size, colour and any other features that may help you classify it.

2 Observe at least 10 organisms. Then work in a group to classify the organisms into kingdoms, using the information on pages 98–102.

Discussion

1 Your group may be asked to present your results for 2 or 3 selected specimens to the class. For each specimen, give its number, its kingdom and the reasons why you placed it in this group.

2 Make a list of the kingdoms represented in this investigation and the special characteristics of the organisms in each.

Lab notes

- Set up for this investigation as for Investigate 14 on page 96.
- Use interesting samples such as agar plates with bacteria, bread mould, plankton, seaweed, sponges, coral etc.
- Students may need help to construct a data table and to classify these organisms. It is recommended that students pencil in their choices first and check them in a group discussion.

Research

Students could research a virus that affects humans. Ask them to explain how it enters the body and what happens once it enters. They should also explain why some people are more susceptible to the virus than others.

Check!

1 Explain what each of the following words means by writing a sentence to show its meaning. Then check your explanation with the one in the text or in the glossary.

photosynthesis	vertebrate
decomposer	parasite
kingdom	spores

2 Copy and complete the following sentences.
- **a** The green substance _____ absorbs the energy of sunlight and uses it in the process of _____.
- **b** Bacteria are classified as _____ because they have a very simple _____ structure.
- **c** Fungi do not contain _____ therefore they rely on other organisms for _____.
- **d** The kingdom Monera contains _____ and _____.
- **e** Seaweeds are a type of _____ which belong in the _____ kingdom.
- **f** Spores are very tiny _____.

3 Use the list below to match each organism to its description.

animals	fungi	algae
bacteria	protists	plants

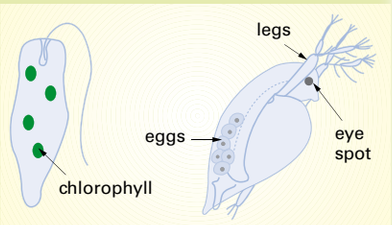
- **a** The organisms which belong to this kingdom are mostly unicellular.
- **b** These organisms are multicellular and contain chlorophyll.
- **c** These organisms are plant-like but do not contain chlorophyll.
- **d** These organisms are very small and have a very simple structure.
- **e** The organisms in this kingdom are multicellular and eat other organisms for food.
- **f** These organisms contain chlorophyll but do not have the structures common to plants.

4 Fungi are often called decomposers.
- **a** Why is this? What other organisms could also be called decomposers?
- **b** Is there a difference between a decomposer and a parasite? Explain your answer.

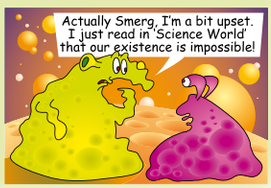
5 The photo below shows an organism growing on a dead tree. To which kingdom do you think this organism belongs? Give reasons for your answer.

challenge

1 Below are two organisms; one is classified as a protist and the other as an animal.
- **a** Both organisms are microscopic but one is five times larger than the other. Which one is smaller? Suggest why.
- **b** Suggest why they are placed in two separate kingdoms.
- **c** Suggest how the protist is able to move.



2 In a science fiction story, organisms called blobs have the characteristics of protist organisms but are as large as a car or a house. Suggest why protist-like organisms could not be this size in real life.



Check! solutions

1
- Photosynthesis is the process in which plants are able to use energy from the Sun to make their own food.
- A vertebrate is an animal with bones in its body and particularly a backbone.
- A decomposer is an organism which is able to break down and recycle dead material.
- A parasite is an organism which lives in or on another organism.
- A kingdom is a major group of living things which are similar to each other.
- Spores are very tiny structures which help some plants such as fungi, ferns and mosses to reproduce.

2
- **a** The green substance **chlorophyll** absorbs the energy of sunlight and uses it in the process of **photosynthesis**.
- **b** Bacteria are classified as **monerans** because they have a very simple **cell** structure.
- **c** Fungi do not contain **chlorophyll** therefore they rely on other organisms for **food**.
- **d** The kingdom Monera contains **bacteria** and **blue–green algae**.
- **e** Seaweeds are a type of **algae** which belong in the **Protist** kingdom.
- **f** Spores are very tiny **cells**.

3 The correct matches are as follows:
- **a** protists
- **b** plants
- **c** fungi
- **d** bacteria
- **e** animals
- **f** algae

4
- **a** Fungi are often called decomposers because they break down dead materials and recycle these materials, usually in the soil. Other organisms which can also be called decomposers are the Monerans, especially bacteria, because they also break down dead materials.
- **b** A parasite is an animal which lives in or on another living thing, whereas a decomposer lives in and on dead organisms.

5 The organism shown growing on the dead tree is a fungus. The reasons for this suggestion are that it does not appear to have roots or leaves and is growing on a dead organism.

Challenge solutions

1 After referring to the diagram:
- **a** The organism on the left is unicellular. The organism on the right has different types of cells in its body (eyespot, legs, eggs), so it is multicellular and therefore likely to be bigger.
- **b** The main reason that these two organisms are placed in different kingdoms is that the one on the left consists of only one cell whereas the one on the right is multicellular.
- **c** It is likely that this protist is able to move by flicking the long, thread-like 'flagellum' around.

2 There are several very good reasons why large organisms consist of many cells rather than one cell. The main reason is that small cells have relatively more membrane which allows food and other nutrients to pass into the cell more easily. With a large cell, food and oxygen cannot pass into the middle of the cell quickly enough for the cell to survive.

When an organism consists of many cells it is possible for the cells to be different and specialised to perform special functions. In our bodies, for example, some cells are for movement (muscles), some for thinking (brain) and some for supporting our body (bones).

5.3 Animals and plants

The animal and plant kingdoms contain the organisms that are most familiar to you. If you were asked to name a type of organism, it is likely you would name an animal or a plant.

The animal kingdom

On page 95 you saw in the key how animals can be divided into two large groups—the vertebrates and the invertebrates. Of these, the invertebrates contain many more types of animals than the vertebrates. There are about 950 000 different types of animals on Earth. Of these, about 800 000 are arthropods!

Fig 25 A lobster is an arthropod. Its exoskeleton supports and protects its body.

Arthropods are invertebrate animals with a jointed body-covering that supports and protects their bodies. This covering is called an **exoskeleton** (*exo* means *out*) because it is on the outside of the arthropod's body.

Most arthropods are *insects*. Members of this group of arthropods have six legs and three distinct body segments—a head, thorax and abdomen. *Arachnids* belong to another group of arthropods that includes spiders and ticks. These animals have eight legs and only two distinct body segments. Crabs, prawns and lobsters are called *crustaceans* and breathe through gills. Most crustaceans live in water.

The second largest group of animals is the **molluscs.** Most of the animals in this group have shells; for example, snails and oysters. Molluscs live in water (both sea water and fresh water) or in moist surroundings. This is because they take in oxygen through a delicate membrane underneath their shells which has to be kept moist. When conditions are dry, many molluscs can withdraw their bodies into their shells. They seal the opening and can stay like this for long periods of time until water is again available.

Some molluscs have no shell (eg slugs and octopuses) or a small internal shell (eg squid and cuttlefish).

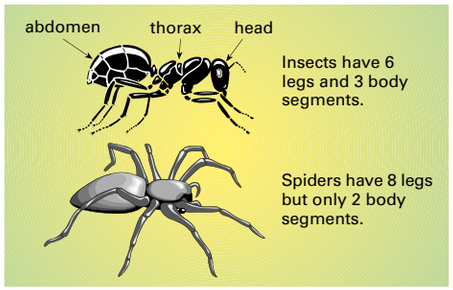


Fig 26 The differences between insects and spiders

Fig 27 Molluscs, such as these periwinkles, move by sliding over the ground on a film of mucus.

The vertebrate animals are those with an internal skeleton or endoskeleton. Biologists have classified these animals into five groups. There are photos and descriptions of them on the next page.

Hints and tips

Prepare some flash cards with the new words students have learnt so far, including words on this page. At the start of the lesson, test them to see what they can remember. Revise the words they have trouble remembering.

Learning experience

Arrange students into groups of four. Allocate each group an arthropod or mollusc to research and present to the class. Ask the groups to find interesting and intriguing facts about their organism.

Allow students to allocate the following roles to their members:

- Builder: Their job is to construct a model of the organism or its environment.
- Reporter: They will present information about the organism to the class.
- Two biologists: They will research the animal's structural and behavioural characteristics.

The vertebrates

Fish The animals in this group live in water and breathe the oxygen dissolved in the water through gills. Fish have a changing body temperature (they are incorrectly called cold-blooded). Most fish lay their eggs in the water and the young hatch outside the mother's body. Sharks and rays are fish but have a skeleton made from cartilage instead of bone.

Amphibians These animals have a moist skin and include frogs, toads and salamanders. Their eggs have no protective covering and are laid in water. The larvae of amphibians live in water and breathe through gills, while the adults live on land and breathe through lungs. These animals have a changing body temperature.

Mammals These animals have a constant body temperature and usually have hair or fur that keeps them warm in cold weather. They breathe air through lungs. Most mammals give birth to live young and feed them on milk. Humans are mammals.

Reptiles These animals have a dry, scaly skin and a changing body temperature. Turtles, snakes, lizards and crocodiles belong to this group. They all lay eggs with a tough, flexible covering, and all breathe air through lungs.

Birds All the animals in this group have a constant body temperature (they are warm-blooded). They have feathers and breathe air through lungs. They lay eggs with a hard outer shell.

Hints and tips

This topic can be very tactile. Be sure not only to display specimens but also to allow students the opportunity to touch them. You may like to have some sea sponges, snake skins, shells, feathers or stuffed mammals out on display.

Research

Ask students to research the subgroups in each of the vertebrate groups, eg mammals are divided into monotreme, marsupial and placental organisms.

Learning experience

Set up aquariums in the classroom or purchase a pet mouse and cage and allow the class to take responsibility for these animals. Each week, allocate a group to be responsible for feeding the mouse or fish and for the cleaning of their cage or aquarium.

Often students are unable to keep pets at home; this will allow these students to experience the responsibilities associated with having a pet. Run a competition for the best name for the pet, as they do at zoos.

Learning experience

Write a list of vertebrate organisms on the board and ask students to draw up a classification table based on their physical features that would separate them into fish, bird, amphibian, reptile and mammal groups.

Investigate

16 OBSERVING ANIMALS

Aim

To observe the features of animals that belong to different groups.

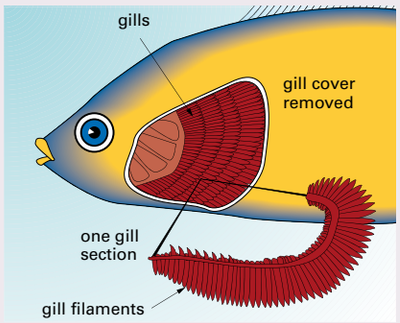
Materials

- a freshly-killed fish, preferably with gills (from the fish markets or a fish shop)
- part of a cooked crab, eg a leg or claw
- dissecting board or dish
- dissecting scissors, probe and forceps
- disposable gloves
- an insect and a spider (either freshly killed, preserved or a good photo) for Part C
- hand lens
- stereomicroscope (optional)
- glass dish, eg petri dish

PART A
Observing a fish

1 Observe the outside of the fish.
Sketch the shape of the fish and label the various structures that help it live successfully in water.

2 Look inside the fish's mouth and observe the gills. Then open the gill covers on the outside behind the head.
What do you think is the function of the gill covers? Suggest why fish open and close their gill covers when they swim.



3 Use scissors to cut one gill section from the fish. Use the hand lens (or stereomicroscope) to observe the gills.

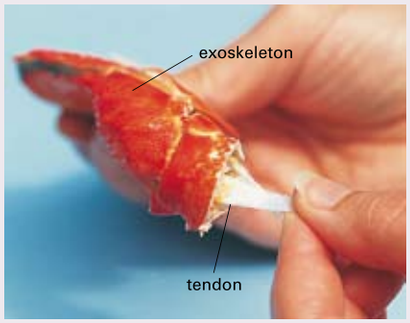
4 Place the gills in a shallow dish of water. Observe the gills again with the hand lens.
What differences do you see when the gills are in water? Suggest how this helps the fish survive.

5 Use scissors to cut the flesh away from the backbone. This flesh is the muscles that move the backbone.
Observe the flexibility of the bones and the joints in the backbone.

PART B
Observing an exoskeleton

1 Use the crab leg to observe the exoskeleton (shell). Look at the joints to see how the hard pieces of exoskeleton are connected.
Sketch the crab's leg and label the hard and softer parts.

2 Break some of the shell away to expose the white or pinkish flesh. This is a muscle which moves part of the leg.
Keep breaking away the shell and remove the muscle until you find a piece of hard, shiny, white tendon. Try pulling on this tendon to move the leg.



Lab notes

Part A

- Always phone the day before to order your fish in case there are none with gills available.
- A web cam with a flexible cord attachment and stand, connected to a laptop and data projector, can be used to show the class gills, exoskeletons and other structures.
- There may be some students who do not wish to do this investigation and they will need other work to do.
- Make sure you have strict rules about behaviour when working on the specimens.
- Open all windows and ensure good ventilation.
- Ensure that all waste material is properly disposed of.
- Ensure that soap, hot water and towelling are available for cleaning hands.

Lab notes

Part C

- Some students are arachnophobic and/or dislike insects. They should be allowed to opt out of the activity.
- Other animals may be more convenient to obtain and use, eg slaters, cockroaches, or prawns.
- This is another good place to use the video camera to get a close-up of the animal bodies and little breathing holes.

Consider using some commercial DVDs to supplement the content of this chapter and engage students. The David Attenborough *Life of Mammals* and *Planet Earth* series are particularly well done.

Homework

Ask the students to compile a list of endangered and threatened native animals. What is the difference between extinct, endangered and threatened in the context of flora and fauna?

PART C
Observing other arthropods

1 Look at the insect and the spider. Compare the number of legs and the number of body segments.

2 Compare the thickness of the exoskeleton of the insect and the spider with that of the crab.

3 Use the hand lens to observe the various structures of each arthropod. If you can find a grasshopper, look along the side of its abdomen with the hand lens. You will see tiny holes through which it breathes.

Make a labelled sketch of interesting structures on each arthropod.

Discussion

1 What happens to gills in and out of water? Suggest why fish suffocate and die when they are left out of water.

2 Suggest why fish have such large muscles along their backbones. Do they have a similar bone arrangement to humans? For example, do they have ribs?

3 Suggest why the thicknesses of the exoskeletons of the crab, insect and spider are different? Would it help the insect to have a very thick exoskeleton?

4 Arthropods do not grow as large as most vertebrates. Use your knowledge of exoskeletons to suggest why this is so.

Science in action

The Tasmanian tiger or Thylacine (THIGH-la-scene) looks similar to modern day dogs but is classified as a marsupial. Marsupials, like possums, koalas and wallabies, give birth to immature young which then develop further in a pouch.

The Thylacine is now considered extinct. The last documented animal died in captivity in Hobart Zoo in 1936. However, many people believe that others exist in the undisturbed forests of central Tasmania.

In 1999 a project was undertaken by a team of biologists from the Australian Museum to bring the Thylacine back to life just like the dinosaurs in the film *Jurassic Park*.

Cells from a preserved Thylacine pup were extracted in the hope that the DNA (the substance that carried the animal's genes) could be used to produce offspring. However, the project proved too difficult and was scrapped in 2005. New technologies and techniques might in the future be used to continue the project.

The Thylacine was an amazingly unique Australian marsupial. Use the website links to answer the questions below.

1 In what ways was the Thylacine similar to present-day dogs? How was it different?
2 What factors may have caused the animal's extinction on mainland Australia? In Tasmania?
3 How did they propose using the cells of the Thylacine pup to produce offspring?

WEBwatch

To find out more about the history of the Tasmanian tiger (Thylacine) go to www.scienceworld.net.au and link to **Thylacine**.

Issues

Human thoughtlessness and neglect have led to the extinction of many of Australia's unique vertebrates. It is our responsibility to ensure that endangered animals are saved from extinction and that other vertebrates never experience this problem.

Ask students to write a letter to their local newspaper explaining why we need to save our animals from extinction. They will need to explain how we as a society can do this.

The plant kingdom

This kingdom includes all the multicellular organisms that can photosynthesise and make food from carbon dioxide and water, using the energy of sunlight.

Look at the plant key below. This is another way to draw a key. Both types of keys are used by biologists when studying living things.

You can use this plant key to identify the four main groups in the plant kingdom.

Plant key

1	No stem	Mosses
	Stem	go to 2
2	Makes spores	Ferns
	Makes seeds	go to 3
3	Has flowers	Flowering plants
	No flowers	Conifers

Mosses

Mosses are the simplest plants. They have simple leaves and very simple roots but no stem.

In larger plants, water from the ground is carried up to the leaves in the stem. But because mosses have no stem their leaves have to be close to the water on the ground. This is why most mosses grow only to a few millimetres high and live in moist places.

Mosses reproduce by spores. These tiny cells are found in spore cases that grow at the top of the plant. When the conditions are right, the spores are released. If they fall onto moist ground they will form new moss plants.

Ferns

Ferns are much larger than mosses. They have a stem as well as leaves and roots. The stem is called a *rhizome* (RYE-zome) and it grows horizontally under the surface of the soil.

The fern that you see is the leaf or *frond*. These grow up from several places along the rhizome. The new fronds are curled up, but as they grow they uncurl (see Fig 34).

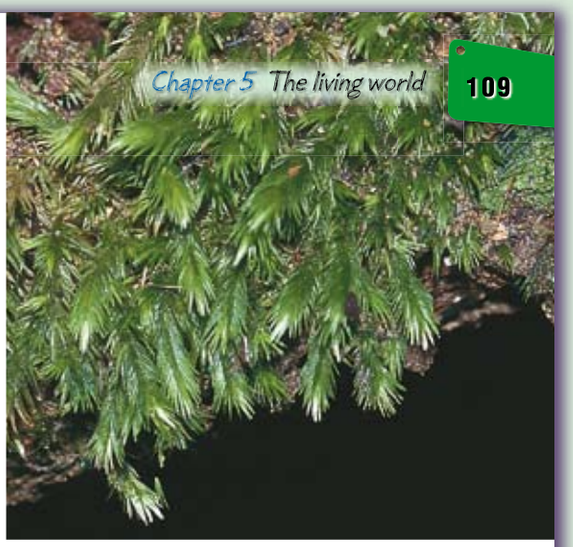


Fig 33 Mosses are very simple plants. They are small and have a very simple leaf and root structure.

If you cut a rhizome and observe it under a microscope you will see tiny tubes. These tubes carry water and food to all parts of the fern. Because it has these tubes in the stem, roots and fronds, ferns can grow much taller than mosses. Mosses have to be close to the ground so that all parts of the plant are near a supply of water.

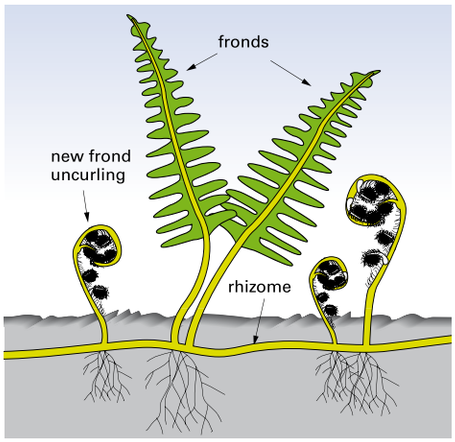


Fig 34 Fern stems or rhizomes grow horizontally under the ground.

Hints and tips

Have some microscopes set up around the room for the students to observe in greater detail different plant species. Ferns are interesting, especially viewing the spores on the underside of the frond.

Learning experience

Take the class for a walk around the school and observe as many plant specimens as possible. If possible take digital photos. Try to classify each specimen. Some will be easy to classify, others a little more difficult. You may need reference books or access to the internet.

Learning experience

Using the written information in the plant key on this page, ask the students to draw their own key similar to the one on page 95. If they wish to construct a more detailed key, further research will probably be required.

Hints and tips

Teach the class how to draw botanical diagrams. Select some simple plants for them to try first, then set a challenge with a complex species. This will appeal to the more artistic students and most find it fun.

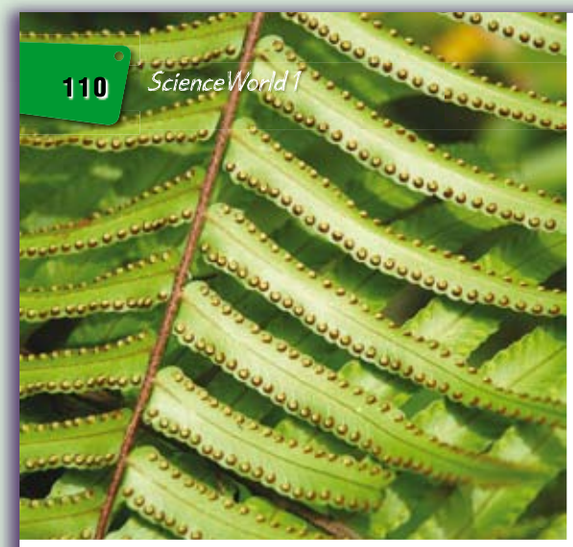


Fig 35 Spore cases on the underside of a fern frond

Ferns, like mosses, reproduce by spores. At certain times of the year, ferns grow tiny rows of brown spots under their leaves. These brown spots are spore cases and are filled with thousands of spores. When the spores are mature, the spore cases break open, and the spores fall out and are dispersed by the wind.

Conifers

Conifers have stems, roots and leaves and reproduce by seeds instead of spores. Seeds are larger and more complex than spores. Conifers include pines and fir trees. These all have cones that contain the seeds. Male cones are small and produce pollen, while female cones are mostly large and woody and produce eggs.

Fig 36 Waterlilies are flowering plants.

Flowering plants

Flowering plants have stems, roots and leaves and reproduce by seeds. They include grasses, bushes, shrubs, most trees and even water plants such as waterlilies. The flowers produce pollen and eggs, although some types of flowering plants produce only pollen or only eggs. When the eggs are fertilised by the pollen, they develop into seeds. These seeds are contained in a fruit that may be fleshy and edible as in a pumpkin, apple or grape, or hard and woody as in a walnut, wattle or eucalypt.

Fig 37 The seeds of apples, watermelons, pawpaws, kiwifruit and grapefruit develop inside fleshy, edible fruit.

Learning experience: examining pollen

Collect various flowering plants and shake off the pollen onto a piece of clean paper. Place the pollen gently on a slide and view it under a microscope. Does the pollen of different plants look different?

Dissection of a flower is done in Chapter 9, page 199. However, you may decide to do it now rather than in Chapter 9.

Dissect the flower and examine the ovules that are fertilised by pollen. Any flower can be used, but ones with a large pistil, such as hibiscus, are easier to dissect. Simply dissect the plant down the centre to form two halves.

science bits

Plant medicines

For thousands of years, plants have been the source of medicines for illnesses and injuries.

Early Europeans scraped the bark of the willow tree and used it to ease headaches and pain. We now know that the bark contained a chemical called salicylate which chemists use to make aspirin.

Australian Aborigines had a wealth of knowledge about plant medicines. Medicines were prepared by crushing the plant and soaking it in water, often for a long time. The patient would drink it or have it rubbed on a wound. Ointments were made by mixing crushed leaves in animal fat.

Today chemists often use the active substance from a plant to make a synthetic 'copy' that is then used in modern medicines.

WEB watch

To find out more about plant medicines go to www.scienceworld.net.au and follow the links to **Plant medicines**.

Check!

1 Use the list below to match the organism to its description.

mosses arthropods ferns
reptiles conifers mammals

- **a** These plants produce seeds in a cone.
- **b** The organisms in this group have a constant body temperature.
- **c** These organisms contain chlorophyll but do not have a stem.
- **d** These organisms include arachnids and crustaceans.
- **e** Female organisms in this group lay eggs with a tough, flexible covering.
- **f** These plants produce spores but have a stem and leaves.

2 How would you tell the difference between:
- **a** a conifer and a flowering plant
- **b** a fern and a conifer
- **c** a moss and a fern?

3 *Amphibians usually live close to water. In times of drought, they often burrow into moist soil. In the colder months of the year they hide in burrows or under logs and rocks.*
For each of the three sentences in the description above, suggest why amphibians show this behaviour.

4 Why are snakes and earthworms classified in different groups (see page 95)?

5 Use the key on page 109 to write a description for the plants in the photos below.


6 There are two ways of drawing keys. Use the information in the key on page 109 to draw the other type of key.

7 Whales and dolphins spend all their life in water. Why are they classified as mammals?

8 In the two polar areas on Earth where snow and ice are present all year round, some of the following animals might be seen on the icepacks—polar bears, penguins, seals and sea lions.
To which groups do these animals belong? How can they survive when other animals such as insects, reptiles and amphibians cannot?

Check! solutions

1 The correct matches are as follows:
- a conifers
- b mammals
- c mosses
- d arthropods
- e reptiles
- f ferns

2 a The best way to tell the difference between a conifer and a flowering plant is whether it has its seeds in cones or flowers.

b The best way to tell the difference between a fern and a conifer is whether it produces spores or seeds.

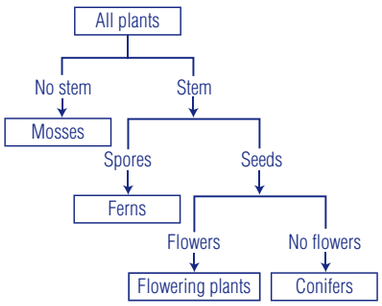
c The best way to tell the difference between a moss and a fern is its size and whether it has leaves and roots.

3 Amphibians have moist skin and need to live near water to avoid drying out. This also explains why they burrow in moist soil in times of drought. Amphibians do not have a constant body temperature and in colder months become very slow and inactive, so they hide in burrows or under logs for protection.

4 Snakes and earthworms are classified in different groups because a snake has a backbone and scales and a worm does not.

5 The plant on the left has a stem and seeds but no flowers. The plant on the right has a stem and makes spores.

6



This is sometimes called a flowchart key and there are always two choices.

7 Whales and dolphins are classified as mammals because they have backbones, a constant body temperature and no feathers. Where they live is not an important factor in their classification.

8 Polar bears, seals and sea lions are classified as mammals because they have backbones, a constant body temperature and no feathers. However, penguins are classified as birds because they have backbones, a constant body temperature and feathers. The reason why these animals are able to survive in such an environment is because they are warm blooded and can remain active while the other animals mentioned cannot.

challenge

1 The animal key on page 95 contains three invertebrate groups—arthropods, worms and molluscs. However, there are a number of other invertebrate groups. Use the information below to redesign the invertebrate part of the animal key on page 95.

Arthropods (insects, spiders, crabs): jointed covering over body

Molluscs (snails, clams, oysters, mussels, squid, octopuses): soft body, not segmented, usually with a shell

Echinoderms (starfish, sea urchins, sea cucumbers): hard, spiny skin, all live in the sea

Flatworms and roundworms (tapeworms, liver flukes, threadworms, nematodes): long, flat or round soft body with no body segments, poorly developed gut

Segmented worms (earthworms, leeches, beach worms): long, round and soft body divided into segments, well-developed gut

2 Tan and Kif were studying mangroves—flowering plants that grow in salty water along river banks. They used the key below to identify the mangroves they observed when they were on a field trip.

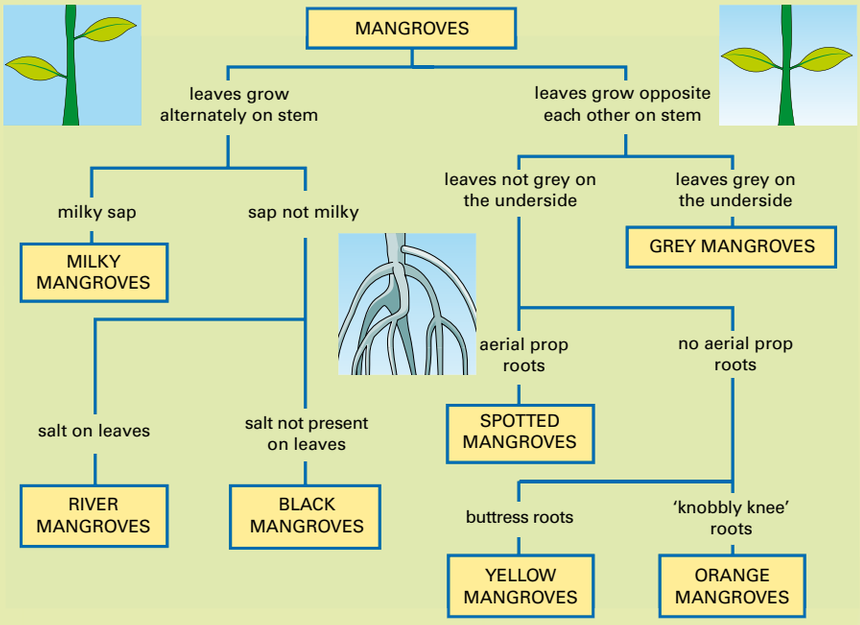
a Tan observed a mangrove that had salt crystals on its leaves, and its leaves were growing alternately on the stem. Which mangrove was Tan observing?

b There may be terms in the key that you have not met before. Draw a sketch of what you think buttress roots and 'knobbly knee' roots are. Discuss your sketches with other people.

c Write a description for the yellow mangrove.

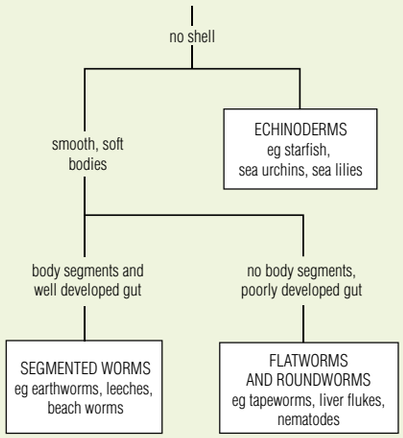
d Kif noticed a mangrove with opposite leaves and aerial prop roots. Which mangrove was he observing? What further observation would be necessary to be sure of the type of mangrove it was?

e In which way is a black mangrove different from an orange mangrove?



Challenge solutions

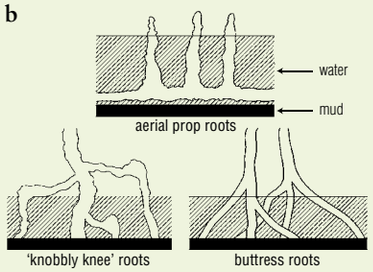
1 The following is one way to include these groups in the key. You may have a different way.



2 Using the key provided:

a Tan was observing a river mangrove.

b



c The yellow mangrove has buttress roots, no aerial prop roots, leaves that are not grey on the underside and leaves that grow opposite each other on the stem.

d Kif was probably observing a spotted mangrove. To be sure he would need to check underneath the leaves to see whether they are grey or not.

e The difference is that the black mangrove has leaves which grow alternately on the stem whereas the orange mangrove has leaves which grow opposite each other on the stem.

MAIN IDEAS

Copy and complete these statements to make a summary of this chapter. The missing words are on the right.

algae
chlorophyll
classified
conifers
decomposers
fungi
key
kingdoms
mosses
oxygen
protists
reproduce
structural
vertebrates

1 Living things can be _____ into groups by observing their similarities and differences. A good way to do this is to use a _____.

2 Biologists find _____ and functional features much more useful to classify organisms than features such as colour, shape or size.

3 The need for _____ and food, and the ability to _____ are some of the seven characteristics used to show something is living.

4 Biologists usually classify organisms into five _____: animals, plants, _____, protists and monerans.

5 Most _____ are unicellular organisms and have very simple cell structures. _____ are plant-like protists which contain chlorophyll but have no stem, roots or leaves.

6 Fungi do not contain _____ and reproduce by spores. Most fungi are _____ because they help break down the bodies of dead organisms.

7 Animals can be classified into two main groups: _____ which have bones, and invertebrates which do not.

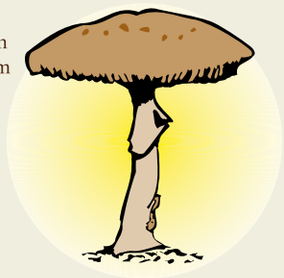
8 The plant kingdom is divided into four main groups: _____, ferns, _____ and flowering plants.

Try doing the Chapter 5 crossword on the CD. Working with technology

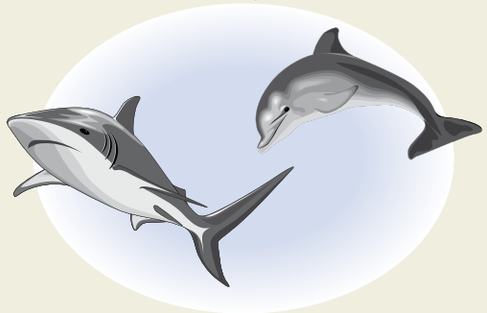
REVIEW

1 Leon catches an animal in a pond. Which characteristic would be the most useful in classifying the animal?
A whether or not it has a backbone
B what type of food it eats
C whether it lives in a group or on its own
D its colour

2 In which kingdom does this organism belong?
A plant
B protist
C monera
D fungi



3 Zian classified the two animals in the diagram below in the same group because they both live in the ocean, have a similar shape and feed on fish. Bruno disagreed with her and said they belong in different animal groups.
Who was correct and why?



Main ideas solutions

1 classified, key
2 structural
3 oxygen, reproduce
4 kingdoms, fungi
5 protists, algae
6 chlorophyll, decomposers
7 vertebrates
8 mosses, conifers

Review solutions

1 **A** When classifying organisms, their structural or functional characteristics are generally used.

2 **D**

3 Zian was correct because the dolphin is a mammal and breathes oxygen from the air through lungs, while the shark is a fish that breathes through gills. (Lungs and gills are structural characteristics.)

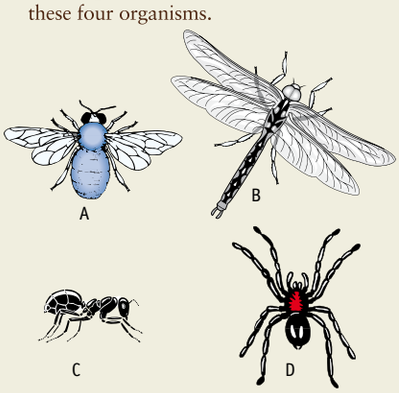
4 Which characteristic can be used to tell a fern from a conifer?
- **A** where it grows
- **B** whether it has a stem or not
- **C** its colour
- **D** whether it produces seeds or spores

5 How can you tell the difference between a reptile and an amphibian?

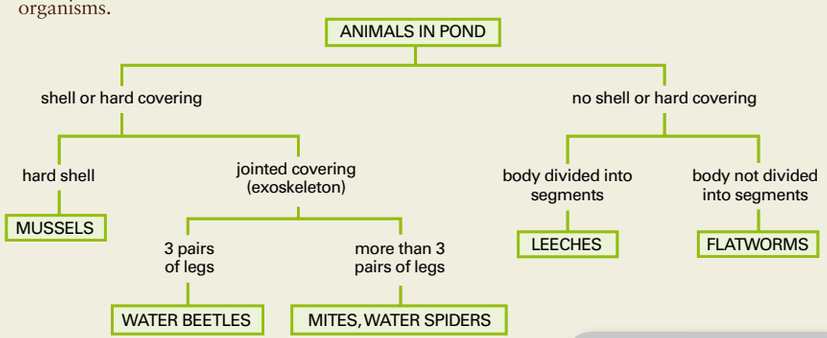
6 Into which group would you put this organism? It is green in colour, has very small root-like structures, is quite small (about 10 mm across) and lives in moist places.

7 Which of the following statements is *incorrect*?
- **A** Turtles and lizards belong to the reptile group of the animal kingdom.
- **B** Flowering plants, conifers and ferns all produce seeds.
- **C** Mammals and birds are two groups of vertebrates which have a constant body temperature.
- **D** Bacteria and fungi are decomposers because they break down the bodies of dead organisms.

8 Look at the diagrams of the four organisms.
- **a** In which *two* ways are they similar?
- **b** How is organism D different from the others?
- **c** Make up a key that could be used to classify these four organisms.



9 The key below was used to classify some organisms in a pond.
- **a** Describe in one sentence the characteristics of mites and water spiders.
- **b** How are flatworms and leeches similar? How are they different?
- **c** Suppose you observed a frog and some fish in the pond. Why would this key be unsuitable for classifying these animals?



Check your answers on page 301.

REVIEW

4 **D**—see the plant key on page 109.

5 A reptile has a dry, scaly skin and lays eggs with a tough, flexible covering. Amphibians, on the other hand, have a moist skin and lay eggs that do not have a protective covering. Amphibians also spend some of their life cycle breathing through gills.

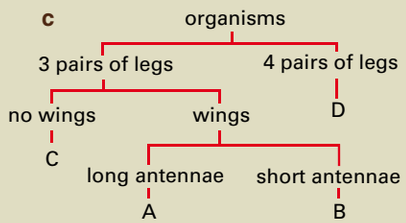
6 The organism is green and has root-like structures so it would be classified as a plant. It would then be placed in the moss group because it has no stem.

7 **B** Flowering plants and conifers produce seeds, but ferns produce spores.

8 **a** The organisms all have a segmented body, a number of legs, antennae and eyes.

b Organism D has four pairs of legs (8 legs), while the others have three pairs (6 legs).

c



9 **a** Mites and water spiders are animals that have a jointed, hard covering (exoskeleton) and more than three pairs of legs.

b Flatworms are similar to leeches because they do not have a shell or hard body covering. However, flatworms do not have body segments as leeches do.

c The animals in this key are all invertebrates, but frogs and fish are vertebrates (they have a backbone). Therefore the key cannot be used to classify them.