

PEARSON
Science

STUDENT BOOK | VICTORIA

7



Topic 5 Classification and biodiversity

Prior knowledge

Living and non-living things

- 1 Answers may include: respire, grows, moves, reproduces, responds to external stimuli, reproduces.

Grouping living things by characteristics

- 2 A butterfly, a caterpillar or a honeybee could be classified according to winged flight, or how legs are used to move.
- 3 Invertebrates, such as jellyfish, do not have a backbone. Vertebrates, such as mammals, have a backbone.

Identifying patterns and relationships

- 4 Answers may include: similar body covering (skin) or similar anatomy such as trunk could be used to determine if the elephants are related.

Using models to represent data and observations

- 5 An advantage of this classification model is that it provides safety benefits by distinguishing edible plants from those with medicinal properties. It also allows for practical applications of traditional knowledge, ensuring sustainable use of natural resources for nutrition and healthcare.

5.1 Introduction to classification

Check your understanding

SC 1: I can describe the role of classification of biodiversity on Earth

Classification in biodiversity is the process of grouping organisms based on their shared characteristics.

SC 2: I can describe at least two reasons for classifying the diversity of life on Earth

Answers should include two of: name new species, compare characteristics of new species to current or extinct species, study how organisms are connected or related to each other, create a universal language for scientists to use that is standard across the globe to share their findings, explore new understandings of species.

SC 3: I can suggest how classification systems are affected by cultural perspectives and world views

Non-western cultures may categorise elements of the natural world based on their roles within the ecosystem, physical attributes, cultural significance or spiritual importance.

Lesson review

- 1 Classification is important for studying biodiversity because it helps scientists organise and understand the vast diversity of life including the relationships, behaviours and characteristics of different species.
- 2 To classify a newly discovered organism, you could observe its physical characteristics and compare them with known organisms.
- 3 Sample answer: I would explain that classification is like organising a library. Just as books are grouped by genre, author and topic to make them easier to find and understand, organisms are grouped by their characteristics.
- 4 Sample answer: First Nations Australians might classify plants as being edible or inedible.

5 Sample answers:

- a** First Nations peoples have communicated their understanding of classification over generations through storytelling and cultural ceremonies.
- b** Story telling of seasons, knowledge practices and behaviours that show seasonal changes are occurring, or story telling of events such as the emu in the sky.
- c** Scientists can gain deeper insights into how different environments function and how they can be classified.

5.2 Recognising similarities and differences in objects and living things

Results

Sample table:

Name of food item	External features observed	Internal features observed	Classification: fruit or vegetable	Reasons for classification

Features observed could include colour, taste, size, shape, type of seeds, outer coating/skin.

Some characteristics are better for classification than others. Generally, the more consistent a characteristic is, the better it is for classification (for example, size is not a good characteristic because it can vary, but type of seeds and skin could be more consistent and reliable).

Conclusion

- 1** Fruit has seeds and tends to have fleshy material, often surrounded by a skin. Vegetables could have roots or be tubers, have hard flesh, and the stalks and leaves can be eaten.
- 2** A tomato is classified as a berry because it is an edible fruit that has seeds embedded within its flesh. Fruit is the seed-bearing structure of the plant, whereas vegetables are generally the other parts of the plant; for example, leaves or roots.

Evaluation

Answers could include:

- Observations were based on a small sample of fruits and vegetables. Increasing the number of fruits and vegetables could improve the investigation.
- Lack of unusual examples of fruits and vegetables. Using a more diverse types of fruit and vegetables including lesser known or unusual items could improve the investigation.
- The observations were only superficial. Use of additional features like texture, colour, size of seeds would provide extra information when classifying items.
- Some items had very similar features that made it difficult to classify them. Using fruit and vegetables that have different features would make it easier to classify them.

5.3 Introduction to keys for identification

Check your understanding

SC 1: I can use a branching dichotomous key to identify objects or organisms

Branching dichotomous keys function by presenting a series of choices that lead the user through a branching path. Each time the path narrows until the correct identification is reached.

SC 2: I can use a table dichotomous key to identify objects or organisms

A table dichotomous key presents choices in a table format, allowing users to compare characteristics side by side.

SC 3: I can evaluate the strength of dichotomous keys and suggest ways to make them more effective

A dichotomous question is a question that limits responses to only two possible answers.

Try yourself: Dichotomous questions

Thinking	Working
a Does the tree have lots of leaves?	
Only two possible answers?	No
Suitable?	No
b Does the animal have four legs?	
Only two possible answers?	Yes
Clear question?	Yes
Observable answer?	Yes
Suitable?	Yes
c Where does the animal live?	
Only two possible answers?	No
Suitable?	No
d Does the insect have more than one pair of wings?	
Only two possible answers?	Yes
Clear question?	Yes
Observable answer?	Yes
Suitable?	Yes

Lesson review

- 1 A dichotomous key is used to identify and compare organisms that have been observed or have known characteristics.
- 2 Two features of a branching dichotomous key include a tree-like structure and two possible choices for each branch.
- 3 Answers may include: has long wings / has short wings, or has long body / has short body.
- 4 Dichotomous keys are useful tools for scientists because they provide a clear and structured way to identify organisms, making it easier to study and communicate about biodiversity.

5.4 Creating dichotomous keys

Method
Part A: Types of pasta

- 1 Sample answer:

Tube-shaped	Shell-like	Flat and long	Thread-like	Twisted
penne rigatoni cannelloni macaroni	conchiglie	tagliatelle pappardelle	spaghetti	fusilli

2 Sample answer:

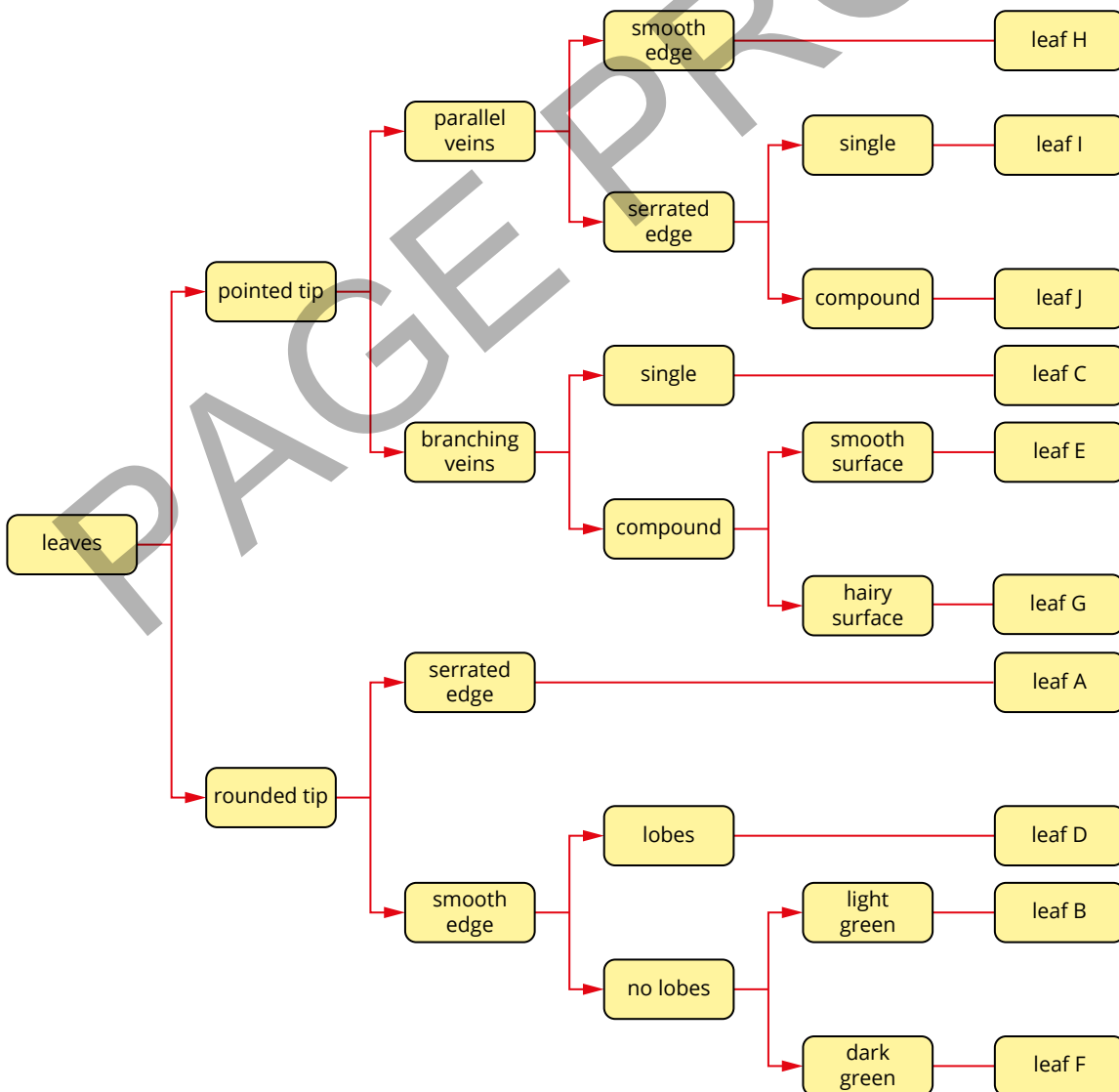
- Is the pasta tube-shaped?
- Is the pasta thread-like?
- Is the pasta smooth?
- Is the pasta straight or curved?

3 Sample answer:

1a tube shape	go to 2
1b not tube shape	go to 3
2a straight	penne
2b curved	macaroni
3a longer than 10 cm	go to 5
3b shorter than 10 cm	go to 4
4a twisted	fusilli
4b shell shape	conchiglie
5a round	spaghetti
5b flat	tagliatelle

Results

Sample answer:



Evaluation

- 1 Answers may include:
 - Providing more specific statements/questions.
 - Making more precise observations of the pasta or leaves and creating statements that reflect those observations.
 - Some items had very similar features that made it more difficult to classify them; be able to make more precise measurements and observations to determine more differences.
- 2 Responses should reflect understanding of classification.
Some strengths of a dichotomous key:
 - It is a useful tool for visualising features and relationships between organisms.
 - It helps to organise living things based on their features.
 - It is a systematic way of identifying organisms.
 - It makes it easy to group living things.
 Some weaknesses of a dichotomous key:
 - Not all features can be classified.
 - Features can change over time, so it may be difficult to find strong features.
 - Some features may be shared but not due to evolutionary relationships, making key identification misleading.
 - Sometimes a key can become too complex to include all features.

5.5 Linnaean classification system

Check your understanding

SC 1: I can list the levels in the Linnaean hierarchical classification system in order

The levels of the Linnaean hierarchical system from highest to lowest are kingdom, phylum, class, order, family, genus, species.

SC 2: I can classify an organism's kingdom, phylum and class using the Linnaean hierarchical classification system

- a Animalia
- b Chordata, because reptiles have a backbone.

SC 3: I can identify the genus name and species name in an organism's scientific name

The genus name for a cat is *Felis* and the species name is *catus*.

Try yourself: Scientific names

Thinking	Working
1 Identify the genus name	<i>Anigozanthos</i>
2 Identify the description of the species	<i>masquerade</i>
3 Combine the name	<i>Anigozanthos masquerade</i>

Lesson review

- 1 The levels of the Linnaean hierarchical system from smallest to largest are: species, genus, family, order, class, phylum, kingdom.
- 2 When writing a scientific name, you need to know the genus and species.

- 3 The kingdom and phylum for a magpie is Animalia and Chordata as it has a backbone.
- 4 For a *Homo sapiens* the genus is *Homo* and the species is *sapiens*.
- 5 Scientific names are unique and the same all around the world whereas common names are not as accurate because they can change between locations and cultures.

5.6 Levels of classification in the animal kingdom

Check your understanding

SC 1: I can describe the characteristics of nine major animal phyla and give examples of each

Answers should include any three of: Arthropoda (e.g. insects), Mollusca (e.g. snails), Chordata (e.g. mammals), Platyhelminthes (e.g. flatworms), Nematoda (e.g. parasitic worms), Annelida (e.g. earthworms), Echinodermata (e.g. sea stars), Cnidaria (e.g. jellyfish), Porifera (e.g. sponges).

SC 2: I can describe the characteristics of the classes of chordates and state an example of each
Aves, or birds, are characterised by feathers, beaks and laying hard-shelled eggs.

SC 3: I can describe the classification levels of a range of Australian native animal species

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Lesson review

- 1 A category of Linnaean classification above class and below kingdom.
- 2 Answers may include:
 - a humans and dogs
 - b frogs and toads
- 3 The phylum Chordata is defined by characteristics such as being bilateral symmetry, having an endoskeleton, and a backbone with a nerve cord that runs down it.
- 4 The class Mammalia is defined by characteristics such as the presence of mammary glands, fur or hair, being endothermic and using lungs to breathe.
- 5 Answers may include:
 - a Kangaroo – kingdom: Animalia; phylum: Chordata; class: Mammalia
 - b Emu – kingdom: Animalia; phylum: Chordata; class: Aves
 - c Saltwater crocodile – kingdom: Animalia; phylum: Chordata; class: Reptilia
- 6 Classifying Australian native animal species is significant because it helps scientists accurately identify species and develop effective conservation strategies to protect Australian fauna.

5.7 Levels of classification in the plant kingdom

Check your understanding

SC 1: I can describe the characteristics of some plant divisions and give examples of each

Major plant divisions include mosses and liverworts, ferns, and seed-producing plants.

SC 2: I can describe the characteristics of flowering plants and state an example

Flowering plants produce flowers as their reproductive systems.

SC 3: I can describe the classification levels of a range of Australian native plant species

Kingdom: Plantae

Division: Angiosperms

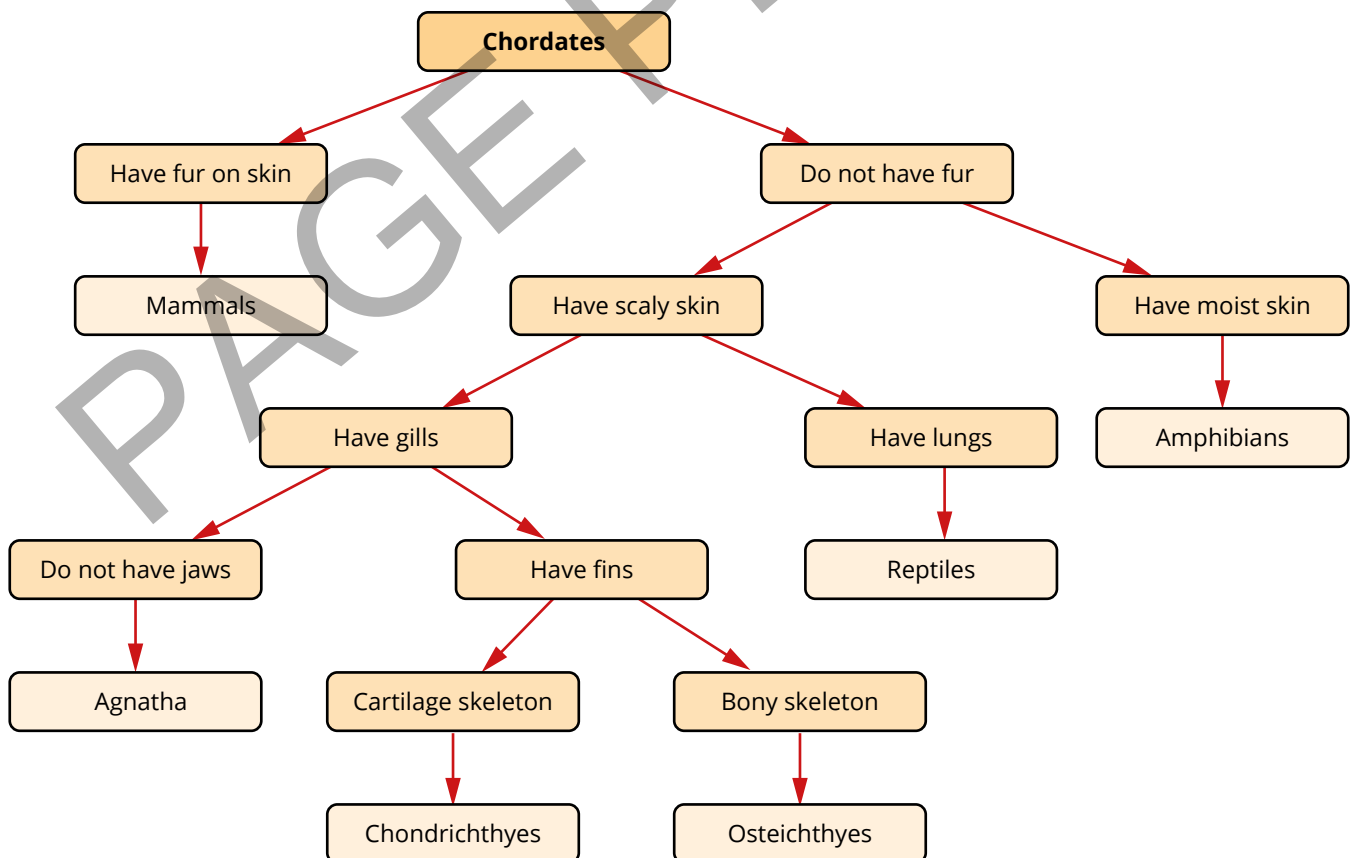
Class: Dicotyledons

Lesson review

- 1 Photosynthesis is the chemical reaction in plants that converts carbon dioxide and water into oxygen and glucose using energy from sunlight.
- 2 Flowers are significant in the reproduction of flowering plants because they contain both male and female reproductive parts, enabling pollination and seed formation, which leads to the growth of new plants.
- 3 Answers may include:
 - a Eucalyptus – kingdom: Plantae; division: Angiosperms; class: Dicotyledons
 - b Wollemi pine – kingdom: Plantae; division: Pinophyta; class: Pinopsida
- 4 Sample answer:
I would observe the plant’s characteristics such as type of roots, leaves, and reproductive systems. Based on these characteristics, I would compare them with known plant divisions and classify the plant accordingly.
- 5 Characteristics would include location of male and female cones, differences in seed shape and features, and how seeds are dispersed.

5.8 Creating and using keys for Linnaean classification

Results



Evaluation

- 3 Answers may include:
- Providing more specific statements/questions.
 - Making more precise observations of the animals and creating statements that reflect those observations.
 - Addressing cases where animals have very similar features by incorporating more precise measurements and distinctions to better differentiate them.

5.9 Fieldwork as a part of science inquiry

Check your understanding

SC 1: I can describe methods that scientists use to observe and identify organisms in the field

Answers may include: making notes, sketching, taking photos, taking measurements, using existing data, using dichotomous keys.

SC 2: I can explain how scientists reduce their impact on organisms and the environment during fieldwork

Answers may include:

- Before entering the field, especially if you have been on a farm or in a contaminated area, thoroughly wash all shoes and boots.
- Stick to designated pathways to avoid disturbing natural habitats.
- Avoid removing any organisms from the area.
- Leave the environment in the same condition as you found it.
- Ensure you leave no litter behind, including liquid in containers (which can alter the area's scents), when you depart.
- Refrain from introducing any substances into the water, including beverages.
- Avoid altering the natural lighting conditions in the area, such as shining a torch at night on possums or owls, which can disrupt their natural behaviour.

SC 3: I can analyse ethical and cultural considerations in conducting fieldwork

Considering cultural perspectives ensures respect for local traditions and knowledge of ecological processes over long periods of time.

Lesson review

- 1 A description of something that relates to ecosystems or interactions between living things and their environment.
- 2 Answers may include any of: air temperature, humidity, light intensity, soil type, or details about organisms present.
- 3 Sample answers:
 - a A technique could include staying on designated paths, avoiding trampling vegetation, or using non-invasive observation methods such as binoculars and cameras.
 - b Minimising impact is important to ensure that the frogs' natural behaviours and habitat are preserved, leading to more accurate data collection and less disruption to the ecosystem.
- 4 When recording details about the structure and features of organisms, scientists make sketches and take photographs in addition to their notes and measurements. This allows them to compare observations from previous studies and use keys to identify the organisms observed.
- 5 Answers could include any of: addressing ethical considerations by consulting with local councils and communities or ensuring that my methods minimise impact on the environment.

5.10 Using the Linnaean classification system and a dichotomous key in fieldwork

Results

Sample observation notes:

- leaves are green and tapered
- leaves have central vein and have approximately six veins coming from the central one
- small pink flowers with yellow centres
- leaves measure approximately 10 cm long and 5 cm wide
- plant has stems
- plant is in the Dicotyledon class within the division of flowering plants

Evaluation

- 2 Answers could include providing more specific observation notes.
- 3 Answers could include comments about not leaving litter, not walking in the habitat, and leaving the habitat as it was found.

5.11 First Nations Australians' classification systems

Check your understanding

SC 1: I can describe how a group of First Nations Australians classify plants or animals in their environment

Students may identify classification based on size, colour and habitat of kangaroos, as well as noting their seasonal movements and the types of plants they eat.

SC 2: I can compare First Nations Australians' systems of classification and the Linnaean classification system

First Nations Australians' systems often incorporate cultural and ecological knowledge, while the Linnaean system is based on observable physical characteristics only.

SC 3: I can describe how First Nations Australians' knowledge have contributed to development of knowledge of biodiversity

Traditional ecological knowledge provides insights into managing landscapes, identifying and monitoring threatened species, and sustainable management practices.

Lesson review

- 1 Sample answer: First Nations Australians classify plants by their uses, such as for food or medicine.
- 2 Sample answer: First Nations Australians manage fish populations to maintain biodiversity by only taking what is needed, avoiding capturing undersized or pregnant fish, and not overfishing.
- 3 First Nations Australians often use different names for the same organism living in a different area. For example, an organism that lives inland is named differently to an organism that lives in ocean water.
- 4 First Nations cultural burning practices are used to promote soil fertility and encourage the growth of new plants.

5.12 Changing classification systems

Plan

- 1 Answers could include anatomical evidence, behaviour traits, genetic evidence, fossil records, ecological evidence, biochemical evidence.
- 2 Answers could include the reclassification of the kangaroo from a single species to different species partly based on genetic evidence. Similarly, African elephants were once considered a single species, but genetic studies have identified clear differences between African forest elephants and African savannah elephants, leading to their classification as separate species.

Design

- 1 Examples could include the reclassification of the kangaroo, platypus, echidna or lungfish. Flora examples could include *Eucalyptus*, *Acacia* or *Banksia*, where genetic studies have led to revisions in their classification.
- 2 These findings could be communicated in a poster, video, podcast, PowerPoint presentation, webpage or role play.

Improve

Answers could consider how students chose the organisms, how they went about collecting information, whether the information collected was relevant, whether the presentation mode was the most effective for their communication, and whether they completed the investigation in a timely manner.

Evaluate

- 1 Answers will vary. Skills could include determining the best way to present information, summarising information and communicating scientific findings.
- 2 Sample answer: As genetic data becomes faster and cheaper to analyse, classification may rely more on genetic information. Increased sharing of data across the world—and the use of super computers—will help to bring research together from more scientists. With improved microscope technology, scientists may be able to improve the classification of microscopic organisms.

Topic review

Remember

- 1 The main purpose of classifying biodiversity on Earth is to organise and understand organisms and the connections between them.
- 2 The purpose of a dichotomous key is to assist scientists correctly identify organisms.
- 3 The first step in creating a dichotomous key is to list all the items or organisms that need to be identified.
- 4 Answers may list one of the following characteristics: the presence of an exoskeleton, jointed limbs, or three body segments.

Understand

- 5 Classification helps in the study of biodiversity by grouping organisms based on shared characteristics, making it easier to identify, study and understand their relationships.
- 6 A dichotomous key can determine which group an organism belongs to by asking a series of questions to identify similarities and differences.
- 7 A lion (*Panthera leo*) would be in kingdom: Animalia; phylum: Chordata; class: Mammalia.
- 8 First, determine its kingdom from the six groups: ferns are plants. Then, determine its division based on reproduction and water transport: ferns.

- 9** Answers could include: understanding how marine life can be conserved to reduce overfishing and impacts on fish generations, understanding of how to protect threatened species, or understanding of how to cultivate plants to re-build vegetation.

Apply

10 Sample answers:

- a** sketching, photos, notes
 - b** Collect data on the shell's characteristics (e.g., colour, size), then use a dichotomous key or reference guide to classify the shell into its kingdom, phylum and class.
- 11** You could incorporate First Nations Australians' knowledge by looking at different ways they classify plants based on their use including if they are edible, non-edible or can be used for another purpose.

Analyse

- 12 a** Kangaroos belong to the phylum Chordata as they have a long backbone with a nerve cord inside it.
- b** Both kangaroos would have the same kingdom, class and order, but have different genus and species as their scientific names differ.
- 13** Flowering plants (angiosperms) produce flowers and seeds enclosed within a fruit, while non-flowering plants (such as ferns and mosses) reproduce via spores or other methods and do not produce flowers or fruits.
- 14 a** Ethics looks at the moral values that regulate a person's behaviour and the way they conduct their research activities.
- b** Answers could include ethical considerations such as: ensuring minimal disturbance to the species and their habitat, obtaining necessary permits, and following guidelines to avoid harm or stress to the animals.

Extension: Classifying

- 15 a** First, research the characteristics of Australian native animals. List the features that make them different from others, then create a series of questions that progressively separate them into classes such as mammals, birds, reptiles, amphibians and fish.
- b** Answers should include a branching diagram with dichotomous questions that lead to a specific Australian animal.