Chapter 5: Classification

5.1 Classification organises our world

Student book answers (pages 80–81)

Check your learning 5.1

Remember and understand

1 Why did Carl Linnaeus simplify the classification system used by previous scientists?

Many species were regularly referred to by a number of different names, some of which were very long and complicated. This made communication between scientists very difficult. So Linnaeus simplified the classification system by using two names for every species.

2 Give two reasons scientists still classify organisms today.

Scientists still classify organisms today in order to organise life forms in a logical fashion. This helps us to better understand the world, and it is a basis for study of any new life forms that are discovered. The ultimate goal of classification is to show the evolutionary history of life on Earth.

Analyse and apply

3 Why would it be difficult to classify frogs and tadpoles using the early methods of classification?

The early methods of classification relied on hand-drawn pictures and worded descriptions. Most tadpoles look similar and grow into frogs so it would be difficult to identify which species they are by the early methods.

Evaluate and create

4 The earliest scientists did not have pens or paper. How would they have passed on the information they received? How accurate would it have been?

The earliest scientists would have passed on their information verbally and perhaps with drawings. The accuracy would have been questionable because spoken details often change as information is passed along.

5 Aristotle was one of the first scientists to try to gather information from wide regions. What method might he have used to tell the differences between a horse and a fly?

Aristotle might have used the fact that in those days horses were much more important animals than flies and he would have separated them accordingly.

5.2 Living organisms have characteristics in common

Student book answers (pages 82–83)

Check your learning 5.2

Remember and understand

1 The system scientists’ use to group things divides them first into two groups. What are the two groups?

The two groups scientists divide all things into are living and non-living.

Apply and analyse

2 Consider the things listed below.

Eucalypt tree, water, paper, robot, leather belt, wombat, roast chicken, chair

a With a partner or by yourself, decide whether each of the items meets the requirement to be classified as a living thing.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eucalypt tree | Water | Paper | Robot | Leather belt | Wombat | Roast chicken | Chair |
| Moves by itself | Y | N | N | Y | N | Y | N | N |
| Reproduces itself | Y | N | N | N | N | Y | N | N |
| Requires nutrition | Y | N | N | N | N | Y | N | N |
| Grows as it gets older | Y | N | N | N | N | Y | N | N |
| Responds to changes in its environment | Y | Y | N | Y | N | Y | N | N |
| Exchanges gas (e.g. oxygen) | Y | Y | N | N | N | Y | N | N |
| Produces wastes | Y | N | N | N | N | Y | N | N |
| Requires water | Y | Y | N | N | N | Y | N | N |
| Living or non-living? | L | NL | NL | NL | NL | L | NL | NL |

b Decide whether each should be classified as living or non-living.

The eucalypt tree and the wombat both have all the characteristics of living things. Water is non-living and exhibits few of the characteristics of living things, but it does respond to changes in the temperature of the environment: heating and cooling causes it to change state, and gases dissolve into and come out of solution. Paper, the leather belt, a robot, roast chicken and the chair are non-living and exhibit none of the characteristics of living things. Robots may move and respond to changes in their environment, but only do so under ‘instructions’ from an operator, not by themselves.

3 Are any of the items listed in question 2 dead? Explain your answer.

The roast chicken is dead because it once had all the characteristics of a living thing. Paper was once part of a plant, and leather comes from the hide of an animal, so they are part of something that is dead. The chair may be made from wood, in which case it is part of something that is dead.

Evaluate and create

4 Use the characteristics of a living thing to describe a bushfire.

A bushfire has all the characteristics of living things except ‘requires water’ and ’grows as it gets older’.

5 Is a bushfire alive? Explain your answer.

A bushfire is non-living because it does not require water. If water is applied to fire, the fire will be extinguished.

5.3 Classification keys are visual tools

Student book answers (pages 84–85)

Check your learning 5.3

Remember and understand

1 What is a dichotomous key?

A dichotomous key is a visual tool used in the classification of organisms. Scientists use this type of key to make simple ‘yes’ or ‘no’ decisions at each branch. Each answer leads to another branch and another question, and, eventually, to the identity of the organism.

2 Why is it called ‘dichotomous’?

It is called a ‘dichotomous’ key because the branches always split into two.

3 What does the term ‘classifying’ mean?

Classifying is the process of grouping items based on similarities and differences in characteristics.

Apply and analyse

4 Which of the following descriptions would be good to use to classify a group of birds in a dichotomous key? Give a reason why each one is or is not a good method of classification.

a is eating bird seed

This description is bad because it doesn’t describe a characteristic; it describes a behaviour that many birds will display.

b has a blue stripe above the eye

This description is good because it describes something the bird can be identified by.

c has a broken leg

This description is bad because it describes something that is not permanent.

d is sitting on the ground

This description is bad because it is a behaviour that is not permanent.

Evaluate and create

5 Draw a key that could be used to identify laboratory equipment. Include these items: tripod stand, Bunsen burner, gauze mat, 50 mL beaker, 150 mL beaker, 100 mL measuring cylinder, 10 mL measuring cylinder, 500 mL beaker, 500 mL measuring cylinder, retort stand, clamp.

Student responses will vary. Students are likely to group the equipment by size first; however, they could also start by grouping according to whether the equipment is used to measure or for another use. For example, 1a is made of Pyrex glass, 1b is not made of Pyrex glass, and so on.

6 Use the dichotomous key in Figure 5.16 to help with the following tasks.

Allow some leeway here as it is a little hard to tell if they have wings or not.

a Identify and name the four beetles in Figure 5.17.

i Grot

ii Frap

iii Grong

iv Frot

b Draw a simple sketch of the following:

Students’ drawings should have the following elements:

i frope beetle

Round, no antennae, stripes, no wings

ii gring beetle

Oval, antennae, stripes, wings

iii gripe beetle

Oval, no antennae, stripes, wings

iv frong beetle

Round, antennae, stripes, no wings

5.4 The classification system continues to change

Student book answers (pages 86–87)

Check your learning 5.4

Remember and understand

1 Who invented the naming system that is still used today to name living things?

Carl Linnaeus

2 What are the seven groups that living things are divided into? Write them in order from largest to smallest level of organisation.

Kingdom, phylum, class, order, family, genus, species

3 How do you know if two organisms are the same species?

They are the same species if they look similar to each other and can successfully breed together.

Apply and analyse

4 Select three species of animal. For each animal:

a describe its appearance

b give its common and scientific names.

Answers will vary depending on the animals chosen.

Evaluate and create

5How has an understanding of genetic material changed classification?

The understanding of genetic material changed classification because some species originally considered to be related because they looked similar are actually quite different based on each one’s genetic material.

5.5 All organisms can be divided into five Kingdoms

Student book answers (pages 88–89)

Check your learning 5.5

Remember and understand

1Name four features that all animals have in common.

All animals are multicellular, their cells lack a cell wall, they gain energy from other living things and they have genetic material in their nucleus.

2 Name four features of Kingdom Fungi.

Fungi develop from tiny spores, contain a nucleus, do not make their own food and feed on the remains of dead animals and plants.

3 Name an organism made up of just one cell.

Student answers may vary, but a typical answer is bacteria.

Apply and analyse

4 How is a protist different from a bacterium?

A protist is different from a bacterium because its cells have a nucleus: eukaryotic. As a group, protists are much more varied than bacteria and can be either multicellular or unicellular.

5 What is the difference between cells in Kingdom Plantae and Kingdom Fungi?

Cells in the plant kingdom gain energy by making their own food from sunlight, whereas those in the fungi kingdom do not. (Plant cells make food whereas fungi cells break down organic matter.)

Evaluate and create

6Why was the invention of the microscope important to our understanding of living things?

The invention of the microscope was important to our understanding of living things because it had a big impact on scientific thinking. Very small organisms were discovered that did not fit

5.6 Animals that have no skeleton are called invertebrates

Student book answers (pages 90–91)

Check your learning 5.6

Remember and understand

1 Animals are divided into two main groups.

a What are the names of the groups?

Vertebrates and invertebrates

b What do the names of these two groups mean?

Vertebrates have an endoskeleton (internal skeleton). Invertebrates have no internal skeleton; they may have an exoskeleton (external skeleton) or no skeleton.

2 What percentage of animals are invertebrates?

96%

3 Give two examples of animals with an exoskeleton.

Any 2 of: beetles, crabs, grasshoppers, cockroaches etc.

4 Give two examples of animals with no skeleton at all.

Any 2 of: worms, snails, slugs, jellyfish, sea stars, leeches etc.

Apply and analyse

5 Beetles have segmented bodies and jointed legs. To which phylum do they belong?

Arthropods

Evaluate and create

6 Eighty per cent of animals on the Earth are arthropods.

a Which characteristic does their name refer to? (Hint: ‘arthritis’ and ‘podiatrist’)

The word ‘arthropod’ means ‘jointed feet’, which refers to the jointed legs these organisms have.

b Draw three different arthropods and label the features that make them part of this phylum.

Answers will vary depending on arthropods drawn, but emphasis should be on their jointed legs.

5.7 Vertebrates can be organised into five Classes

Student book answers (pages 92–93)

Check your learning 5.7

Remember and understand

1 What are the main characteristics of mammals?

The main characteristics of mammals are that they give birth to live young and they produce milk to feed their young.

Apply and analyse

2 A dolphin lives in the ocean and has fins. It breathes air, gives birth to live young and feeds them milk. To which class does it belong? Explain.

Dolphins belong in the class Mammalia as they give birth to live young and produce milk to feed their young.

3 A flying fox can glide through the air like a bird but is covered in fur. To which class does it belong? Why?

Flying foxes, although similar in structure to birds, belong to the class Mammalia as they give birth to live young rather than lay eggs and they produce milk to feed their young.

4 What does a placental mammal look like when it is born? How does this differ from monotremes and marsupials?

Placental mammals look similar to their parents when born whereas monotremes and marsupials are born immature and look nothing like their parents.

Evaluate and create

5 Seals have fins like fish and live on the land and in the water like amphibians.

a Find out how a seal’s young are born.

Seals give birth to live young, usually on land. The young are well developed at birth and grow and develop into self-sufficiency very quickly.

b Given that the seal has long whiskers, is endothermic and breathes air, to which class of vertebrate does it belong?

Seals belong to the Mammalia class of vertebrates.

6 The vertebrates have five classes: Mammalia, Reptilia, Amphibia, Aves and Pisces. What are the more common names for these classes?

Mammals, reptiles, amphibians, birds and fish

5.8 Plants can be classified according to their characteristics

Student book answers (pages 94–95)

Check your learning 5.8

Remember and understand

1 What kind of plants are:

a ferns?

Ferns do not form seeds but have vascular tissue.

b mosses?

Mosses have no vascular tissue abnd do not form seeds, but they do have structures that look like leaves and roots.

2 Which group do these household plants belong to?

a fruit tree

Angiosperms

b palm tree

Angiosperms

c green weed in a fish tank

Angiosperms

d maidenhair fern

Pteridophytes

e bird nest fern

Pteridophytes

f moss on the path

Bryophytes

g rose bush

Angiosperms

h vegetables

Angiosperms

i pine tree

Gymnosperms

j grass and lawn

Angiosperms

3 How do mosses, ferns and conifers reproduce?

Mosses and ferns reproduce with spores, and conifers produce pollen cones.

4 What is the difference between vascular and non-vascular plants?

Vascular plants have tube-like structures that carry water inside the plant. Non-vascular plants do not contain these structures and can absorb water through all parts of their structure.

Apply and analyse

5 Who am I? I am large and green. I use sunlight to make my own food. I smell nice and like to come inside at Christmas. Some people do not like me because my leaves can be prickly and needle-like. I use a cone to help me reproduce. Which plant phylum do I belong to?

Gymnosperm

Evaluate and create

6 Locate a plant in your garden.

a Draw a labelled diagram of the plant.

b What features could you use to classify your plant?

c Name at least one feature that is not currently present that would help you classify your plant.

Student answers will vary.

5.9 Science as a human endeavour: The first Australian scientists classified their environment

Student book answers (pages 96–97)

Extend your understanding 5.9

1 Find out about the kind of environment that the Anangu lived in and the foods they ate to survive. List at least five animals and five plants they ate.

Student answers will vary.

Plant food sources: bush onion, desert raisin, bush plum, quandong, seeds of native grasses, wattle seeds, nectar from grevillea etc.

Animal food sources: honey ants, witchetty grubs, kangaroo, goannas and their eggs, bird eggs etc.

2 The early explorers left this environment because they couldn’t survive. Why did they struggle to find food here?

Student answers will vary. Typically: The early European explorers lacked local knowledge about where and when the food would be available, and lacked the flexibility to embrace new food sources. They were also ignorant about water holes and their food searches were compromised by low water availability.

3 In a group of four, use a large sheet of paper to create two collages on the one sheet, one showing living things and one showing non-living things you would expect to find in Uluru–Kata Tjuta National Park. One pair should create the ‘living’ collage and the other should create the ‘non-living’ collage.

Student answers will vary.

4 Why do you think the Anangu devised a system of classification for the natural habitats around them?

Student answers will vary. Typically: Aboriginal people needed to see differences between ecosystems in Uluru and Kata Tjuta to understand the cycles of growth and activity in the context of the seasons. In this way they could predict food and water availability, and plan their movements to provide food for their families.

5 Investigate the mammals, reptiles, birds and invertebrates found in the Uluru–Kata Tjuta National Park. Make a list of five for each category. Classify each one into its correct group.

Student answers will vary.

7 One of the classes of vertebrate is Amphibia. What characteristic of amphibians would make it difficult for them to live in arid environments? What other animal classes would struggle to survive in arid environments?

Their moist skin and their need to lay eggs in water would make it difficult for amphibians to live in arid environments. Fish would also struggle to survive here.

8 Why do you think the bilby’s pouch is rear facing?

Student answers will vary.

9 Discuss why monotremes would find it difficult to breed in arid environments.

Student answers will vary.

10 Investigate which mammals can be found in Australia’s arid environments. Classify each of these mammals as placentals, monotremes or marsupials. List any specific Latin double names (genus and species) given for each animal.

Student answers will vary.

Review 5

Student book answers (pages 98–99)

Remember and understand

1What is an organism?

An organism is a living thing that has (or can develop) the ability to act or function independently. It can react to stimuli, reproduce, grow and maintain a stable internal environment. It can be a bacterium, protist, fungus, plant or animal. Viruses are not regarded as organisms because they require a living host cell to reproduce.

2 Give an example of plants moving by themselves.

Student answers will vary but may include that sunflowers turn their ‘heads’ to follow the sun and leaves face the sunlight.

3What are the advantages of using a dichotomous key?

The advantage of using a dichotomous key is that it requires simple ‘yes’ or ‘no’ decisions. Each answer leads to another branch and another question and it is often simple to follow and understand.

4 Why is it important for scientists to use a common system to group all living things on the Earth?

It is important for scientists to use a common system to group all living things because they may inadvertently identify the same organism in a different way. Also, it is easier for scientists to infer something about one species when a similar species has already been classified.

5 What is the difference between vertebrates and invertebrates? Write a definition for each.

Vertebrates have an endoskeleton. Vertebrates are the group of animals that have a backbone and a nerve cord that runs through the backbone. Invertebrates have an exoskeleton or no skeleton. Invertebrates are the groups of animals that do not possess a backbone.

6 List the five main classes of vertebrate and give an example of each.

The five main classes of vertebrates are Mammalia (e.g. human), Reptilia (e.g. crocodile), Amphibia (e.g. golden bell frog), Aves (e.g. kookaburra) and Pisces (e.g. Murray cod).

7 List at least five phyla of invertebrates and give an example of each.

Any five of: poriferans (e.g. sea sponges), cnidarians (e.g. jellyfish, coral, anemone), molluscs (e.g. snails, shell-covered aquatic animals, octopus), nematodes/annelids (worms; e.g. leech, tapeworm, flatworm), echinoderms (e.g. sea star, sea urchin, sea cucumber) and arthropods (e.g. spiders, insects).

Apply and analyse

8 ‘Biodiversity’ is the word used by scientists to describe a variety of different organisms in the same region. Why is it important to preserve a large biodiversity of plants and animals in the world?

Student answers will vary.

9 Imagine that an unknown organism was discovered during a space mission and brought back to Earth. Briefly outline two different methods that scientists could use to decide whether it was living or non-living.

Scientists would need to identify whether the organism had all the characteristics of a living thing, such as whether it breathes, moves by itself, needs nutrition, can reproduce, grows as it gets older, responds to stimuli, exchanges gases with the environment, produces wastes and requires water. This might be especially challenging to do for an organism from space because it may have unique ways of fulfilling the characteristics or it might be in a state of hibernation. Scientists could place it in sealed atmosphere and monitor changes in levels of gases or water vapour.

10 Refer to Figure 5.14 showing Dr Redback’s family. How might you adjust the dichotomous key in Figure 5.15 if his ‘family’ included his sister, Melinda; his mother, Frances; he had two daughters, Stef and Gemma (Stef wears glasses); and he had a pet lizard named Stealth, but not a bird named Charlie?

Student answers will vary. Typically students may choose to:

**•** change the ‘feathers covering body’ to ‘scales covering body’ to include the pet lizard

**•** add ‘immediate family members’ and ‘other family members’ to include his sister and mother

**•** add another branch for females under 20 to separate the daughters

**•** remove the ‘facial hair’ branches as Dr Redback will now be the only male

**•** remove the ‘able/unable to walk’ branches as all family members are able to walk.

11 Place the items in the following list in the correct columns in Table 5.2: *stewed apple*, *iPod*, *daffodil bulb*, *DVD* , *hairs in your brush*, *your teacher*, *shark’s tooth*, *germs*, *soft drink bottle*, *your pet*, *silver chain*, *dinosaur skeleton*.

|  |  |  |
| --- | --- | --- |
| **Living** | | **Non-living** |
| **Currently living** | **Dead** |
| daffodil bulb | stewed apple | iPod |
| your teacher | shark’s tooth | DVD |
| your pet | dinosaur skeleton | soft drink bottle |
| germs | hairs in your brush | silver chain |

Evalute and create

12One of the main contributors to the *Encyclopedia of Life* is the *Atlas of Living Australia*. Do an Internet search for the *Atlas of Living Australia* and click on ‘Explore’. From this page you can create a species list and map for the area in which you live.

a What is the most frequently seen animal in your area?

b What is the most frequently seen plant in your area?

Student answers will vary depending on the area.

13 Look at Table 5.3, showing the number of living things on the Earth.

aHow many species of plant are estimated to be on the Earth?

It is estimated that in excess of 390 800 species of plant live on Earth.

b Compare the number of *known* plant species with the total number of *known* animal species (add animals without a backbone and animals with a backbone together). Are you surprised with the result? Explain.

There are 1 424 153 known animal species and 297 857 known plant species on Earth. Students may or may not be surprised with this comparison: Animals have the ability to move around and change their habitat if required, while plants must remain where they grow. Animals tend to breed more quickly than plants and so will adapt more quickly to their environment, creating more different species.

14 Download a copy of the collection of insects in Figure 4.45 from your obook.

a Cut out the pictures of the insects so you can move them around on your desk.

No answer required.

b Working on your own, sort the insects into groups based on some aspect of their appearance. Justify your system of classification

Student answers will vary, but include groups based on the number of wing pairs, the length of antennas or body shape.

c Compare your groupings with those of a partner. Between the two of you, can you think of other ways to classify the insects?

Students answers will vary.

d With your partner, create a dichotomous key for this group of insects.

Student answers will vary, but must show logical divisions at each branch.

15Design an experiment to show that plants are living things that respond to stimuli. Choose one stimulus only (such as reaction to light or to a lack of water) to investigate. This stimulus is the experimental variable, so you will need to change the variable in some way and control the rest of the variables in the experiment. Make a list of the equipment you would need.

Student answers will vary.

16 Why was the invention of the microscope important to the development of the classification system? How did it change the number of organisms for identification, classification and communication?

The invention of the microscope was important to the development of the classification system because it had a big impact on scientific thinking. Very small organisms were discovered that did not fit into either the plant or animal groups. It also meant that a more systematic approach was needed to ensure all species could be included as the number of organisms requiring identification, classification and communication increased dramatically.