Curriculum guidance

Diversity

Why do scientists classify?

Until the 1960s, any group of scientists could land on the Antarctic continent to do research. Often, the groups would be working on the same organisms but with different names. Each would publish their results in their own language. The scientists worked as isolated groups to help them share the results of their efforts.

Three days at the Antarctic continent had a common twist: working together to conserve every type of plant and animal in this very special continent.

How do scientists organise life?

In 1895, the first group of scientists were founded, with the aim of studying the Antarctic continent to do research. Often, the groups would be working on the same organisms but with different names. Each would publish their results in their own language. The scientists worked as isolated groups to help them share the results of their efforts.

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2. Eye colour
3. Hair colour
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Big Ideas

The idea of classification should be approached as a human construct that is attempting to bring order and understanding to a complex world. Therefore there are great opportunities for a large emphasis on the area of science as a human endeavour and inquiry skills. It is important to emphasise that evidence for evolution was largely through the idea of differences between species.

Therefore there should be an emphasis on the differences between species, rather than using this chapter as a ‘method of classification’ section. Opportunities linking to the work of Darwin and other ‘early biologists exist here, as they will enhance the link to the evolution aspect of the Big Idea in Year 10. This topic also allows specific references to adaptations which may well have been introduced in Year 6, and also the idea that different species or groups are found in different habitats.

Summary

Differences between living things can be observed and this helps classify organisms at a range of different levels. This diversity has arisen from evolution over time and classification can help to provide evidence for this evolution.

2.2 How do scientists organise life?

1. Taurus is a Latin word meaning ‘bull’, which would explain the researchers’ name for the antarctic.
2. Two characteristics that make Tauroglossus antarcticus seem to be plants are:
   a. They have branches.
   b. They lay roots into the sea bed.
3. To divide a class, the characteristic used could be:
   a. Sex (male/female)
   b. Eye colour
   c. Hair colour
   d. Eye colour

2.3 Where do I fit in?

1. Qualities or features of animals may include:
   a. Respiration
   b. Movement
   c. Cells
   d. Reproduction
   e. Respiration
   f. Movement
   g. Cells
   h. Reproduction
   i. Respiration
   j. Movement
   k. Cells
   l. Reproduction

2.4 Characteristics which are similar to human characteristics include:
   a. They are social
   b. They communicate
   c. They have teeth
   d. They are protective of their young
   e. They nurture their young with mammary glands
   f. The adults teach their young
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   L. They nurture their young with mammary glands
   M. The adults teach their young

Answers

2.1 Why do scientists classify?

1. Three regulations or rules scientists might have to agree to before undertaking research in the Antarctic would include (students may suggest other plausible options):
   a. Abide by the treaty and the Antarctic Treaty
   b. Share the results of their work; freedom of scientific investigation
   c. Undertake an assessment of planned activities and the ‘scientific research’ framework of the treaty
   d. Follow the regulations or rules scientists might have to agree to before undertaking research in the Antarctic

2. The treaty has been signed by 45 countries including: Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, Poland, South Africa, Russia, United Kingdom and the United States of America

3. The Antarctic Treaty protects every type of plant and animal and therefore all resources these organisms need to survive.

ID02.01 Weblink: Antarctic Treaty classroom resources
2.1 WHY DO SCIENTISTS CLASSIFY?

Every year, scientists are discovering plants and animals that have never been seen before. What if you were to find a new organism at your school? How would you know that no one else had discovered it before you? Could you describe it so that everyone else would know that it was alive?

Why do scientists classify?

Early classification methods

Early European classification systems, such as those used by Aristotle (384–322 BCE), classified animals as either living or non-living. Scientists used these systems to classify plants and animals, and to communicate their findings. However, these systems were limited, as they did not take into account the diversity of life on Earth.

Aristotle's system was based on the concept of a hierarchy, where all living things were divided into categories based on their characteristics. For example, animals were divided into those that breathe air (e.g. fish and birds) and those that do not (e.g. plants and fungi). Each category was further divided into subcategories based on additional characteristics, such as whether the organism was plant or animal, and whether it was living or non-living.

Linnaeus's system

Linnaeus's system was based on the concept of binomial nomenclature. Each organism was given a two-part scientific name, consisting of the genus and species. This system allowed for greater precision in naming organisms, and made it easier to communicate findings.

The history of classification

Early classification systems didn't have the tools or knowledge to make or record images of their discoveries. Most of their communication was written as writing or letters, and spread around the world in the form of books. As scientists learned more about the plants and animals in their environment, they began to divide them into groups based on their characteristics. This process of classification is still used today to help scientists understand the diversity of life on Earth.

Early classification methods

ICT

A wide variety of examples of early ‘encyclopedia’ illustrations are available to view on the Internet. Students could search for the following titles to prepare for their understanding of early classification:

- Al-Jahiz –-kitāb al-ahbar
- Aristotle – Scala Naturae
- Carolus Linnaeus – Bibliotheca Botanica
- Andrea Cassalpino – De Plantis Libri XVI
- Conrad Gesner – Historiae animalium.

Who am I?

Choose a partner to work with. Describe an animal to your partner—make sure you don’t use the animal’s name. Your partner should try to draw the animal you describe. How accurate are they?

Who do scientists classify?

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Early classification methods
Critical and creative thinking: Literacy

Ask students to carefully examine Figure 2.7, which shows a section of Linnaeus’ classification system. A more complete version could also be obtained. The language used in this document is Latin, however these are some examples.

1 Arguments for non-living—doesn’t have ALL of the criteria of life. It doesn’t have a cell membrane, doesn’t have DNA, doesn’t exchange gases with the environment.

2 Aristotle used an order of least important (rocks) to most important (wild animals, man, etc.), and then divided this into animals with blood (dogs, cats, etc.) and those he thought had no blood (insects, worms, etc.).

3 Carl Linnaeus simplified the classification system previously used because he found the descriptions too long and decided there needed to be a simpler system.

4 An ‘animalcule’ is a tiny (microscopic) organism named by Antonie van Leeuwenhoek to describe the microbes he saw in his water supply.

5 Scientists still classify animals today in order to organise life forms in a logical fashion. This helps us to better understand the world.

Finding new species

Students will most likely have learned the term ‘species’ prior to Year 7. It may be appropriate, however, to remind them of the definition.

A species is the basic unit for classification—each species will have its own classification. Organisms within a species are capable of successfully interbreeding to produce fertile and viable offspring.

This term could be linked to the theory of evolution, in which scientists explain the diversity of species on Earth. Evolutionary theory also provides explanations for changes within and between species, in the past and in the future.

PRACTIVITY 2.1

The great Guzzlemobile debate

Students may come up with additional ideas, however these are some examples.

1 Arguments for being a living creature. The other pair has to argue that it is not alive.

2 Aristotle was one of the first scientists to try to gather information from wide regions. What method did he use to organise all the observations from his observations?

3 Why did Old Carl Linnaeus simplify the classification system using previous scientists?

4 What is an ‘animalcule’?

5 Give two reasons scientists still classify organisms today.
Living and non-living

Students should examine the images that represent the eight characteristics of living things in Figures 2.11–2.18.

While some of these characteristics are straightforward, several will require discussion for clarification and to dispel students’ misconceptions. For example, students regularly struggle with the idea of plants moving. Ask students what wastes they think plants get rid of through their leaves.

Students should attempt to provide alternative examples for each characteristic to reinforce their understanding. Prompts are provided in the captions.

Movement

Plant movements need to be clarified for many students. Simply blowing in the wind is not considered to be movement as the plant is not in control. Movement is generally through the action of chemicals (plant hormones) that control the growth of cells on one side of a stem or another to cause the stem to bend. Similarly, growth in certain areas of a plant can result in the plant reaching towards sunlight due to warmth triggering hormone production. Movement in plants is not necessarily for travel, but often in response to environmental stimuli.

Microorganisms are capable of movement due to the action, in many cases of cilia or flagella. Cilia are tiny hairs that line the external surface of the microbe and ‘beat’ to propel the organism; flagella are whip-like ‘tails’ that can flick or move in a spiral manner to act like a motor on a man-made object.

Reproduction

Reproduction is covered in Year 8; however, certain examples provided here will reinforce the variability of reproductive strategies employed by living things.

Plants can reproduce through the action of seeds, but many also produce spores (firms) or are able to generate new plants through vegetative reproduction. This last form involves parts of the plant ‘breaking off’ to form a new plant, for example bulbs that can be split or runners that put down new root systems.

Microbes generally use binary fission, which translates to ‘splitting in two’. All the contents of the organism (cell) need to be doubled before this occurs so that the new cells are identical to the original parent cell.

Students may find it interesting to research examples of reproduction by animals.

Nutrition

When asked why they eat, many students are likely to refer only to food as a source of energy. Students should be asked to think of all the other reasons food is required by living things. Growth, repair, defense, and reproduction are just a few, not to mention the healthy functioning of muscles, bones, and other organs.

Growth

Students should be aware that growth is not simply ‘getting bigger’. Many organisms change throughout their life cycles, and this can be significant or minimal. Examples of each should be explored.

Response

Responding to the environment is an essential characteristic of all organisms. A response may be fast-acting or slow-acting and will depend on the potential consequences of the stimulus. Burning yourself needs a fast response to minimise damage, while feeling warm can be suffered for longer before you eventually decide to remove a jumper, have a cold drink or open a window.

Exchange gases

The function or purpose of the gases may be mentioned: oxygen is responsible for releasing energy from food through a chemical reaction called respiration, while carbon dioxide is responsible for producing food in plants and some microbes through photosynthesis.

Wastes

All substances are potentially toxic to organisms if they occur in large enough amounts. A system for monitoring the amounts of substances and removing them accordingly is therefore required by all organisms.

Carbon dioxide is a waste product of respiration in both plants and animals; plants can use this carbon dioxide in photosynthesis, while animals need to remove it through exhalation.

Oxygen is a waste product of photosynthesis, and again plants are able to use it in respiration.

Water

The importance of water in a healthy organism is something on which students could elaborate. When a person is dehydrated, they are often tired, grumpy, and have a headache. We often mistake thirst for hunger. Additionally, controlling the growth of microbes in our homes can be done simply by keeping surfaces dry. Ask students to consider these points.

Plants are generally incapable of quick responses; however, nastic responses are similar to our nervous system’s reflexes. Nastic responses can be seen with plants such as the Venus flytrap that snaps shut when hairs are stimulated by insects, and Mimosa pudica that curls its leaves when the hairs are brushed to avoid predation.
Answers
What do you know about living and non-living?

1. The two groups scientists divide all things into are Living and Non-Living.
2. See the table at the bottom of this page.
3. The roast chicken is dead because it once had all the characteristics of a living thing.
4. Students will create their own mnemonics.
5. A bushfire is non-living as it does not require water. If water is applied to it, it will extinguish the fire and thus ‘kill’ it.

Eucalypt tree Water Paper Robot Leather belt Wombat Roast chicken

1. Moves by itself Y N N N N Y N
2. Reproduces itself Y N N N N Y N
3. Requires nutrition Y N N N N Y N
4. Grows as it gets older Y N N N N Y N
5. Responds to changes in its environment Y Y N N N Y N

Table 2.1: What do you know about living and non-living?

1. Write a partner or by yourself, decide if each of the items meets the requirement to be classified as a living thing.
2. Decide if each should be classified as living or non-living.

Living or non-living? L NL NL NL NL L NL

2.1 WHY DO SCIENTISTS CLASSIFY?

Imagine how useful it would be to have a list of every single living species on the Earth. Now imagine how long the list would take to compile given that there are nearly 2 million known species on our planet.

This seemingly impossible task has now been taken on by Edward O. Wilson, one of the world’s most well-known biologists. He is developing an online database of all life on Earth. This database of life (EOL) aims to make all knowledge of the world’s known species freely available to all. The initiative was launched on 9 May 2007. As new species are discovered, they will be added to the database. Every species will have its own page, with links to all known information about that species. The EOL will be used by scientists for research, teachers and the public to gain a better understanding of all life on the Earth. People are saying that this is the most significant development in the life sciences for more than 250 years. The EOL will be a global tool and will be used by people around the planet. The richness of life will only be one click away!

ZOOMING IN
Encyclopedia of Life

Students could investigate the website of the Encyclopedia of Life. They could comment on the information they discover and suggest the intended audience for the project.

Comparisons could be made with similar projects such as:
- Atlas of Living Australia
- Tree of Life
- Catalogue of Life
- Global Biodiversity Information Facility
- ZooKeys.
2.1 Why do scientists classify?

**BIG IDEAS**

### Diversity

Why do scientists classify?

**Remember and understand**

1. The eight characteristics of living things are:
   a. Movement
   b. Reproduce
   c. Nutrition needed
   d. Grow as they get older
   e. Respond to stimuli
   f. Exchange gases with their environment
   g. Waste produced
   h. Water required

2. 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 homeostasis. It can be a virus, bacterium, protist, fungus, plant or animal.

3. ‘Dead’ refers to something that was once living.

4. Examples of plants moving by themselves:
   a. Sunflowers turn their heads to follow the sun.
   b. Leaves face the sunlight.

5. A living plant needs nutrition such as sunlight, water and adequate soil including nitrogen, potassium and phosphorus.

6. It is important for scientists to use a common system to group all living things because they may inadvertently identify the same organism. It is also easier for scientists to infer something about one species when they have another species classified that is similar.

7. Plants exchange oxygen and carbon dioxide with their environment during photosynthesis.

**Apply**

8. It is important to preserve a large biodiversity of plants and animals as it is a measure of the health of an ecosystem. A diverse ecosystem is more likely to be able to recover from a disturbance and the availability of medicinal resources such as penicillin and aspirin.

9. In order for scientists to decide if something is living or non-living, they need to identify whether it has all the characteristics of a living thing such as whether it breathes, moves by itself, needs nutrition, can reproduce, grows as it gets older, respond to stimuli, exchange gases with the environment, produce wastes and require water. (Two of these would be required.)

10. Today, scientists commonly use photography or videos to show what an organism looks like. What is an organism?

**Analyze and evaluate**


12. Answers will vary depending on the area you live in.

13. Refer to Table 2.2

   a. It is estimated there is in excess of 10927630 species on Earth.

   b. Answers will vary. Some students will be surprised, others won’t. Animals on Earth—2144155. Plants on Earth—297857.

14. Answers will vary – some interesting animals are the eyelash mite, pony fish, vampire bat, echidna, platypus, etc.

### Diversity

- **Applying characteristics**
  
  - The eight characteristics of living things are:
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    - Nutrition needed
    - Grow as they get older
    - Respond to stimuli
    - Exchange gases with their environment
    - Waste produced
    - Water required

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- **Classifying**
  
  - Today, scientists commonly use photography or videos to show what an organism looks like. What is an organism?
Scientists group the millions of living things on the Earth so that they can see similarities and differences between organisms. This system helps scientists to communicate with each other when describing the characteristics and behaviour of living things. What characteristics do scientists use to divide the different animals into groups? How big are the groups? How do scientists classify living things?

Using dichotomous keys

A key is a visual tool used for the classification of organisms. A key is often more useful than a list of characteristics and similarities of each group. A branched key (it looks like a tree) helps us to see how a particular member of the group fits in with all the rest. One common type of key is called a dichotomous key (pronounced ‘die-ko-TOM-us’) as each branch is split into two (yes or no) decisions. Dictionaries use this type of key to make simple ‘yes’ or ‘no’ decisions at each branch. For example, does the animal have fur? Does it have scales? (Yes or no) Use arrows to move from branch to another branch and another question.

The following example is a newly discovered insect from the family Lepidoptera. A newly discovered organism would need to be studied first and then placed into branches.

Using keys

When you visit an outdoor market, you may wander around for some time before you find what you want. A department store is more organized, with similar items grouped together. If you were looking for the latest movie on DVD, you would first locate the electronics section. In that section you will often find the recordings and descriptions of organisms easier to find.

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The following example is a newly discovered insect from the family Lepidoptera. A newly discovered organism would need to be studied first and then placed into branches.
Answers

What do you know about using keys?

1. 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.

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

3. The term ‘classifying’ means to divide or group something based on certain characteristics.

4. Classifying groups of birds:
   a. Is eating bird seed—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—good because it describes something the bird can be identified by.
   c. Has a wing span of 32 centimetres—good but would need to be accompanied with other information (juvenile/adult, colour etc).
   d. Has a broken leg—bad because it describes something that is not permanent.
   e. Is sitting on the ground—bad because it describes a characteristic that is not permanent.
   f. Has a high-pitched, bell-like song—good because not all birds have the same song.
   g. Has brown tail feathers—good as it describes the behaviour of the bird’s plumage.

5. Answers will vary—students are likely to group the observation by size first, however they could also start by grouping according to whether the equipment is used to measure or for another use.

6. Answers will vary depending on which dinosaurs are researched.

7. a. Grot
   b. Frap
   c. Grype
   d. Frap

   Students’ drawings should have the following elements:
   i. Frap—round, no antennae, stripes, no wings
   ii. Grop—oval, antennae, stripes, wings
   iii. Grpe—oval, no antennae, stripes, wings
   iv. Frong—round, antennae, stripes, no wings.

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**Dichotomous keys**

**Challenge**

Using what you have discovered about the characteristics of living things, design your own dichotomous key.

**Questioning and predicting**

Think about objects that could be sorted into five groups. For example, you might be able to separate foods, such as corn chips, fried foods or plain chips.

**Planning and conducting**

• What similarities or differences can you find to separate the objects into two groups?

• What similarities or differences can you find to separate them into further groups?

Keep classifying into two groups until each item is on its own.

**Communicating**

Draw your dichotomous key with another group. How effectively have they constructed a dichotomous key?

Ask them to evaluate your key. Which was the best dichotomous key designed in your class? What features made it the best key?

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**What do you know about using keys?**

1. What is a dichotomous key?

2. Why is it called ‘dichotomous’?

3. What are the terms ‘branching’ or ‘clustering’?

4. Which of the following descriptions would be good to use to classify a group of things in a dichotomous key?

   a. is eating bird seed
   b. has blue stripe above the eye
   c. has a wing span of 32 cm
   d. has yellow legs
   e. is sitting on the ground
   f. has a high-pitched, bell-like song
   g. has brown tail feathers

5. Design a key that could be used to identify laboratory equipment. Unlabel these items: tripod stand, hot plate, beaker, graduated cylinder, 150 mL beaker, 100 mL measuring cylinder, 10 mL measuring cylinder, 500 mL beaker, 500 mL measuring cylinder, retort stand, clamp.

6. Design a dichotomous key to identify dinosaurs.

   a. What would you need to be identified?
   b. What is a good method of classification?

   c. Is eating bird seed?
   d. Has a blue stripe above the eye?
   e. Has a wing span of 32 cm?
   f. Has yellow legs?
   g. Is sitting on the ground?
   h. Has a high-pitched, bell-like song?
   i. Has brown tail feathers?

7. Design a key to classify birds using 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.

8. Answers will vary depending on which dinosaurs are researched.

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**OVERARCHING IDEAS**

**Finding the key**

The reverse listing key names two things that a non-living thing could never have.

The ‘what-if’ key

What if living things did not exist? What would the earth be like?

The question key

The answer is ‘single-celled organism’. Think of five questions that give only that answer.

The construction key

Use materials from around your classroom to construct your own type of classification key.

The combination key

Make a list of the attributes of a plant cell and animal cell. Combine the attributes of these two things to make a new and better type of organism.

The disadvantages key

Make a list of the possible disadvantages of classifying things into groups. Suggest ways to correct or eliminate each disadvantage.

The prediction key

Predict what types of organisms might be discovered in the next twenty years.

The alphabet key

Prepare a list of words from 1 to 4 that describe things that a living thing can do.

The community key

What do living things and non-living things have in common?

---

**OVERARCHING IDEAS**

Finding the key

The reverse listing key—a non-living thing could never: move, feed, reproduce, grow, respond, exchange gases, produce waste, require water, think, sense the world (light, hear, etc.).

The ‘what-if’ key—living things did not exist there wouldn’t be much variation. Earth would be a very still and quiet place.

The question key—suggestions include:

1. What is a unicellular organism?
2. What are bacteria?
3. What is the opposite of multicellular?

Construction key—answers will vary depending on classroom resources.

Combination key—new organism will vary depending on student:

- attributes of an animal cell—cell membrane, flexible, nucleus with genetic material
- attributes of a plant cell—cell wall, rigid, nucleus with genetic material

Disadvantages key—suggestions include:

1. We may not identify the species correctly due to lack of information
2. Confusion could occur, for example, it is often debated whether viruses are living or non-living. To correct this, there could be an extra classification group. Archaea, as suggested recently and update the classification as new information is discovered.

Prediction key—organisms are likely to be discovered in the next 20 years. Students may like to be more specific than this.

Alphabet key—students are likely to have things such as respiration, Respond, nutrition, waste, exchage gases, reproduction etc.

Community key—both have a mass/weight, both take up space, made of cells, require all the characteristics of living things, driven by laws such as law of gravity and contain genetic material.
The Linnaean classification system

Literacy: ICT

To reinforce the hierarchy described by Linnaeus, ask students to examine the series of names used to classify the domestic cat in Figure 2.28.

Students could be asked to select three animals or plants and create a similar classification tree for each. They could present their research in the form of a poster that includes an image of the organism and the common name, where appropriate. Students should represent the binomial name using the scientific conventions:

- genus and species
- using the scientific conventions: Students should represent the binomial name of a poster that includes an image of the organism or plants and create a similar classification tree for to classify the domestic cat in Figure 2.28.

The Linnaean classification system

Deciding to use an enormous dichotomous key to classify every living thing was largely the work of a new named Carl von Linné (1707–1778). This system of classification, called the Linnaean taxonomy, is still used today.

Linnaeus was born in Sweden in 1707 and was originally studied medicine. However, his real love was for collecting plants and he went on many expeditions to different countries to collect new plants. He was able to make sense of all of the plants he had collected by naming them. He worked as a professor at the University of Upsala in Sweden, in his spare time, arranged all the plants in a system similar to his own system of classification.

Linnaeus’s classification system was extended from just grouping plants to classifying all the kingdoms of living organisms.

Making a field guide

Scientists often use field guides to determine the group to which an animal belongs. These guides are visual and a tabular key, where you read through the numbered options in a table, until you get to the bottom. Each question presents two options and the answer information is given at each step. Eventually, the final answer can be identified.

1. Use the information given to identify the class of each of the animals shown.

2. The information given is about the class of each of the animals shown.

3. The information given is about the class of each of the animals shown.

4. The information given is about the class of each of the animals shown.

5. The information given is about the class of each of the animals shown.

6. The information given is about the class of each of the animals shown.

7. The information given is about the class of each of the animals shown.

Understanding scientific names

The scientific names of animals usually come from Latin (and sometimes Greek) words. Why, you might ask, do scientists use Latin? The language of science for many centuries was Latin. This enabled scientists who lived in different countries and spoke different languages to use a common language to communicate their work and discoveries.

The words used describe physical features, behaviors and other characteristics of organisms. Some basic understanding of Greek and Latin will help you to interpret scientific names. Table 2.3 contains some examples.

PRACTIVITY 2.3

Making a field guide

The animals in the images fit the following classes from top left—clockwise: Aves, Mammalia, Pisces, Amphibia, Reptilia. A tabular key for Dr Redback’s family should resemble the following:

1. No feathers covering body
2. Go to 2
3. Feathers covering body
4. Go to 2
5. Hair all over body
6. Go to 3
7. Hair covering parts of body
8. Go to 4
9. Long ears
10. Go to 5
11. Short ears
12. Go to 6
13. Long tail
14. Go to 7
15. Short tail
16. Go to 6
17. Unable to walk
18. Go to 9
19. Male
20. Go to 10
21. Female
22. Go to 11
23. No facial hair
24. Go to 12
25. Facial hair
26. Go to 13
27. Red hair
28. Vanessa
29. Not red hair
30. Daphne

Understanding scientific names

Critical and creative thinking: Literacy

Students could look at Table 2.3 to create their own combinations of Latin and Greek root words. They would form ‘new’ binomial names, then attempt to describe or draw their creatures. Illustrations with names could be displayed around the room. Alternatively, students could keep unlabelled drawings of classmates and ask them to work out what the name of the creature might be.

e-book

ID02.09 Weblink: Activity classifying organisms from kingdom to species Interactive activity to classify organisms from kingdom to species level. Suitable for students to demonstrate their understanding of how to classify.
What do you know about the Linnaean classification system?

1. Identification of species using Latin name:
   a. Macropus rufus – Red kangaroo
   b. Tachyglossus aculeatus – Short-beaked Echidna
   c. Pheucticus colobe – Koala
   d. Ornithorhynchus anatinus – Platypus
   e. Cidionyphomyia longipalpis – Frill-necked lizard

2. A Macropus rufus would, by name, be a large-tongued spiny creature.

3. Carl Linnaeus invented the naming system that is still used today to name living things.

4. The seven groups living things are divided into are: Kingdom, Phylum, Class, Order, Family, Genus, Species.

5. Giving your address as ‘John Campbell, Southern Hemisphere, The Earth’ is too general. It doesn’t provide enough information in order for someone to locate you to deliver the letters.

6. Taxonomists need very detailed systems, as they allow them to make sense of all the organisms studied and identify a specific species in a simple and practical manner. Every species can be given a unique name, as compared with common names that are often neither consistent nor unique.

7. The first level of the Linnaean classification system is Kingdom.

8. Species means a group of organisms that look similar to each other.

9. Answers will vary depending on animals chosen.

What do you know about cells in living things?

1. Cells are the basic unit of life. It is at the cellular level that we can study living things in a simple and practical manner. Every species can be given a unique name, as compared with common names that are often neither consistent nor unique.

2. The cells of unicellular organisms tend to be very basic in structure but may have external features such as a flagellum or cilia. Multicellular organisms are made up of large-tongued spiny creature.

3. The role of a cell wall is to provide extra support for the plant cell. It enables the plant cells to remain rigid in place of a spine like some animals.

4. An example of an organism containing just one cell is bacteria.

5. Multicellular means more than one cell.

6. The invention of the microscope was important to our understanding of things as it allowed us to view life previously unseen. It changed the classification system as scientists could consider smaller details when grouping organisms according to features.
BIG IDEAS
2.2 How do scientists organise life?

Remember and understand
1. The largest cell in the ostrich egg, which is about as big as an apple.
2. Most keys are dichotomous because scientists can make simple ‘yes’ or ‘no’ decisions at each branch.
3. Most animals are multicellular as they require more than one cell to carry out the functions needed to survive.
4. 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.
5. Two characteristics that would divide a class into two groups of equal size could be: gender, hair colour, eye colour.

Apply
7. Order of Linnaean classification system is: Kingdom, Phylum, Class, Order, Family, Genus/Group, Species.
8. Students’ own responses.
9. Students may opt to:
   i. Change the ‘feathers covering body’ to ‘scales covering body’ to include the pet Redback.
   ii. Add ‘immediate family members’ and ‘other family members’ to include his sister, Melinda, and mother, Frances.
   iii. Add another branch for females under 20 to separate the daughters.
   iv. Remove the facial hair branches as Dr Redback will now be the only male.
   v. Remove the able/unable to walk branches as all family members are able to walk.

Analyze and evaluate
10. Students’ own responses.
11. Other types of classification keys are:
   i. Tabular
   ii. Circular
   iii. Polydichotomous keys which offer several choices at each step.
12. Students’ own responses.

Critical and creative thinking

<<CONNECTING IDEAS>>
15. a. The dichotomous key was important to the development of the classification system as it provided scientists with a simple way to identify and group species based on what they observed.

<<DISCOVERING IDEAS>>
Grouping animals

Where do I fit in?
The animal kingdom contains a large range of organisms: from the tiniest fairy fly, which can fit within 1 millimetre, to the giant blue whale, which is up to 33 m long—about the size of a house. Size is not a very suitable characteristic for classifying animals into groups, especially as size grows over time. So what characteristics are chosen to group animals? And where do humans fit in this system?

1. Identify some of the difficulties of using your dichotomous key or the contents of someone else’s key or chart.
2. Analyse the different types of classification keys that can be used to identify organisms.
3. Describe a copy of the collection of insects in Figure 2.31 from your book.
4. Cut out the printed card and try to make sense of the content.
5. Identify your own family groups based on some aspect of their lifestyle. Add to your chart of family groups.
6. Compare your groupings with those of a partner. Between the two of you, can you refine the dichotomous key?
7. Write a short story to describe the challenges of using a dichotomous key.
8. Propose and discuss some of the advantages and disadvantages of a dichotomous key.

Critical and creative thinking
13. a. Why was the invention of the dichotomous key important to the development of the classification system?
14. b. What are the limitations of a dichotomous key?

Grouping animals
Responses will vary significantly. Students might discuss the difficulties or challenges associated with grouping organisms with which they are not familiar. They might also evaluate classification systems that are based purely on appearance, rather than examining an organism in its natural habitat.

Kingdoms
Literate
As students read through the information about the various kingdoms, they could be encouraged to prepare lists of the features that separate the groups. This information will assist them with Praxis 2.4 and the questions on page 68, as well as providing a quick reference. All the information they require is provided in short paragraphs.

The images selected to represent each kingdom highlight the variation within the kingdoms. For example, Kingdom Animals includes four of the five classes of vertebrates and one invertebrate.

Critical and creative thinking
What does the word ‘kingdom’ mean outside of science? Students will no doubt be familiar with the idea of a kingdom being a societal structure controlled by a king.

Ask the students to identify the levels of power in a kingdom. They can then use this structure to assist them in understanding the application of kingdoms to classifying living things.

Kingdom Animalia
All organisms in this kingdom are multicellular. Each cell has its own set of instructions for making the part of the organism it produces. Each cell, therefore, has its own genetic endowment, and each organism also has an endowment. Kingdoms are the scientists who study animals.

<<DISCOVERING IDEAS>>
Grouping animals

Where do I fit in?
The animal kingdom contains a large range of organisms: from the tiniest fairy fly, which can fit within 1 millimetre, to the giant blue whale, which is up to 33 m long—about the size of a house. Size is not a very suitable characteristic for classifying animals into groups, especially as size grows over time. So what characteristics are chosen to group animals? And where do humans fit in this system?

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Critical and creative thinking
13. a. Why was the invention of the dichotomous key important to the development of the classification system?
14. b. What are the limitations of a dichotomous key?

Grouping animals
Responses will vary significantly. Students might discuss the difficulties or challenges associated with grouping organisms with which they are not familiar. They might also evaluate classification systems that are based purely on appearance, rather than examining an organism in its natural habitat.
Kingdom Plantae

Critical and creative thinking

Figure 2.35 provides students with examples of five significant groups of plants. Additional examples could be found for each group. Similarities and differences within and between the groups could then be made to highlight the characteristics used to group organisms and simultaneously highlight the diversity within each group, both at Kingdom level and below.

Kingdom Fungi

Critical and creative thinking

Reinforce the key concept of diversity for students by examining the wide range of organisms that comprise the Fungi kingdom.

Within the mushroom group, students may be familiar with the range on offer at local supermarkets and green grocers, particularly due the influence of Asian cooking. Additionally, students are likely to have seen fungal growth on dead and decaying logs and trees. Plate fungi can comprise the Fungi kingdom.

Students could investigate these and other applications of fungi.

Critical and creative thinking

Some sources claim that a 3-domain system is now in effect. This system groups organisms into Archaea, Bacteria and Eukaryota. The Bacteria domain would therefore be comprised of the Monera kingdom, while plants, animals and fungi would fit into Eukaryota and protists into Archaea.

We have chosen not to use this system in order to simplify the delivery of the content to students and highlight the diversity without delving into the cellular structures that inform the 3-domain system.

Kingdom Protista

Critical and creative thinking

Protists are regularly referred to as ‘the leftovers’ or ‘miscellaneous group’. Ask students to consider the reasons behind placing organisms in this group.

A major deciding factor is lack of knowledge and understanding of the organisms. Similarly, the massive number of organisms on the planet requires time and energy to identify characteristics for classification purposes. This in turn requires someone to be interested in carrying out such a task, and others financing the project.
**PRACTIVITY 2.4**

Classifying living things

- **Seaweed** - Plantae
- **Shark** - Animal
- **Sea monkey** - Animal
- **Sea jelly** - Animal
- **Robot and ice crystals** are non-living.

Students could add other living things into their columns and could aim to have a certain number of organisms.

### Answers

**What do you know about Kingdoms?**

1. Four features of animals could include:
   - multicellular
   - genetic material in a nucleus
   - gain energy from other living things
   - cells don't have a cell wall
2. Four features of Kingdom Monera include:
   - simplest and smallest living things
   - unicellular
   - cells have a cell wall
   - no nucleus
3. A protost cell structure is more complex than that of a bacterium.
4. Kingdom Plantae gain energy by making their own food from sunlight, whereas Kingdom Fungi do not.

### ZOOMING IN

**Giant squid dissection released on the web**

*By Matthew Moore, 5:19PM BST 18 Jul 2008*

A giant squid has been dissected live on the internet for the first time—such as the giant squid's 18-minute clip has been made public for the first time.

The first live 18-minute online dissection was carried out by biologists in front of hundreds of school kids and biologists at Melbourne Museum in Victoria, Australia.

The team of scientists provided a running commentary as they revealed the squid's internal organs, including the three brains and three-gland shaped brains.

They also established the squid was female, and cut into her stomach in an unscrupulous attempt to discover her final meal.

**Classifying living things**

**What you need:** Sorting into Kingdoms* worksheet from your workbook or an A3 card/paper, scissors, glue.

The scientist whose nose is key to classifying living things is known as a taxonomist. In this activity, you become the taxonomist.

1. Download the *Sorting into Kingdoms* worksheet (or a copy of the worksheet) from the Melbourne Museum website.
2. Label the columns 'Animalia', 'Plantae', 'Fungi' and 'Other (Monera and Protista).'
3. Cut out each organism from the worksheet and paste it into the correct columns.

### Amazon Kingdoms

#### External or internal skeleton

In the same way as creating any kind of discipline key, dividing the animal kingdom into groups first requires a question. The system scientists use to divide animals into groups is based on their structure. The questions is: *Does this animal have an internal or external skeleton?*

Animals such as cats, humans and birds have an external skeleton (called exoskeleton) of bone, horn, or skin. Other animals with an external skeleton (exoskeleton) include crabs and crabs and their relatives (the crustaceans), marine spiders and crabs, and some snails and slugs, all of which have exoskeletons of all sorts—known as exoskeletons. Invertebrates dominate the animal kingdom.

Many people in the audience held their breath in front of their faces because of the revolting smell. The creature was wrapped up in fish nets and then viewed by the world's first direct inspection of its body. The camera took three days to focus on its features, and those who had never seen a squid in the flesh were disappointed. Female squids are not fit for human consumption, but this type of squid was a female, and we can see it in all its horrible glory in this video.

After tests on the squid are complete it will be cut and cut half and then peeled

**Examine the skeletons**

- Fish: The skeleton is outside the body.
- Squid: The skeleton is inside the body.

**Discussion**

1. Consider the fish. A. Where is the skeleton of the fish located? B. What is this type of skeleton called?
2. Consider the squid. A. Where is the skeleton of the squid located? B. What is this type of skeleton called?
3. Does the squid have a skeleton? A. In which group of animals (vertebrates or invertebrates) would you place each of the organisms (skeletally)? B. What are your reasons for placing each organism in the group you chose?
4. What types of skeletons are possible?

**考練問題**

1. 以下の生物をどの王国内に分類するか。
   - Robot (無機物)
   - Ice crystal (無機物)
   - Sea jelly (動物)
   - Sea monkey (動物)
   - Shark (動物)
   - Seaweed (植物)

2. *Kingdoms* は以下の4つから選びます。
   - Animalia
   - Plantae
   - Fungi
   - Other (Monera and Protista)

3. 以下のような問題を考える。
   - どの種類の動物に関するか。
     - 体内に骨があるか。
     - 体外に骨があるか。

### Examine skeletons

**Aim**

To examine the essential structures of these marine organisms.

**Materials**

- Fish (whole)
- Squid
- Newspaper
- Dissecting board
- Pair of safety glasses
- Rubber gloves

**Method**

1. Observe the external features of the fish.
2. Carefully cut the fish in half lengthways so you can see the internal skeleton.
3. Observe the skeletons of the fish.
4. Feel the outside of the fish and feel it half.
5. Cut the fish open in half and observe the skeleton.
6. Feel the outside of the squid and cut it in half.
7. Observe the inside of the squid.

**Discussion**

1. Consider the fish. A. Where is the skeleton of the fish located? B. What is this type of skeleton called?
2. Consider the squid. A. Where is the skeleton of the squid located? B. What is this type of skeleton called?
3. Does the squid have a skeleton? A. In which group of animals (vertebrates or invertebrates) would you place each of the organisms (skeletally)? B. What are your reasons for placing each organism in the group you chose?
4. What types of skeletons are possible?

**Safety**

The use of vinyl gloves is recommended, as latex gloves are usually made from proteins, which can be a cause of allergic and asthmatic reactions.

### Lab tech notes

Fish shops and markets, if given time, will supply whole squid, whole or filleted fish, and prawns.

**Class clean up**

- Dirty scalps to be collected and kept separate from other dissection equipment to avoid cuts.
- Ask the lab tech to clean.
- All other equipment should be washed in hot soapy water. Ensure safety glasses are free from specks and parts, they will smell.
- Wrap all specimens and dirty gloves in newspaper, place in and sealed bag, and bin.

### Experiment 2.1

**Examine skeletons**

**Aim**

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**Materials**

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- Squid
- Newspaper
- Dissecting board
- Pair of safety glasses

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6. Feel the outside of the squid and cut it in half.
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**Discussion**

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2. Consider the squid. A. Where is the skeleton of the squid located? B. What is this type of skeleton called?
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### ebook

- ID02:1a Video demonstration: Using dissection tools—Flower dissection
- ID02:1b Video demonstration: Squid dissection
- ID02:15 Video link: Giant squid dissection Museum Victoria demonstration of squid dissection. Introduces the concept of how these organisms evolved. Suitable for demonstrating scientists at work.
What do you know about Kingdom Animalia?

1. Animals are divided into two main groups:
   - Endoskeleton – meaning internal skeleton
   - Exoskeleton – meaning external skeleton
2. Examples of animals with an exoskeleton include: worms, snails, slugs, jellyfish, starfish, leeches etc.
3. About 95% of all animals are invertebrates
4. Invertebrates are such a dominant group because of their size. Their size allows them to occupy a wide variety of habitats as well as many microhabitats, which may not be visible to the eye.
5. The world’s biggest known invertebrate is the giant squid.
7. Dissecting a giant squid live on the Internet was interesting to so many people as it is a rare creature. Most people have not seen something this big before, nor have they seen a dissection done in such a way. Additionally, the running commentary allowed viewers to understand what was going on.

Class Mammalia

Critical and creative thinking

Students may be interested in the phenomenon of diapaus. Essentially, it involves marsupials and some other animals ‘pausing’ pregnancies until the conditions are suitable. Additionally, some marsupials are known for being ‘prematurely’ pregnant.

Students could consider the pros and cons of these strategies. They may also endeavour to explain how this may be possible.

Oxford Big Ideas Science 7: Australian Curriculum

2 Sorting Out Biodiversity

2.3 Where Do I Fit In?

Answers

What do you know about Kingdom Animalia?

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   - Exoskeleton – meaning external skeleton
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LITERACY LAB

The enigma of the echidna

By Doug Stewart

One of the most remarkable sights that the intrepid Douglas Mawson captured on his ill-fated Antarctic expedition was a strange, spiny animal with an unusual pouch. Mawson named the creature an ‘echidna’, or spiny anteater, and in his words, it is a ‘thing of the most remarkable character’.

Scientists have learned a lot about echidnas since Mawson’s day, but some questions remain unanswered. For example, why do echidnas have spines? Where do they come from? Why do they dig burrows? And what is the purpose of the pouch?

Echidnas are known for their oddities. They are reptile-like in appearance, yet they are mammals. They are similar to birds in that they have feathers, but they are not birds. They are similar to mammals in that they have fur, but they are not true mammals.

Echidnas are divided into two main groups:

1. Monotremes
2. Marsupials

Monotremes

Monotremes are the only living monotremes, an order of egg-laying mammals found only in Australia and New Guinea. They include the platypus and echidna.

Echidnas can be considered weird, as they are mammals that lay eggs like a reptile, have a beak like a bird, spines like a hedgehog and the pouch of a marsupial.

If scientists had seen an echidna for themselves they are likely to have thought the pictures were false due to the oddities of the echidna’s physical appearance.
Class Reptilia
ICT
Some reptile populations are affected by temperature-dependent gender determination. This means that the gender of offspring is determined by the temperature of the eggs during incubation.

Students could undertake research to find out to which groups of reptiles this phenomenon applies. Does warmer mean female or male? How does an egg’s position in a nest affect temperature? Why might global warming cause extinctions for reptiles that are affected?

Class Amphibia and Class Pisces
Critical and creative thinking
Amphibians and fish are mostly external fertilisers. The female will lay eggs directly into the water, often near a protective structure like a log, crevice or among seaweeds. The male will then spray large amounts of sperm over the eggs to fertilise them.

Students could consider the following questions:
• Why are external fertilisation and internal fertilisation more common than smaller numbers? (increased likelihood of some surviving)
• Why might external fertilisation be easier than internal fertilisation? (less energy required for courtship; likelihood of some surviving)
• What dangers would the eggs face in the environment? (predation and drying out or being washed away)

Students could research examples of external fertilisation and describe the successes and failures of the strategy. Protection of the eggs during incubation and parenting after hatching could be investigated as strategies to increase the success.

Class Reptilia
The skin of reptiles, such as snakes and lizards, is usually covered in a layer of fine scales. Reptiles can change to breathe, even if they live under water (sea snakes). These animals are also ectotherms—we do not see them “cold-blooded” to describe these animals because a cold that has been lying in the sun has very warm blood, even though at night it is cold.

Class Amphibia
Like reptiles, amphibians are ectotherms; however, their skin is usually soft and clammy to touch. They lay their eggs, without shells, in water. For the first part of their life, they have gills and live in the water. As they get older, lungs develop and they become able to live on the land. The only remaining group of amphibians in Australia is frogs. In other parts of the world, caecilians and salamanders may be found.

Class Pisces
Most fish are scelotherms. They are covered in a layer of scales and most have fins. They spend all of their life in water and do not need gills for breathing. Fish are further grouped according to their skeletons. Blanks, rays and sharks have a skeleton made out of cartilage, while all other fish have bony skeletons.

Vertebrate alphabet graffiti
PRACTIVITY 2.5
Who are the vertebrates?

Vertebrate alphabet graffiti
1. On a white sheet of paper, write the names of up to 26 different vertebrates, as shown in Figure 2.47.
2. Cut out small jellyfish with the class names fish, reptiles, amphibians, mammals and birds.
3. Write a description of the characteristics of each class in the appropriate body of each jellyfish.
4. Place the six animals you selected along six tentacles on each jellyfish. Label each jellyfish with the class of each animal.

Jellyfish organiser for vertebrates

Who are the vertebrates?

Vertebrate alphabet graffiti
1. On a page, draw five “jellyfish” connected to the main group (vertebrates), as shown in Figure 2.47.
2. Cut out small jellyfish with the class names fish, reptiles, amphibians, mammals and birds.
3. Write a description of the characteristics of each class in the appropriate body of each jellyfish.
4. Place the six animals you selected along six tentacles on each jellyfish.
Answers

What do you know about classes of vertebrate?

1. a. Seals give birth to live young, often on land.
   b. Seals belong to the Mammalia class of vertebrates.

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

3. Flying foxes, although similar in structure to birds, belong to the class Mammalia as they give birth to live young and feed their young with their own milk.

4. The echidna egg is laid into a backward opening pouch and ten days later it hatches into the pouch. Hatchlings are about 1.5 cm and are known as Puggles. After hatching they attach themselves to the mother’s areolae (monotremes lack nipples) to feed on the milk. Juveniles are evicted from the pouch at about 3 months old, however, they will often be left in the nest while the mother is foraging from when the juvenile starts to develop spines. Weaning occurs at about 6 months of age and they leave the burrow at about this time. The mother and young don’t have contact after this.

5. a. Draw a puggle.
   b. Students’ own drawings.

Vertebrates

Critical and creative thinking

The vertebrate group is varied and numerous. Several examples of each of the main phyla have been given in Figure 2.48.

Invertebrates

Critical and creative thinking

The invertebrate group is varied and numerous. Several examples of each of the main phyla have been given in Figure 2.48.

Identifying invertebrates

In the same way that vertebrates were classified, invertebrates are also grouped by their characteristics. Characteristics used to classify invertebrates include the presence of a shell or hard cover, tentacles or spiny skin. Organisms with similar features are placed in the same group. The dichotomous tabular key in Figure 2.49 can be used to place an organism in a particular phylum.

Identifying invertebrates

Literacy

Have students use the tabular key in Figure 2.49 to systematically identify the organisms in each image from Figure 2.48.

Students could list the characteristics used in the tabular key to identify each organism, and comment on the reasoning behind including certain characteristics over others.

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Invertebrates

Critical and creative thinking

The invertebrate group is varied and numerous. Several examples of each of the main phyla have been given in Figure 2.48.

Students could present these examples in large posters, presentations or web pages, highlighting the characteristics unique to each group and adding further examples.
2.6 Identifying invertebrates

**Answers**

1. About 96% of animals are invertebrates.
2. An exoskeleton is an external skeleton.
3. Beetles belong to the phylum Arthropoda as they have segmented bodies and jointed legs.
4. a. Worm
   b. Arthropod
c. Echinoderm
f. Porifera
g. Annelid
h. Arthropod.
5. Answers will vary depending on arthropods drawn.
6. Answers will vary based on Practicitivity 2.6 results.

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**Practicitivity 2.6**

Identifying invertebrates

Students may find the tabular key on page 75 inadequate for identifying the organisms they discover in their local environment. They should be encouraged to suggest whether it is possible to provide an adequate key for invertebrates given the enormous number that are involved. Obviously, such keys do exist, but the level of inadequacy for identifying the organisms they are familiar with is likely to be such that a student could not be adequately served by a tabular key. The best approach is to have a student try to suggest whether it is possible for existing keys to be improved. Students may find the tabular key on page 75 inadequate for identifying the organisms they are familiar with. Practicitivity 2.6 provides a suitable starting point for this activity.

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**What do you know about invertebrates?**

1. What percentage of animals are invertebrates?
2. What is an exoskeleton?
3. Beetles belong to the phylum Arthropoda as they have segmented bodies and jointed legs.
4. a. Worm
   b. Arthropod
c. Echinoderm
f. Porifera
g. Annelid
h. Arthropod.
5. Answers will vary depending on arthropods drawn.
6. Answers will vary based on Practicitivity 2.6 results.

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**What do you know about the changing face of science?**

1. a. The names of the original three kingdoms were: Plants, Animals and Minerals.
b. The change to five kingdoms was necessary because there were scientific advances and more information and greater detail could now be observed. Students are likely to have different answers based on whether they actually agree with the changes or not.
2. The understanding of genetics changed the classification system, as species that were originally considered to be related because they looked similar are actually quite different based on the genetic material each one contains.
3. A holotype specimen is an example of an organism that was used when the description for classification was decided. These are housed in museums.
4. Scientists choose a single organism to represent the species instead of trying to find a description that fits every single individual in the species, as there is variation within a species. Similar to how every human or dog looks different even though they are all part of the same species.
5. A paper system for classification can be very large and hard to sort through. Today, the Internet and online databases allow more sophisticated ways to store, organise and communicate this information.
BIG IDEAS

2.3 Where do I fit in?

Remember and understand

1. Vertebrates have an endoskeleton. Invertebrates have an exoskeleton or no skeleton.

2. The five main classes of vertebrates are: Mammals, Reptiles, Amphibia, Aves (birds), Pisces (fishes).

3. Carl Linnaeus invented the naming system that is still used today to name living things.

4. The six phyla of invertebrates are: Porifera (e.g. sponges), Cnidaria (e.g. jellyfish, corals, anemones), Molluska (e.g. snails, shell-covered aquatic animals, octopuses), Nemathelminthes (worms) (e.g. leech, tapeworm, flatworm), Echinodermata (e.g. sea star, sea urchin, sea cucumber), Arthropoda (e.g. insects).

5. Living things are classified into: Kingdom, Phylum, Class, Order, Family, Genus/Group and Species.

6. The difference between an endoskeleton and exoskeleton: Endoskeleton – meaning internal; skeleton inside body; Exoskeleton – meaning external – skeleton outside body.

7. A placental mammal looks like a smaller version of the adult when it is born. Monotremes and marsupials are furry, blind and approximately 1 cm when born and travel from the birth canal to the pouch where they grow.

8. Scientists need to classify living things to make sense of all the organisms studied, and identify a specific species in a simple and practical manner. Every species can be given a unique name, as compared with common names that are often not consistent or unique.

Apply

9. More common names for vertebrate classes: Mammals—Mammalia; Reptiles—Reptilia; Amphibia—Anamphibia; Aves—Birds; Pisces—Fish.

10. Analyse and evaluate

11. Students’ own responses.

12. Students’ own responses.
How is life on Earth organised?

1. The Anangu lived in the central Australian desert, where the weather is extreme. It is often dry and hot, rainfall is difficult to predict and the seasons are transitory. They lived a nomadic lifestyle, travelling in small family groups and surviving by hunting wildlife and gathering food from the land.

   - Foods (animals)—honey ants, witchetty grubs, sand goanna, kangaroos, bird and lizard eggs.
   - Foods (plants)—nectar from a home grown grevillea tree, bush onion, native pigweed, desert raisin, bush plum, native fig.

2. The early explorers left this environment because they were confronted by a harsh landscape and couldn't survive as they struggled to find food in the area. This is because they didn't know where to look or what plants were suitable as food, nor did they know how to hunt the native animals effectively.

3. Answers will vary, some suggestions follow:
   - Living – Plants (students may be more specific), kangaroos, lizards, spiders, gnus, birds, snakes, insects (students may be more specific).
   - Non-living – rocks, water, wind, soil.

4. The Anangu recognise habitats in their own way because they have a unique understanding of the relationships between the land, plants and animals. They also knew where to find particular foods.

5. Capillary action in relation to water is the ability of this to flow against gravity where it will rise in a narrow space such as a thin tube.

6. Animals found in the Uluru-Kata Tjuta National Park:
   - Mammals
   - Reptiles
   - Birds

7. Characteristics of amphibians which would make it difficult for them to live in an arid environment:
   - Start life in water, skin slimy and moist to touch, lay eggs in water.
   - Other animal classes which would have difficulty living in this environment would be:
     - Invertebrates

8. The bilby’s pouch is rear facing as they have to dig for food and shelter and don’t want their pouch full of soil.

9. Monotremes would find it hard to breed in arid environments because:
   - Their young don’t spend as long in the pouch and thus aren’t protected from the harsh environment for as long as marsupial young.
   - One fascinating thing that the thorny devil can do is drink water with its feet! It can do this by using capillary action to suck water up to its mouth. However, the traditional owners of the land, the Anangu, knew where to find food to survive and, because they were confronted by a harsh landscape and couldn’t survive as they struggled to find food in the area, this is because they didn’t know where to look or what plants were suitable as food, nor did they know how to hunt the native animals effectively.

10. Monotremes
   - A platypus requires large bodies of water for its entire lifespan, including creek or river systems, ponds, or billabongs. The platypus also has to live near water to protect its eggs and young from the very dry climate of the arid environment.

By the end of Year 7, students:

- Chapter 2:
  - They predict the effect of environmental changes on relationships and classify and organise diverse organisms based on observable differences.
  - They communicate their ideas, methods and findings using scientific language and appropriate representations.
  - They plan fair experimental methods, identifying variables to be changed and measured.
  - They select appropriate equipment that improves fairness and accuracy and describe how they would go about to find out what ‘capillary action’ (in relation to water) means.

- Chapter 3:
  - They draw on evidence to support their conclusions.
  - They summarise data when suggesting improvements to their methods.
  - They choose appropriate equipment that improves fairness and accuracy and describe how they would go about to find out what ‘capillary action’ (in relation to water) means.

- Book:
  - One of the classes of vertebrates in Australia, the monotremes, is an example of an adaptation and now it is difficult for them to live in or around water. Other animal classes which would have difficulty living in this environment would be:
    - Invertebrates
  - Why do you think the bilby’s pouch is rear-facing?
  - Why do you think their pouch is rear-facing?
  - Why do you think monotremes would find it hard to breed in arid environments?

- Book:
  - One of the classes of vertebrates in Australia, the monotremes, is an example of an adaptation and now it is difficult for them to live in or around water. Other animal classes which would have difficulty living in this environment would be:
    - Invertebrates