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Key knowledge

Classification processes

Classification is the sorting or grouping of items based on shared similarities. Biological classification typically focuses on grouping organisms into various classification levels based on morphological and/or molecular similarities. Organisms may also be classified according to reproductive strategies and methods of interaction. Classification processes also extend to the sorting of ecosystems based on their particular features.

CLASSIFYING ORGANISMS

The classification of organisms into groups is important because it provides information and understanding about the biological and evolutionary relationships between organisms. Using the same protocols and language for classification allows for effective communication between scientists. Classifying organisms also allows scientists to:

- identify harmful or dangerous organisms
- recognise potentially beneficial organisms (e.g. for food or sources of drugs)
- understand relationships between various organisms (e.g. to control pests and diseases)
- manage information related to the vast diversity (biodiversity) of organisms on the planet and understand interactions between them and humans, particularly if species are endangered.

The naming of biological groups is referred to as **taxonomy**. Each classification group is called a taxa. Groups can be large or small, and are represented in the form of a **hierarchy**. Groups at the top of the hierarchy contain many organisms that share a few major similarities, while those at the bottom contain fewer organisms that share many common characteristics. Organisms that belong to the same **class** must also belong to the same **domain**, **kingdom** and **phylum**. At the bottom of the hierarchy is the species level. The hierarchy of biological classification is shown in Figure 3.1.1.

A **species** is a group of similar individuals that are able to sexually reproduce in their natural environment to produce fertile offspring.

Some variations on the definition of 'species' are worth noting, given some particular exceptions. For example, some species of bacteria rarely undergo sexual reproduction. Members of some species of organisms are observed to reproduce in captive situations, such as farms and zoos. However, such conditions do not represent the natural environment of those species. The offspring of a mating between two different species is called an **interspecific hybrid**. This phenomenon is highlighted by the mating between a horse and donkey—the two share some general physical features, and can mate to produce offspring called a mule, but the offspring is infertile.

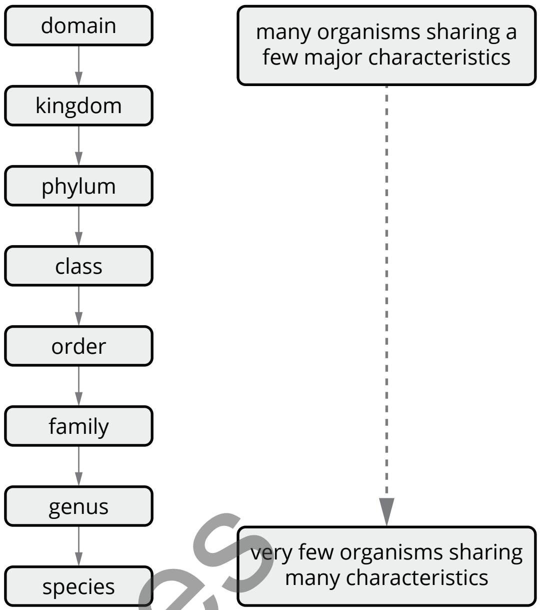

FIGURE 3.1.1 Hierarchy of biological classification

The naming of species is based on a **binomial system** developed by Swedish botanist Carl Linnaeus in the 18th century. This system is referred to as the **Linnaean system** of classification. Each organism is given two Latinised words for its scientific name. The first is the generic name (genus name). The second is the specific descriptive name.

For example, the red kangaroo (common name) has the scientific name *Macropus rufus*.

This naming system avoids ambiguity and clearly indicates which organism is being referred to, regardless of the language you speak.

Classification systems have changed over the years, mainly due to our ever-growing knowledge of organisms and the advances in technology that allow us to study them in more detail (e.g. DNA technology). Organisms have been classified into five kingdoms, but recently a further division into domains has occurred (Figure 3.1.2 on page 4).

Classification keys allow organisms to be identified based on observable features. Dichotomous keys provide an alternative choice of features that leads to accurate identification.

CLASSIFYING ORGANISMS BY REPRODUCTION AND METHODS OF INTERACTION

Organisms can be classified based on other factors besides morphological and molecular similarities.

Other useful approaches can be based on reproductive strategies and methods of interaction.

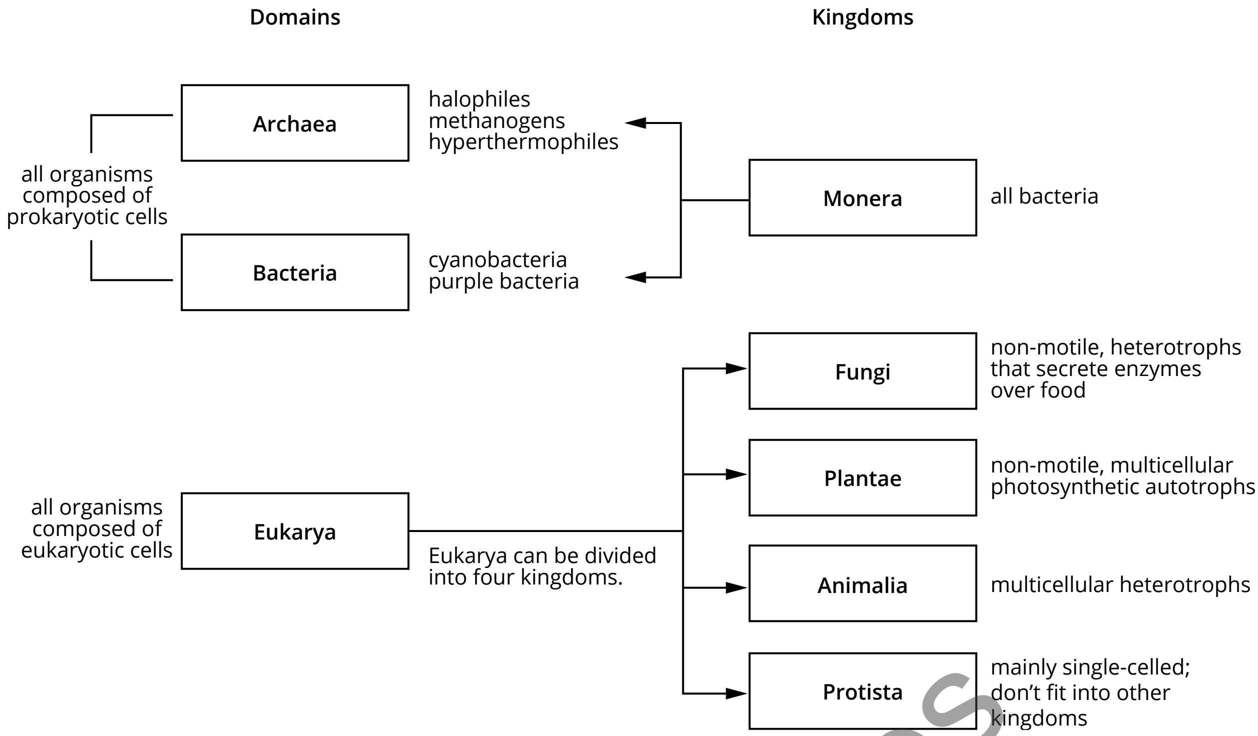

FIGURE 3.1.2 Relationship between the three-domain and five-kingdom classification systems

Classifying organisms by reproductive strategies

Organisms can be divided into two key groups depending on factors related to their reproduction.

- ***r*-strategists** are organisms that typically feature a short lifespan, high rate of reproduction, with individuals maturing rapidly. Such organisms tend to have high numbers of offspring at a time and demonstrate little or no care for their young. Examples include insects, spiders, rodents, bacteria. *r*-selection is an advantage to organisms inhabiting unstable (changing) environments.
- ***K*-strategists** are organisms that typically feature a relatively long lifespan, low reproduction rate, with individuals maturing slowly. *K*-strategists tend to have relatively low numbers of offspring at a time and demonstrate care for their young. Examples include most mammals, and reptiles such as sea turtles. *K*-selection is common to organisms that inhabit stable environments.

Classifying organisms by methods of interaction

Organisms interact with their biotic (living) and abiotic (non-living) environments, and can be classified according to these interactions. Table 3.1.1 summarises some of these key interactions.

These species' interactions are important because they impact on the structure and integrity of the ecosystems in which the organisms live. The survival of one species is dependent on the other species with which it interacts. Population sizes also have an effect on other species, for example, a small population of prey cannot sustain a large population of predators. See page 51 in Topic 2 for further information related to population dynamics in ecosystems.

TABLE 3.1.1 Species interactions

Relationship	Description	Example
predator–prey	Members of one species hunt and consume individuals of another species.	Eagles prey on snakes.
competition	Members of different species vie for resources, such as food, shelter.	Possums compete with parrots for nesting sites in tree hollows.
symbiosis	Individuals from different species demonstrate a close association.	Coral polyps and photosynthetic algae (zooxanthellae) form an alliance in which both benefit.
disease	An impairment occurs in the normal functioning of an organism, caused by pathogens or non-infectious factors such as environmental or genetic.	Infectious diseases are caused by pathogens (disease-causing organisms, such as bacteria, fungi or agents of disease, such as viruses). Non-infectious diseases are caused by environmental factors such as nutrient deficiency (e.g. rickets is caused by severe vitamin D deficiency) or by genetic factors (e.g. cystic fibrosis is caused by a faulty gene).

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Phylogenetic classification

Early classification of organisms relied largely on physical or morphological features. This approach rested on the assumption that the more physically alike organisms are, the more likely they are to be related. However, advances in molecular biology have allowed comparisons of molecules, such as proteins and DNA (deoxyribonucleic acid, of which genetic material is composed), to be made between species, and those comparisons sometimes reveal surprising changes in our understanding of these relationships. For example, a shark and a dolphin share some obvious structural features related to living an aquatic lifestyle. Despite the physical similarities between the two, molecular evidence suggests that dolphins are much more closely related to kangaroos than they are to sharks. This is not so surprising, given both are mammals. As molecules such as DNA are the blueprint for the construction of individuals, it's not surprising that molecular evidence provides a more accurate picture of the relatedness of species than physical similarities.

Phylogenetic classification is the consideration of morphological and molecular similarities between species to classify them. **Phylogeny** refers to the pattern of evolutionary relationships between organisms. Evidence from various sources (e.g. fossils, morphology and molecular characteristics) can be used to build a picture of the evolutionary relationships between different species. Such relationships can be represented in diagrams called **phylogenetic trees** or **cladograms** (Figures 3.1.3 and 3.1.4). A phylogenetic tree and a cladogram are similar in that they both show the degree of relatedness between species represented; however, only a phylogenetic tree features approximate time frames for divergence between ancestral species.

The position of an organism in a cladogram represents its evolutionary relationship to other organisms in the tree. The closer the organisms are positioned in the tree, the more closely related they are. In Figure 3.1.4, it can be seen that birds and reptiles are more closely related to each other than to any other group in the cladogram. This indicates that birds and reptiles share a recent common ancestor.

Molecular phylogeny is called **cladistics**.

A **clade** is a group of related species and the common ancestor from which they have arisen.

Cladistics rests on several assumptions. These include:

- related species that share a common evolutionary ancestor
- a common ancestral species that has split into two (bifurcation) or more groups that have evolved over time, giving rise to new species
- populations that have diverged (bifurcated) from an ancestral group and undergone gradual genetic and physical change.

In evolutionary terms, physical changes are the result of changes in the genetic make-up of organisms. A change in the DNA of an organism is called a **mutation**. Mutations will be discussed in Unit 4 Topic 1.

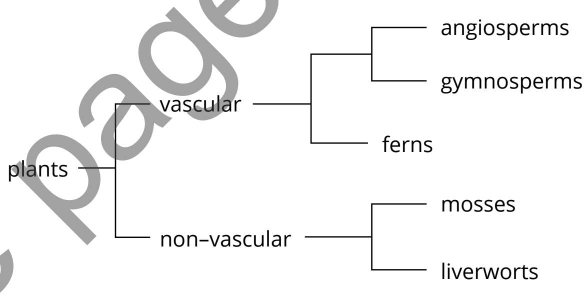

FIGURE 3.1.3 Cladogram of plants

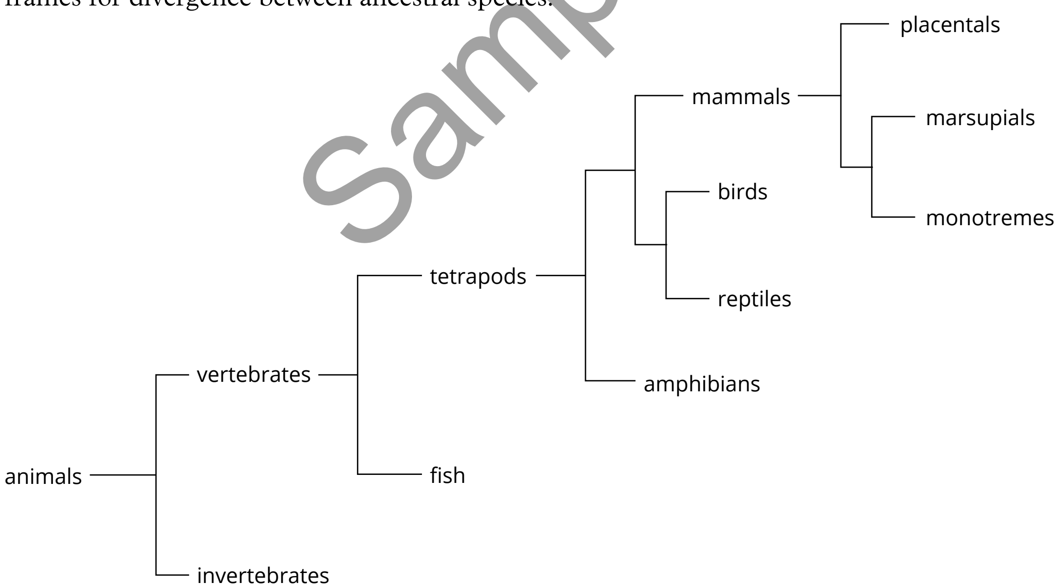

FIGURE 3.1.4 Cladogram of vertebrates

CLASSIFYING ECOSYSTEMS

An **ecosystem** is a system of organisms interacting with one another and with their non-living surroundings. Ecosystems and the larger regions to which they belong can also be classified.

Classifying different kinds of environments is based on various criteria.

- A **bioregion** is a large area defined by its geology, landform, climate and ecosystems.
- An **ecoregion** is a large region of Earth's surface distinguished by its latitude and geography, and generally containing similar ecosystems.

- A **biome** is distinguished primarily by its plant community. The kinds of plants suited to particular biomes depend on features such as type of solid and climatic conditions. Examples of biomes include desert, temperate rainforest, tropical rainforest, grasslands, alpine, coral reef, freshwater river, estuary. The distribution of major biomes in Australia is shown in Figure 3.1.5.

In Queensland, ecosystem classification is based on a three-step process that involves identification of bioregion type, landform and vegetation.

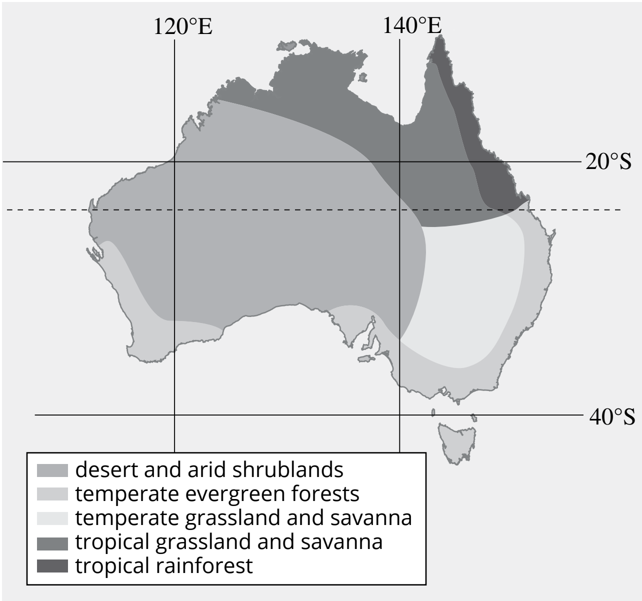

FIGURE 3.1.5 Distribution of major biomes of Australia

There are three main ways of naming an ecosystem.

1. Focus on major abiotic factors for a label (e.g. marine, freshwater and terrestrial). Such factors determine the kind of plants and animals that can live there.
2. Identify the dominant species or most abundant species of the system (e.g. oyster community or eucalyptus forest).
3. Describe it by the plant community of the system. The description is made up of a combination of the tallest or most dominant plant and the percentage of sunlight coverage of the canopy (e.g. closed-forest).

Earth is a **biosphere** that contains all of the ecosystems in the world.

The **abiotic** (non-living) factors in a particular area are key in determining the kinds of ecosystems that develop and the kinds of organisms that can live there. Climate is a significant one of these factors. For example, ecosystems in polar zones are fundamentally different from those in temperate and tropical zones. Other factors include altitude, temperature, geology (rock/soil type and depth), light intensity. Table 3.1.2 lists abiotic characteristics of habitats.

Biotic factors refer to living organisms. Organisms are adapted (suited) to the environments in which they live. They interact with one another and with their non-living surroundings. Their survival depends on these interactions.

Understanding the nature of ecosystem classification is central to their management and conservation. This includes protecting vulnerable species of flora and fauna from extinction, as well as effectively managing natural resources for human benefit.

TABLE 3.1.2 Abiotic characteristics of habitats

Terrestrial			Aquatic	
Tropical (north)	**Temperate (south)**	**Semi-arid to arid desert**	**Freshwater**	**Marine**
• high rainfall • warm • rainforests	• cool • high altitudes • winter snow	• low rainfall • desert-like environment • hot	relatively low water salt concentration; inland lakes, rivers, streams	relatively high water salt concentrations; sea/ocean

Biodiversity

Biodiversity refers to the vast range of different kinds of organisms on Earth. Different kinds of species occupy different kinds of environments to which they are suited (adapted). Organisms in ecosystems form communities, with individuals interacting with one another and with their non-living surroundings.

A **community** is a group of different species living together and interacting with one another in a particular habitat. An organism's **habitat** is the place where it lives at a particular time. A **microhabitat** is a small living space within a larger habitat.

MEASURING BIODIVERSITY

Biodiversity can be measured in terms of genetic and species diversity and also in terms of ecosystem diversity. There are some important patterns to note in terms of increased diversity and robustness of species and ecosystems. For example, the greater the genetic diversity within a species, the greater its potential to tolerate environmental change. The greater the species diversity within an ecosystem, the more stable the ecosystem and the less likely it will be to collapse as a result of small environmental changes. Measuring biodiversity is important because it informs management and conservation strategies.

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Measuring populations in an ecosystem

A range of sampling techniques is available to ecologists to monitor factors in ecosystems (Figure 3.1.6).

Quadrats and transects

A **quadrat** is an area marked out with a frame for the purpose of gathering data related to populations of organisms in a given area.

- It is usually 1 m^2 but can be adapted to suit the specific ecosystem.
- Organisms inside the quadrat are counted and recorded.
- A number of quadrats placed randomly around the habitat can provide a useful estimate of the presence, abundance and density of different species within the area. This method is useful for estimating the percentage frequency of a plant in a surveyed area.

A **transect** is a line marked out randomly through a habitat.

- Every organism on the line at regular intervals or within the transect is recorded.
- Variations in community composition throughout the habitat can be assessed.
- **Line transects** are time-efficient and can minimise disturbance to the environment. However, species of low abundance can be missed.
- **Belt transects** extend out a specific distance to either side of the line. They are time-intensive but can provide more accurate estimates of community populations.

Permanent quadrats and transects can be used to measure, estimate and predict changes in the diversity and abundance of populations over time.

Animal populations are often measured using the Lincoln index. This is discussed in Unit 3 Topic 2.

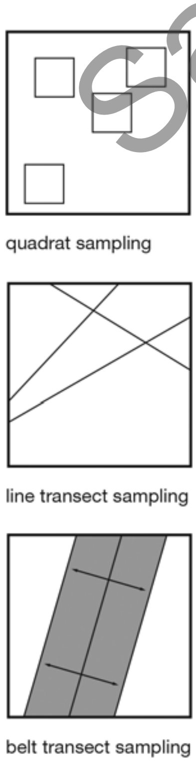

FIGURE 3.1.6 Sampling methods

Stratified sampling

Stratified sampling is an approach to ecological surveying used to monitor ecosystems which are not homogeneous or consistent throughout. It involves using regular techniques, such as transects and quadrats, to sample different strata throughout the area in order to estimate population size and density, as well as distribution of organisms. Stratified sampling is also used to shed light on differences in abiotic factors (environmental gradient) that influence the distribution and abundance of organisms in different zones of the ecosystem in question.

Other ecological survey techniques

Percentage cover is a calculation of the percentage of a given area covered by a particular organism, usually a plant. This approach is more effective in circumstances where counting individual organisms is difficult. For example, calculating percentage cover is useful for estimating the abundance of plants such as blackberry or ivy in a forest or measuring the abundance of corals or sea grasses in a reef ecosystem.

Percentage frequency refers to the percentage of quadrats in which a particular species occurs.

Species richness refers to the abundance or total number of species in an ecosystem.

Simpson's diversity index (SDI) is a tool used to measure the diversity in a population or the biodiversity of a community. The formula for SDI is set out below.

$$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

where

N = total number of organisms of all species

n = number of organisms of one species

SDI is always measured within the range from 0 to 1, with scores close to 1 indicating high diversity and scores close to 0 indicating low diversity.

Species evenness refers to the proportional representation of different species throughout an ecosystem. Tools such as the Shannon-Wiener index can be used to calculate species evenness. The formula for this index is shown below.

$$E = \frac{-\sum (P_i[\ln P_i])}{\ln S}$$

where

P_i = proportion [number of individuals of the species/ total number of individuals of all species present]

S = total number of species [species richness]

ln = natural log

The Shannon-Wiener index is also measured within the range 0 to 1. Scores close to 1 indicate that the species represented are relatively equally abundant, with no single species dominating above others. Scores close to 0 indicate unevenness of species abundance, usually with one species more dominant than others.

Minimising bias

In order to ensure that field data from ecosystem sampling is as accurate as possible, steps must be taken to minimise bias. Several approaches are effective in ensuring the reliability of field data. For example:

- the larger the number of quadrats sampled, the more representative the data are likely to be
- using random number generators to select sites for sampling decreases any unwitting bias by field workers
- applying counting protocols ensures consistent counting of individuals throughout the sample area
- ensuring equipment, such as data loggers, are correctly calibrated; poorly maintained and poorly calibrated equipment leads to unreliable data that fails to provide a true assessment of populations under investigation in ecosystems.

Data presentation and analysis

Once all of the field data from various sampling techniques have been gathered and recorded, they can be processed and analysed to provide meaningful information and conclusions about the ecosystem under investigation. Information can be represented in various useful ways, including tables and profile diagrams, as well as notes and photographs. Processing tabulated data may include calculations such as population means and diversity indices. Data can be manipulated for presentation in graphical form, facilitating interpretation of data and ease of establishing of trends. Data analysis can include deducing information about relationships between species in ecosystems, population ratios such as predator–prey interactions, endangered species numbers and habitat status. It includes the use of field guides and dichotomous keys to classify and identify species, adding to understandings of biotic factors and their requirements, challenges and interactions. Ecosystem features are also analysed to classify the kind of ecosystem. Reliably collected, processed and analysed field data are critical in understanding interactions between organisms and between organisms and the abiotic factors of ecosystems, including the identification of factors which may limit the distribution and abundance of organisms. Together, all of the information is instrumental in informing the implementation of best practice in resource management and conservation strategies.

MONITORING ABIOTIC FACTORS

Environmental factors affect the ability of organisms to function at an optimal level. Various tools and techniques are used to monitor environmental factors. Table 3.1.3 summarises some of these abiotic factors. The use of such tools and techniques is important in the management of plants, animals and environmental resources.

TABLE 3.1.3 Techniques to monitor environmental change

Factor	Technique for monitoring factor	Notes
pH	A pH probe measures the degree of acidity/alkalinity in soil or water.	Different species of plants have particular pH requirements in order to grow efficiently. Australian inland waters have a pH range of 6 to 9. Aquatic organisms tolerate a wide range of pH, but will be adversely affected if pH goes beyond this range.
light	A light meter measures the intensity of light at different levels of penetration in a habitat.	The intensity of light is an important factor affecting the distribution of producer organisms (plants) in a given habitat. This, in turn, affects the abundance and distribution of animals that feed either directly or indirectly on the plants.
oxygen	Probes are available to monitor oxygen concentration.	Oxygen is a requirement for organisms; when oxygen availability is reduced below the tolerance limit for an organism, cellular respiration cannot occur at a rate sufficient to meet the energy needs of cells and the organism dies.
carbon dioxide	Probes are available to monitor carbon dioxide concentration.	Plants require carbon dioxide for photosynthesis; high levels are toxic to animals.
soil structure	Soil samples can be dehydrated and sifted to establish the size of soil particles.	The type of soil, for example, sandy or clay, impacts on its porosity and water-holding capacity; this in turn influences the kinds of plants that can grow and the kinds of organisms the plant community can support.
salinity	The salt content of soils is measured by determining its electrical conductivity.	While some particular kinds of plants are well suited to saline conditions, most plants are sensitive to salinity, and deteriorate when exposed to high salt levels. When a plant community succumbs to saline soils, the animal community it supports is also affected. When plant communities die out in response to saline conditions, their roots no longer bind the soil, and erosion of soil follows.

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WORKSHEET 3.1.1

Knowledge preview—the language of biological diversity

1 Each of the terms listed below will be familiar to you. Recall your understanding of each and write down your own definition in the space labelled 'Initial definition'. Then use your resources to check your understanding and write a more formal definition.

	Term	Initial definition	Formal definition
a	species		
b	biodiversity		
c	ecosystem		

2 State whether or not the following pairs of organisms are members of the same species. Explain your reasoning in each case.

a African elephant and Asian elephant

b Australian cattle dog and labrador

c Horse and donkey

3 The list below is divided into abiotic and biotic factors.
Look for similarities in the items in each list.

Abiotic		Biotic	
air water rock rain snow	lava earthquake lightning cloud sand	spider grasshopper earthworm mushroom lichen	moss fern gum tree kookaburra koala

Define the terms:

a abiotic

b biotic

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WORKSHEET 3.1.2

Classy classification—identifying individuals

1 Use the key words listed and your knowledge of classification to complete the summary notes and table below.

order	Bacteria	biodiversity	class	Plantae	Animalia	phylum
genus	family	Protista	Fungi	taxonomy	species	Archaea

- The enormous variety of living organisms on Earth is described as ________________.
- Scientists group or classify organisms according to features they possess. This practice is called ________________.
- The smallest taxonomic group is a ________________.
- There are three domains and four kingdoms.

Domain	Kingdom	Features of organisms in this taxonomic group	Examples of organisms

- The eight levels of classification are:
  domain, kingdom, ________________, ________________, ________________, ________________, ________________, species
- A species is defined as:

  ____

  ____

  ____

- By convention, species are named using the binomial system. This means:

  ____

  ____

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- Describe three reasons scientists classify organisms.

Reason 1: ______________________________

____

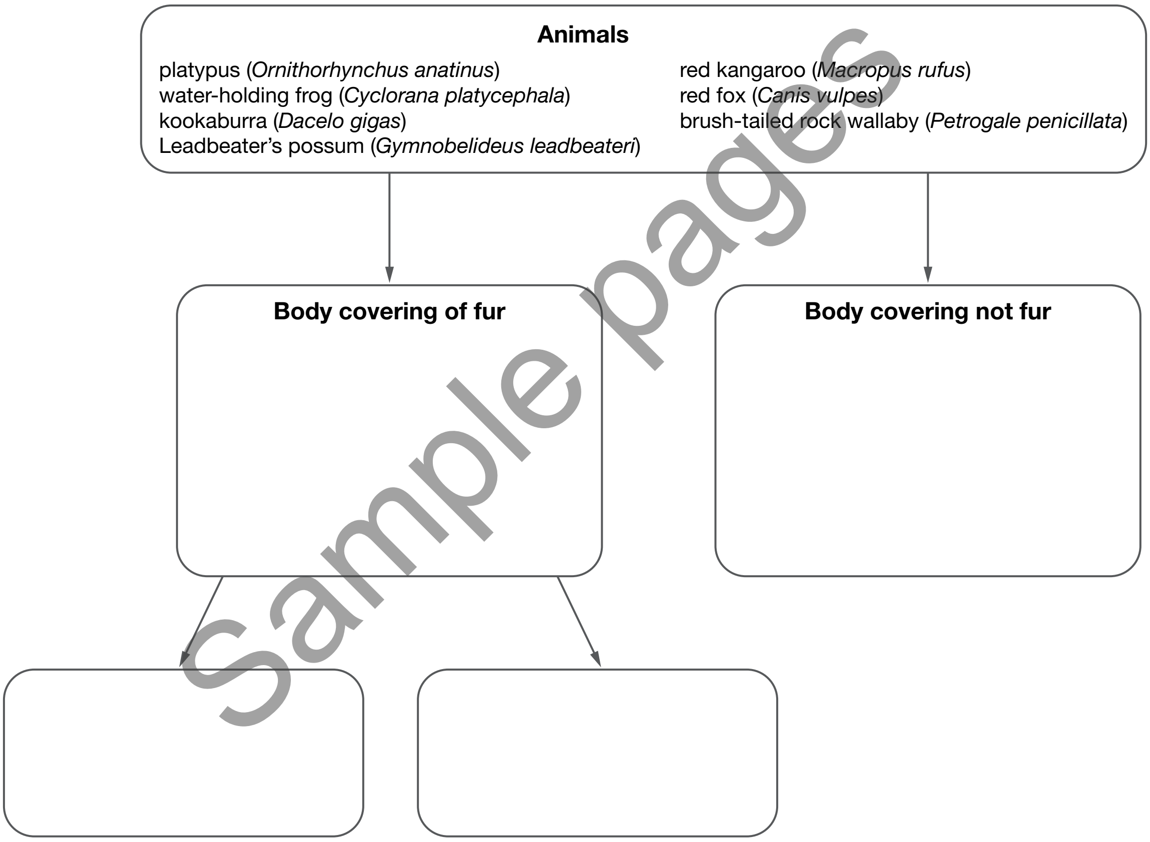
Reason 2: ______________________________

____

Reason 3: ______________________________

____

2 Classification keys are used to identify organisms, placing them into taxonomic groups with other organisms that share similar features. Consider the animals listed below. Use and extend the key provided until you have classified the red kangaroo into a group containing only this organism.



RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

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WORKSHEET 3.1.3

Morphology and molecules—revealing relationships between species

The western quoll, numbat and Tasmanian devil are Australian native animals classified into the class Mammalia and order Marsupiala.

western quoll *Dasyurus geoffroii*	**numbat** *Myrmecobius fasciatus*	**Tasmanian devil** *Sarcophilus harrisii*
		
Length: 36–46 cm Weight: 0.9–1.3 kg Diet: omnivore—small birds and reptiles, insects, seeds, fruit Distribution: south-west Western Australia	Length: 17.5–27.5 cm Weight: 275–450 g Diet: insectivore—termites Distribution: south-west Western Australia	Length: 57–65 cm Weight: 6–7 kg Diet: carnivore—snakes, lizards, birds, fish, insects Distribution: Tasmania

1 Describe two features these animals share that place them into class Mammalia.

2 Describe the distinguishing feature of animals in the order Marsupialia.

3 a Draw a cladogram to illustrate the relationship between the western quoll, numbat and Tasmanian devil.

b Justify the layout of your cladogram.

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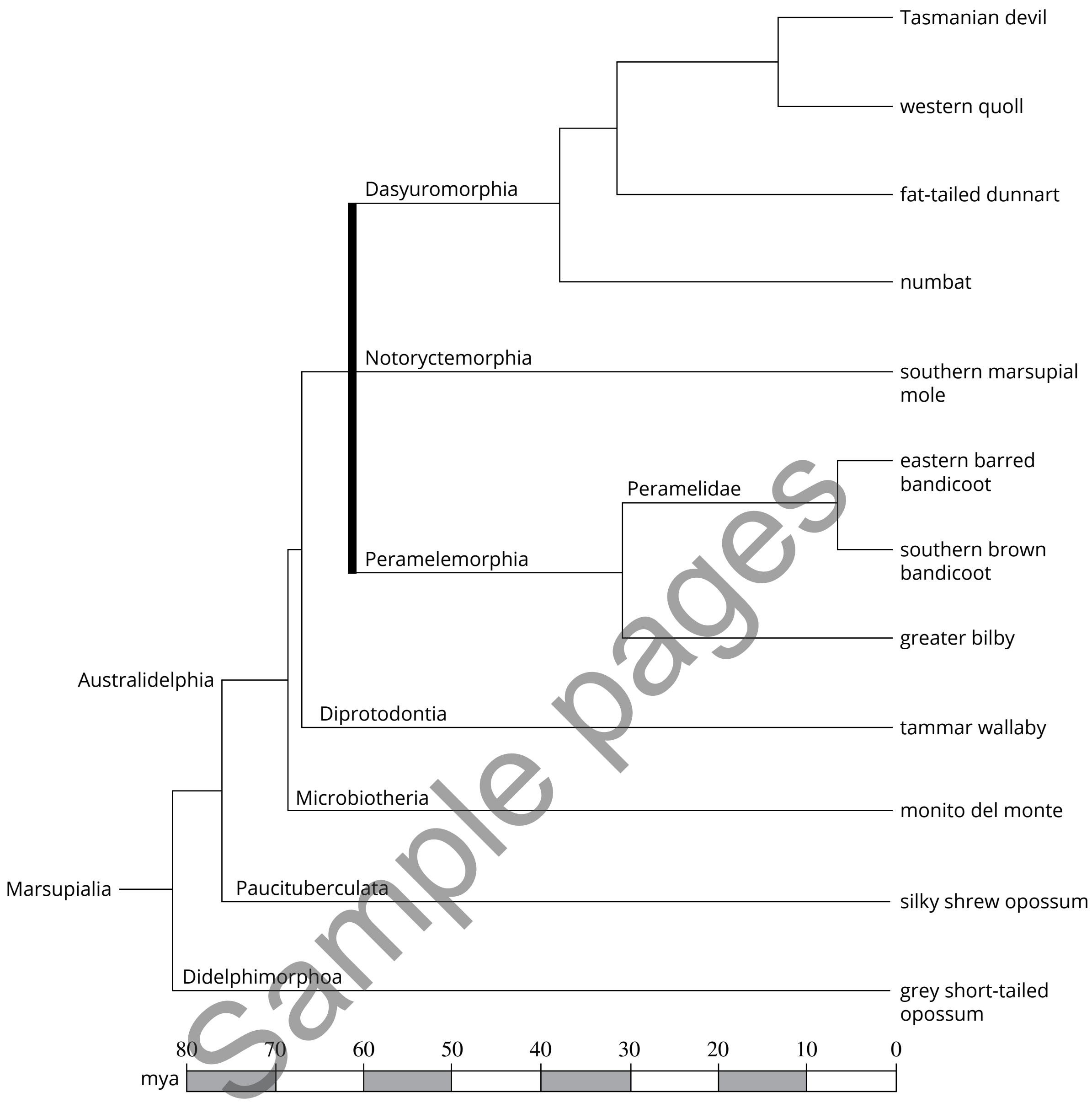
4 The phylogenetic tree set out below illustrates the evolutionary relationship for selected marsupials based on molecular data.



a Recall one assumption upon which cladistics rests.

b Summarise the evolutionary relationships between the western quoll, numbat and Tasmanian devil, based on the phylogenetic tree shown above.

c Identify how long ago the Tasmanian devil and the western quoll shared a common ancestor.

d Identify how long ago the Tasmanian devil and western quoll shared a common ancestor with the numbat.

e Redraw your cladogram for the three marsupials to reflect this relationship.

f Propose an explanation to account for the relationship between the western quoll and the Tasmanian devil.

5 Explain whether similarities in morphological data or similarities in molecular data are more likely to provide the most accurate information about the relationship between the different species.

RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

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WORKSHEET 3.1.4

Ecosystem epithets—naming ecosystems

Ecosystems are classified based on factors including climate, landform morphology and vegetation. The kind of ecosystem that develops in a region is shaped in the first place by the abiotic factors to which the environment is subjected. Only organisms suited to the particular conditions can survive there.

Four different kinds of ecosystems are represented below. Think about the impact that abiotic factors are likely to have in the development of each and how this in turn influences the kind of community living there. Discriminate between the different kinds of ecosystems, the abiotic factors that shape them and the kinds of organisms that inhabit them by completing the table.

	Ecosystem	Name	Key features	Abiotic factors that have helped to shape the ecosystem	Organisms in this community (list at least five)
1					
2					
3					
4					

RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

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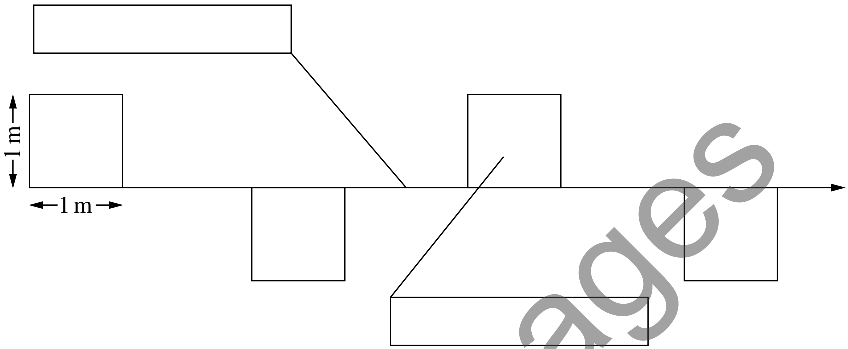
WORKSHEET 3.1.5

Backyard biodiversity—simple sampling techniques and biodiversity assessments

Sampling techniques and biodiversity assessment are important approaches to establishing the health of ecosystems. This applies to large-scale ecosystems, such as national parks, as well as to small-scale scenarios, including local parks and backyards.

1 The sketch below represents common approaches to ecosystem sampling. Select from the terms listed to correctly label the diagram.

quadrat	belt transect	line transect



2 The table below lists the organisms and number of each included in a newly established backyard pond. The pond's biodiversity has been assessed as 0.49 using Simpson's diversity index (SDI), while its species evenness has been identified as 0.65 using the Shannon-Wiener index.

Species	Number
waterlily	1
goldfish	10
rush	1
pondweed	2

a Identify the species richness for this pond ecosystem.

b Interpret an SDI of 0.49 for this pond ecosystem.

c Interpret the species evenness for the pond.

d Propose improvements to this pond ecosystem to enhance its sustainability.

RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

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WORKSHEET 3.1.6

Great Barrier Reef—examining a national treasure

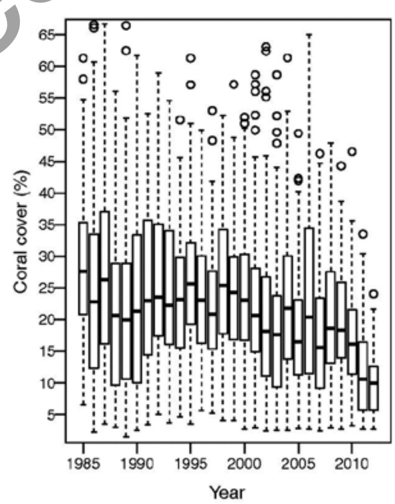
Queensland's Great Barrier Reef is the largest coral reef on Earth. Its 2500 individual reefs extend 2300 km along the coast from the tip of the Cape York Peninsula to as far south as Bundaberg. The Great Barrier Reef is a complex marine ecosystem that is home to a rich diversity of sea life, including over 400 species of coral, 1500 fish species, as well as sea turtles, birds and mammals such as dolphins and dugongs. It has enjoyed international recognition for its global significance since 1981 when it was added to UNESCO's World Heritage List.

Examine the box plot graph, right, illustrating the percentage cover of corals across the Great Barrier Reef between 1985 and 2012.

1 Describe the pattern of coral cover across the Great Barrier Reef during the 27 years of survey data shown.

2 Describe what is meant by coral bleaching, and explain its causes.

3 The crown-of-thorns sea star, *Acanthaster planci*, is a threat to the reef. Determine two reasons that account for the significant impact the crown of thorns starfish has had on the corals of the Great Barrier Reef.



Box plots of percentage coral cover across Great Barrier Reef

4 Identify an abiotic factor that affects the abundance of corals that constitute the Great Barrier Reef. Explain the impact of that factor.

5 Propose two reasons for which the Great Barrier Reef has been cited as having 'outstanding universal value'.

RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

WORKSHEET 3.1.7

Literacy review—concise communication

In this topic you have considered two central themes, classification and biodiversity. Effective communication involves understanding and use of subject-specific terms.

1 Read the definitions listed below in the boxes on the right. Select the correct term from the list below to match each definition and write this term in the corresponding box on the left.

ecosystem	species	transect	species evenness
stratified sampling	taxonomy	quadrat	Simpson's diversity index
clade	ecoregion	species richness	biodiversity

Term	Definition
	the area of science focusing on the classification of organisms
	a line through an ecosystem along which organisms are counted and recorded in ecosystem sampling
	the variety of different kinds of organisms living in an ecosystem
	the abundance of different species in an ecosystem
	a measure of species diversity in a given ecosystem
	a two-dimensional area marked out for counting and recording organisms in ecosystem sampling
	the proportional representation of different species in an ecosystem
	a system that includes organisms interacting with one another and their non-living surroundings

2 You will notice four remaining terms in the list above. Define each of these terms.

Term 1:

Term 2:

Term 3:

Term 4:

RATE MY LEARNING	• I get it. • I can apply/teach it.	• I get it. • I can show I get it.	• I almost get it. • I might need help.	• I get some of it. • I need help.	• I don't get it. • I need lots of help.

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WORKSHEET 3.1.8

Thinking about my learning

On completion of Topic 1: Describing biodiversity, you should be able to describe, explain and apply the relevant scientific ideas. You should be able to work with data to interpret, analyse and evaluate it.

As you complete this worksheet, think about how you learn best. Consider how much control you take for your own learning. Thinking about how you learn is called metacognition and includes:

- being aware of your learning goals
- knowing the best ways for you to learn
- identifying your learning strengths and weaknesses
- planning how to tackle difficult tasks
- monitoring your own progress
- working out how to correct your own errors.

1 In this topic you have studied the two broad areas of classification processes and biodiversity. This has involved a focus on some specific concepts, which are listed below for your reflection.

Think about how well you understand each concept and skill. Indicate your level of understanding by using highlighters to colour-code each point:

- green—very confident
- yellow—in the middle
- red—starting to get the idea.

Concepts and skills:

- definitions of species
- classification of organisms based on different criteria
- interpret evolutionary relationships from cladograms and molecular evidence
- biodiversity
- ecosystem diversity
- methods of monitoring ecosystems.

2 Think about the different learning methods or strategies you used in this topic. Different learning strategies suit different situations and different people. Some common learning strategies include:

- using memory devices, such as lists
- studying and discussing concepts in a group
- restating information in your own words
- using charts such as flow charts and concept maps to represent information and show relationships
- relating concepts to your own experiences
- summarising notes
- teaching someone else
- frequently re-reading class notes
- highlighting key points in notes
- making flash cards.

a In the following table, list two learning strategies you used in this topic. Describe a situation when each learning strategy was used.

b Place a cross along the scale on the right of the table to indicate how effective each strategy was for you.

Learning strategy/situation when used	Effectiveness of learning strategy for my learning
	Not effective ⟺ **Very effective** This strategy was not very helpful for my understanding and learning. / This strategy was very helpful for my understanding and learning.
	Not effective ⟺ **Very effective** This strategy was not very helpful for my understanding and learning. / This strategy was very helpful for my understanding and learning.

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PRACTICAL ACTIVITY 3.1.1

Plants in their place—using line transects

Suggested duration: 50 minutes

Research and planning

AIM

- To use two different methods to determine the composition of a plant community.
- To make some comparisons between the results obtained by using the different methods.

MATERIALS

- clipboard
- paper and pencil
- measuring tape (at least 10 m long) or a line with distances marked on it
- metre ruler
- labels for plant specimens—masking tape is suitable
- secateurs (optional)
- reference material to assist with identification (optional)
- camera (optional)

RATIONALE

In the course of their work, many people seek to describe the vegetation patterns of a particular area.

- An ecologist studies the recovery of an area of bush burnt in a bushfire.
- A biologist describes an area of tropical rainforest for the first time.
- A farmer wishes to re-establish native vegetation on some cleared marginal land.

There is a multitude of reasons for studying vegetation in this way. These may include to:

- identify the plant species that are present in the area
- establish the abundance of different plant species
- understand how the different plant species are distributed.

This background provides vital information about the community under investigation.

A walk through an area being studied is likely to easily reveal many of the larger plant species present. We often give a community a name based on the most obvious or common plant species present (the dominant species) (e.g. a mountain ash forest). However, detailed investigation will be needed to provide information about the abundance and distribution of all the plant species.

Ecologists use several techniques to obtain this information.

In this activity you will survey a plant community using ecological data-gathering techniques. The activity will guide you about how to lay out a line transect and use it to estimate species abundance for the area.

BACKGROUND INFORMATION

Transects

Transects are lines or belts set out through an area as a guide for recording what plant species are present. They provide a useful method for assessing changes in the abundance of a particular species in response to changes in a physical variable in the environment, such as slope or soil moisture content (Figure 1).

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