Science 7–8

Chapter 9 — Biological sciences C: ecosystems

Aboriginal and Torres Strait Islander content has been excluded as accuracy cannot be guaranteed, and it is better to be respectful than cover the entire curriculum inaccurately.

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Contents

Matter and energy through an ecosystem: food webs, food pyramids and trophic levels, and the role of microorganisms

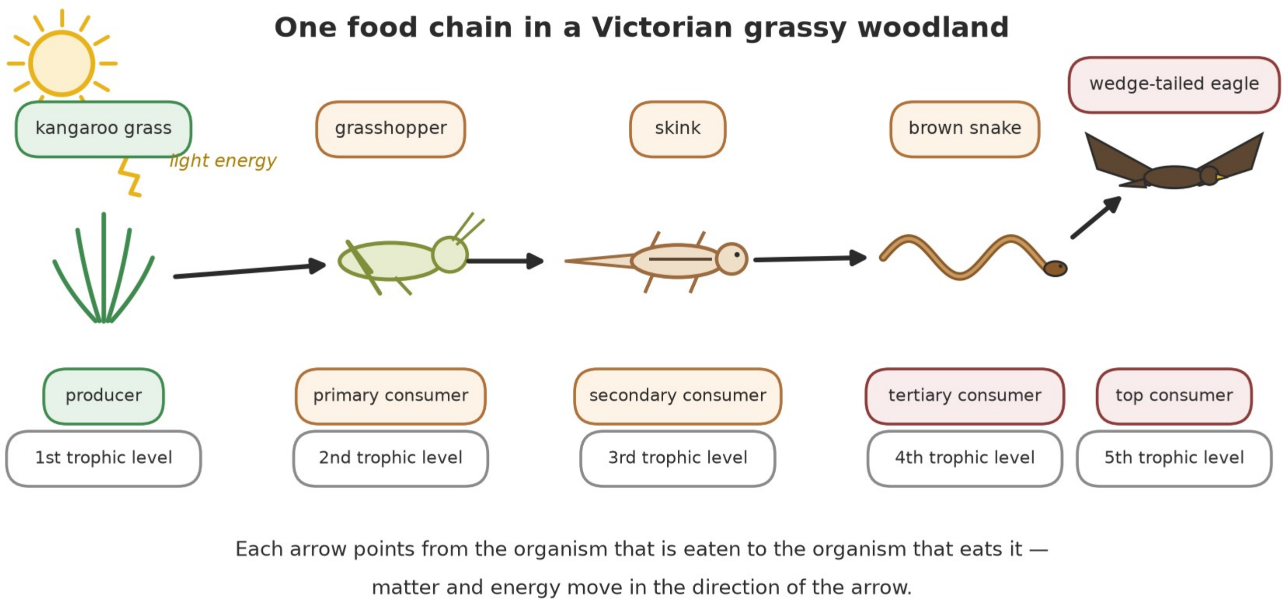
What we teach here — `VC2S8U04` (Victorian Curriculum F–10 Version 2.0, Science, Levels 7 and 8): *"matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids; populations will be affected by changing biotic and abiotic factors in an ecosystem including habitat loss, climate change, seasonal migration and introduction or removal of species"* **This subtopic owns the first clause** — that matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids — together with the feeding relationships those models show and the role of microorganisms (E01, E02). The second clause — populations affected by changing biotic and abiotic factors — belongs to the partner subtopic **9B** († split delivery, D6). Elaborations E03–E06 are drawn on by 9B; E05 and E06 carry Aboriginal and Torres Strait Islander contexts, and under the estate's content-policy decision (ICIP) First Nations content is not taught in this book, so those contexts are not delivered here. **In our words:** the living things in a place are joined by feeding links. Energy enters as sunlight, is captured by producers, then passes along the feeding links — shrinking at every step. Matter, on the other hand, is never used up: decomposers hand it back to the soil to be used again. Food webs and food pyramids are the two models we draw to show these flows, and the steps along a feeding link are called trophic levels. **Achievement-standard extract served here (D13 — 9A is the owner of `VC2S8U04`):** *"They represent flows of matter and energy in ecosystems and use real and hypothetical scenarios and population data to interpret and predict the effects of environmental changes."* (The first half — representing flows of matter and energy in ecosystems — is served here; the population-data half is practised in 9B.) **Elaborations drawn on:** `VC2S8U04.E01` (analysing food webs to show feeding relationships between organisms in an ecosystem and the role of microorganisms) and `VC2S8U04.E02` (using food pyramids to represent the difference in the amount of energy at each trophic level in a food web, with primary producers forming the first trophic level). **Authored from the CD text and the elaboration contexts (D12):** all theory, figures, examples and questions below are original estate writing built from the quoted content description and the two elaboration contexts above.

Word watch — *trophic level*. A feeding step in a food chain or food web, counted up from the producers. Producers form the first trophic level; the plant-eaters that feed on them form the second; the animals that eat those plant-eaters form the third; and so on.

Theory

Energy and matter move through every ecosystem. An **ecosystem** is all the living things in a place, together with the non-living things around them — the soil, the water, the air and the sunlight — linked by flows of matter and energy. Every living thing needs matter to build its body and energy to run it, and both pass from one organism to another at every meal. Two models carry most of the work in this subtopic: the **food web**, which draws *who eats whom*, and the **food pyramid**, which draws *how much energy sits at each feeding step*.

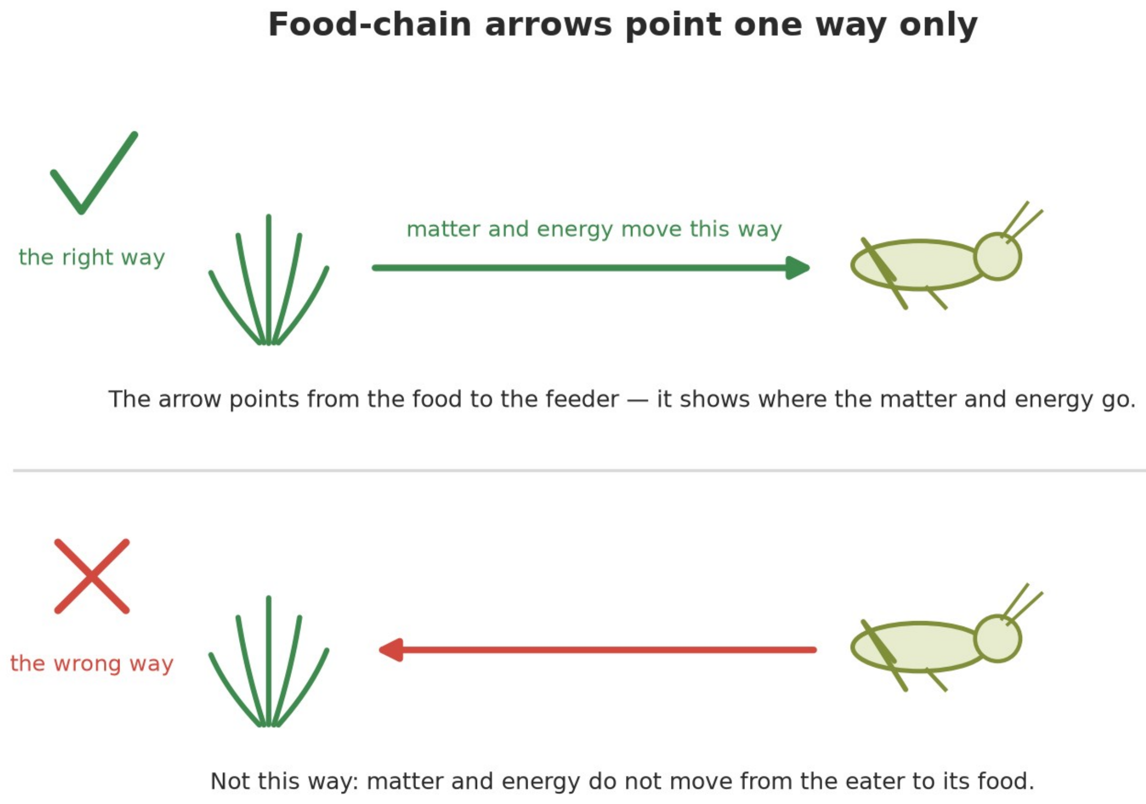
Food chains show one feeding path. A **food chain** follows matter and energy along a single line of meals. Figure 1 shows a chain from a Victorian grassy woodland.



A food chain from a Victorian grassy woodland drawn left to right: kangaroo grass, grasshopper, skink, brown snake and wedge-tailed eagle, with the Sun in the corner sending light energy to the grass. Each organism carries two labels: its role (producer, primary consumer, secondary consumer, tertiary consumer, top consumer) and its trophic level (first to fifth)

The grass is a **producer**: it captures light energy and stores it in the food it makes. Every other link is a **consumer** — an organism that eats other living things. A consumer that eats producers is a **primary consumer**; one that eats primary consumers is a **secondary consumer**; one that eats secondary consumers is a **tertiary consumer**. A consumer that nothing else in the chain eats is the **top consumer**.

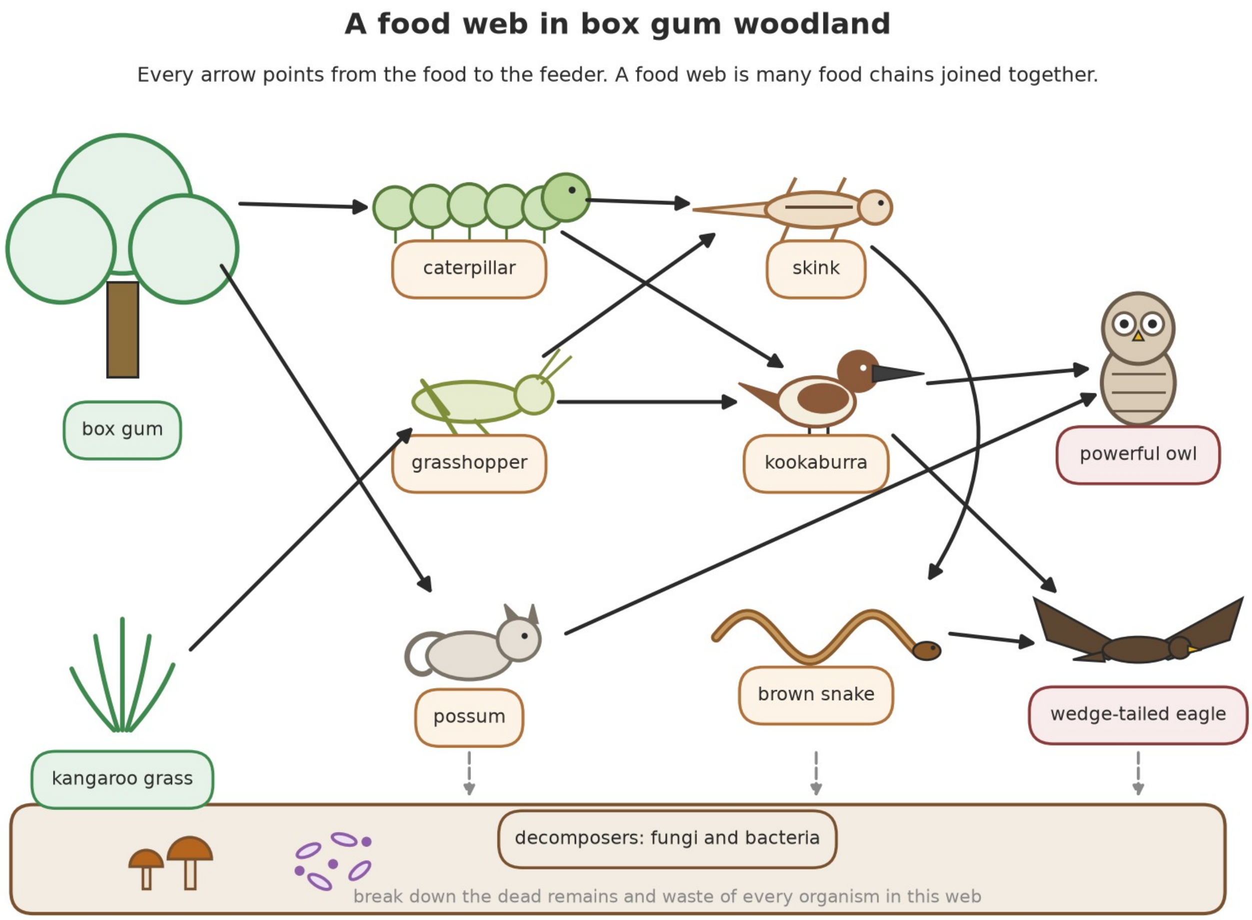
The arrows have one strict meaning. In a food chain or food web, every arrow points **from the food to the feeder** — the direction matter and energy actually travel (Figure 2).



Two panels showing the arrow rule. Top panel: a green arrow pointing from a clump of grass to a grasshopper, with a tick and the words "the right way — matter and energy move this way". Bottom panel: a red arrow pointing from the grasshopper back to the grass, with a cross and the words "the wrong way"

Reading "grass → grasshopper" as "the grass is eaten by the grasshopper" is correct; reading it as "the grass eats the grasshopper" is the classic mistake the arrow rule prevents.

Food webs join many chains together. In a real place, most consumers have more than one food, so the chains cross and join into a **food web** (Figure 3). Analysing a web means following its arrows one chain at a time (E01).

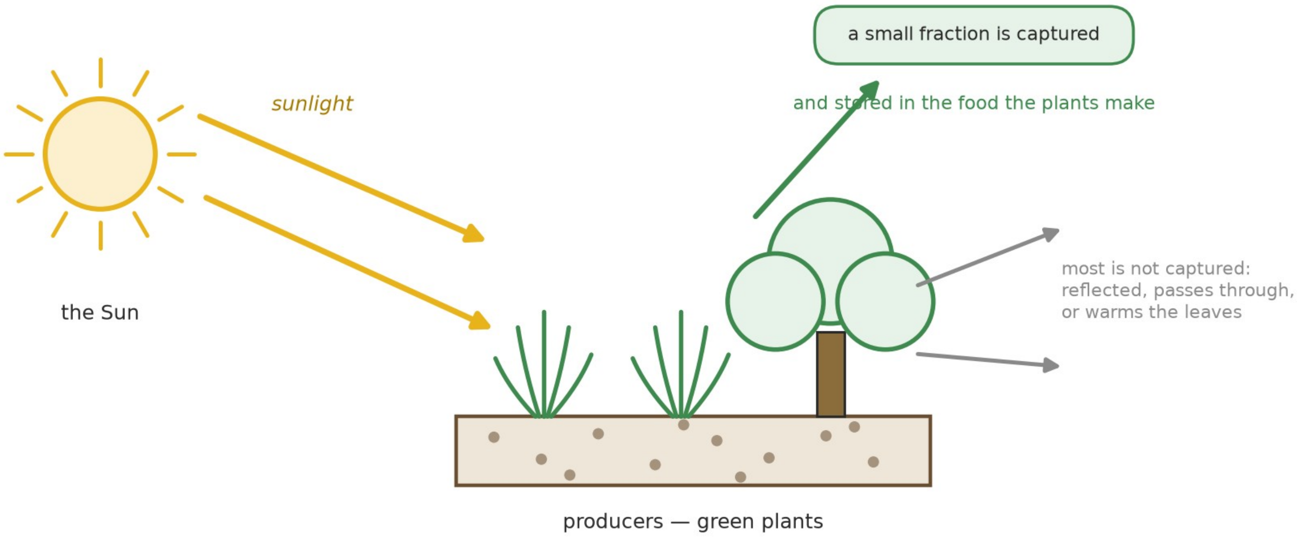


A food web of a box gum woodland with ten organisms: box gum and kangaroo grass as producers; caterpillar, grasshopper and possum as plant-eaters; skink, kookaburra and brown snake as animal-eaters; powerful owl and wedge-tailed eagle at the top. Arrows point from each food to its feeder, and a strip along the bottom shows decomposers — fungi and bacteria — breaking down the dead matter and waste of every organism in the web

Every arrow in the web still points from food to feeder, and every complete path from a producer to a top consumer is one food chain. For example, box gum → caterpillar → kookaburra → powerful owl is one chain hiding inside the web. Notice the grey strip at the bottom: when any organism in the web dies or drops waste, fungi and bacteria — the **decomposers** — break that dead matter down. We return to their job shortly.

Nearly all of the energy enters through the producers. The Sun floods the ecosystem with light, but producers capture only a small part of it and store it in the food they make (Figure 4). That stored energy is the only supply the consumers will ever get: every meal in the web traces back to energy a producer captured. (How producers make that food — from carbon dioxide and water, releasing oxygen — was covered in subtopic 8B; here we follow the energy *after* it has been stored.)

Nearly all of an ecosystem's energy enters through the producers



Producers capture light energy and store it in the food they make. That stored energy then passes along food chains.

The Sun at the left sending sunlight arrows onto grasses and a gum tree labelled "producers — green plants". A green arrow climbs from the plants to a chip reading "a small fraction is captured and stored in the food the plants make"; grey arrows leaving the leaves show that most of the light is not captured

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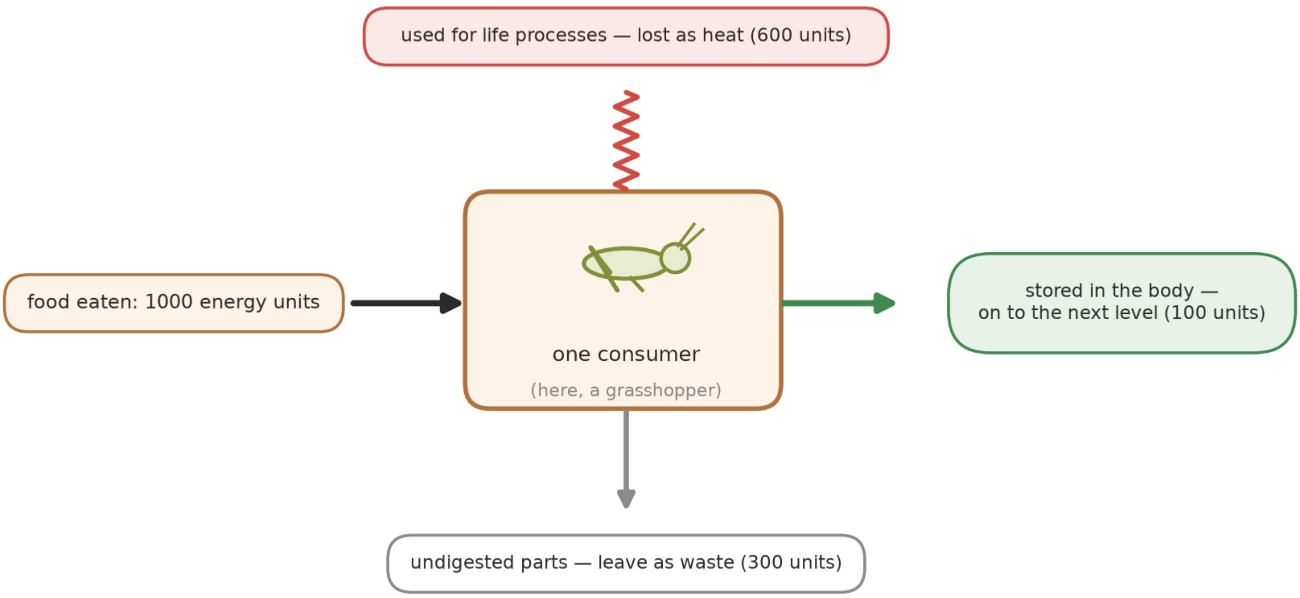
At every step, most of the energy is lost. When a consumer eats, the food energy does not all pass on. Figure 5 keeps the books for one level using simple model values.

What happens to the energy in one trophic level's food

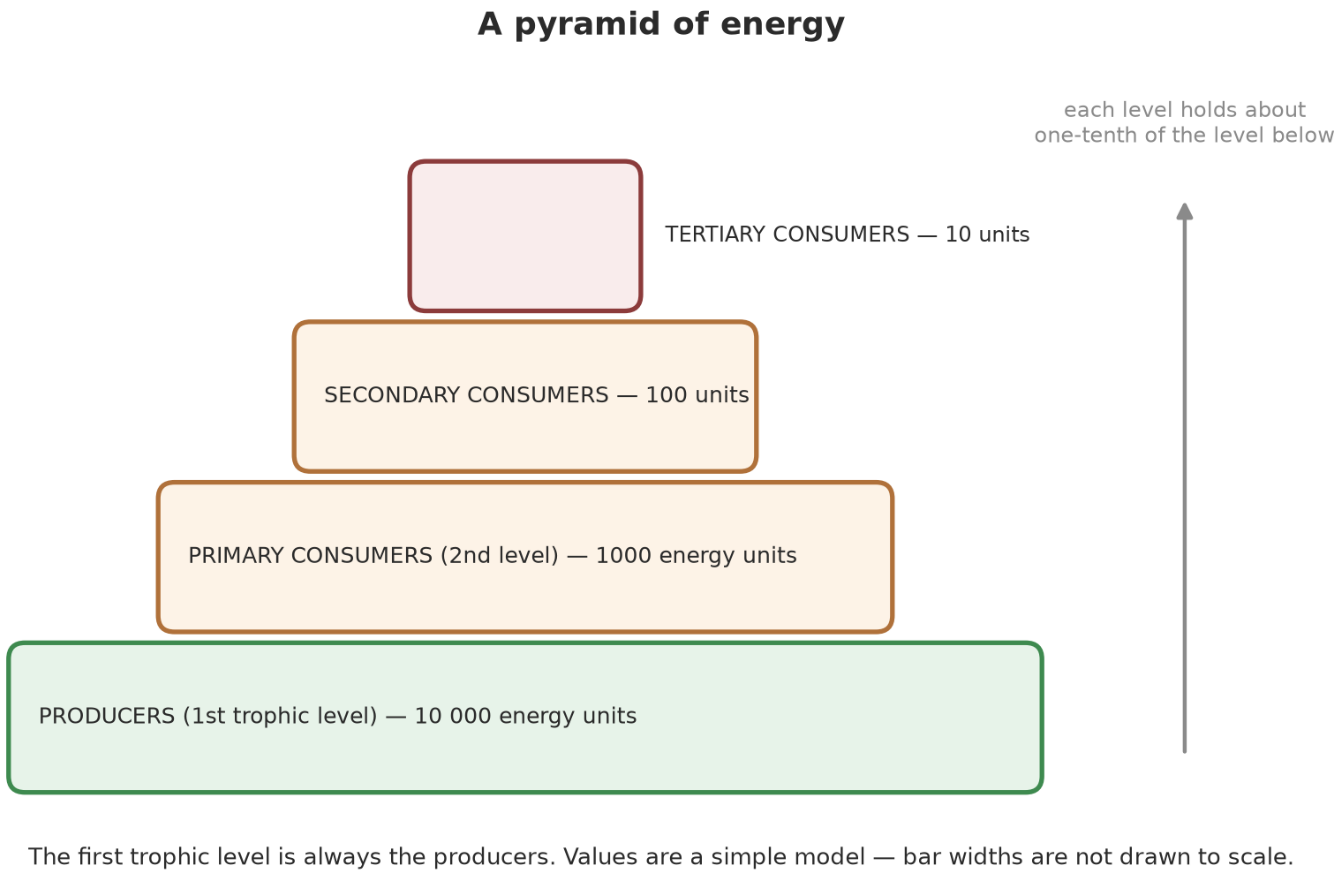


A simple model with rounded values: for every 10 units of food energy eaten, about 1 unit becomes part of the eater's body.

An energy budget drawn as chips and arrows: "1000 units eaten" splits three ways — a red squiggle to "about 600 units lost as heat from life processes", a grey arrow to "about 300 units leave as waste", and a green arrow to "about 100 units stored in the body — on to the next level (100 units)"

The pattern is a ratio: **for every 10 units of energy eaten, about 1 unit ends up stored in the body** and available to the next level. *(Maths link* `VC2M7N09` *— ratios: "for every 10 units in, about 1 unit stored" is a 10 : 1 ratio.)* The rest is not destroyed, but it is lost *to the chain*: life processes release it as heat, and undigested matter leaves as waste. No consumer can pass on what its body has already spent.

Food pyramids draw that shrinking. A **pyramid of energy** stacks one bar per trophic level, with the producers — the first trophic level — forming the base (E02). Each bar shows the energy stored at that level, so with the 10 : 1 ratio the bars shrink fast (Figure 6).



A pyramid of energy with four stacked bars, widest at the bottom: producers 10 000 energy units, primary consumers 1 000 units, secondary consumers 100 units, tertiary consumers 10 units. A side note says each bar is about one tenth of the bar below, and a caption notes that the bar widths are not drawn to scale

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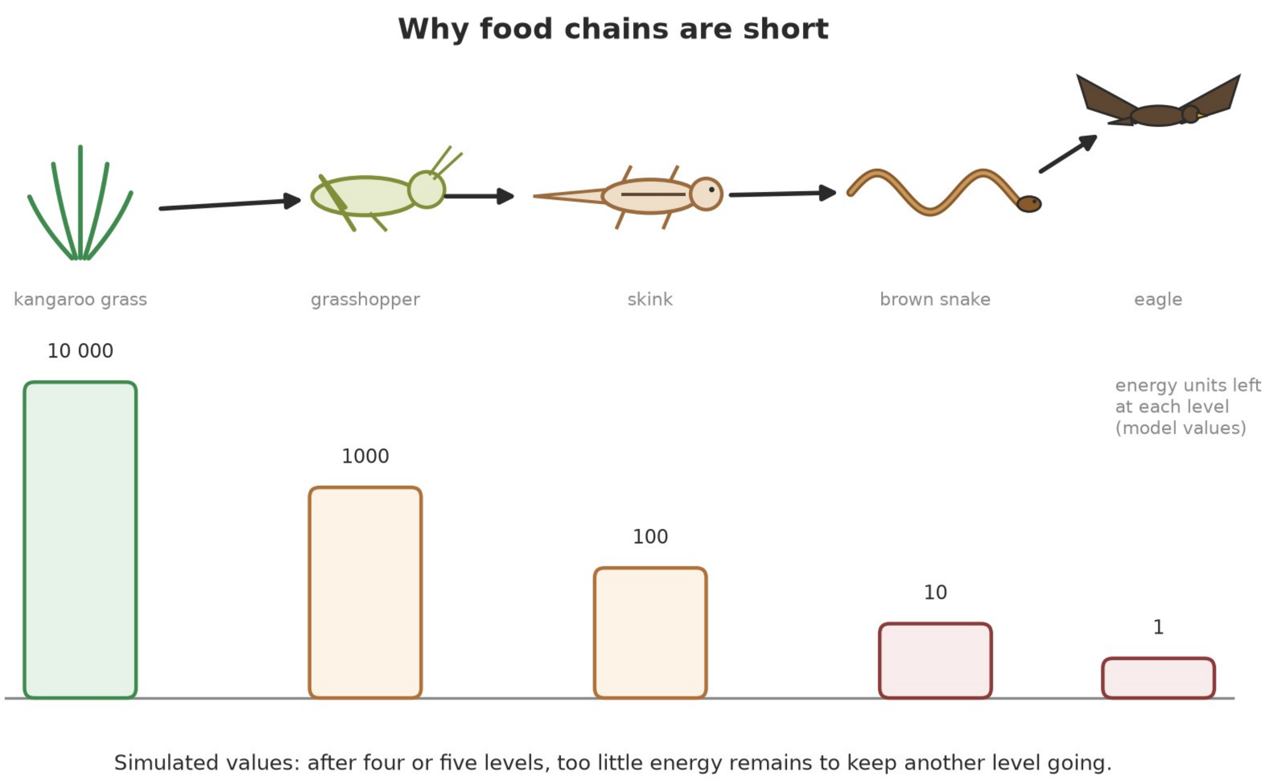
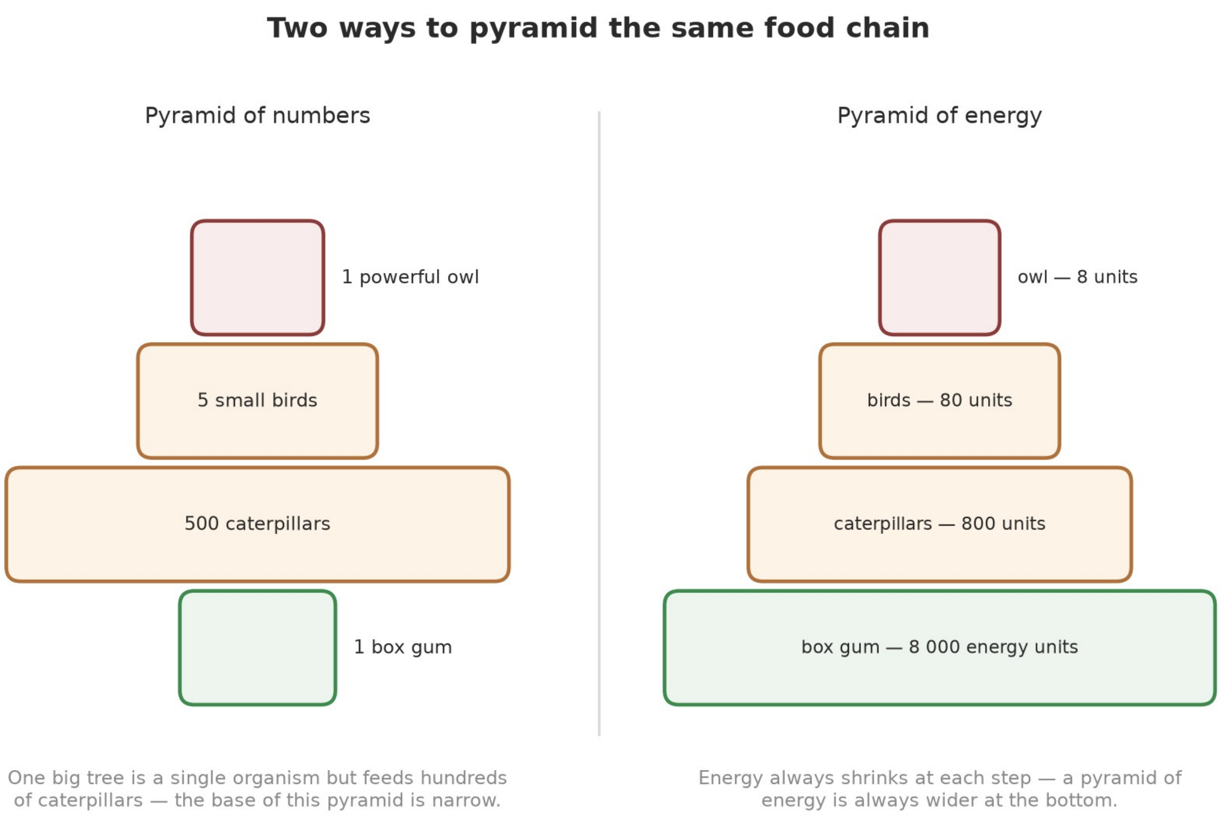
That is why food chains are short. Follow the model values along a chain (Figure 7). Starting from 10 000 units stored in the producers, a fifth level would hold only about 1 unit, and a sixth level would receive about one-tenth of a unit — far too little to support many feeders. Most food chains therefore have only three to five links: the energy simply runs out.



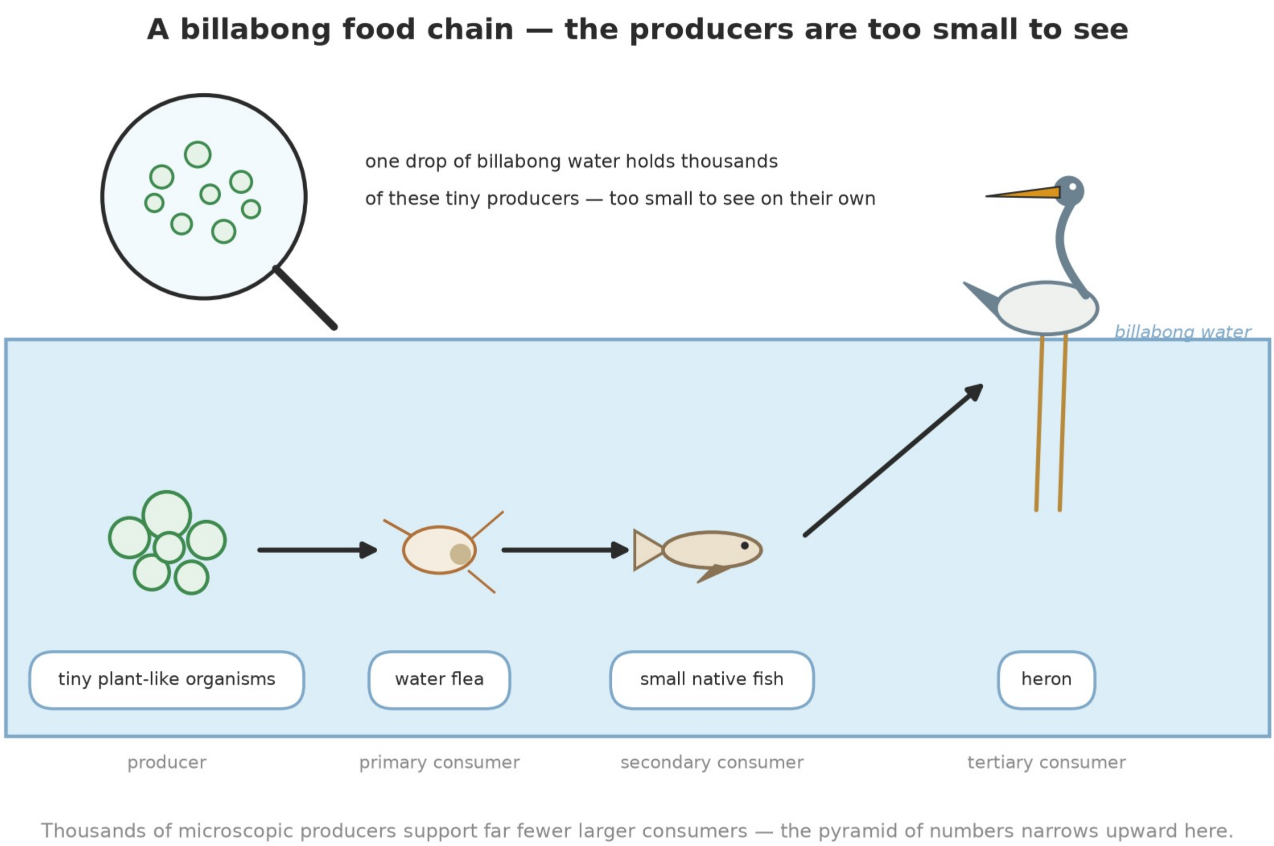
The same four-level chain drawn as shrinking bars labelled with the energy units left at each level: 10 000 at the producers, 1 000 at primary consumers, 100 at secondary consumers, 10 at tertiary consumers and about 1 at a fifth level, with the note "energy units left at each level (model values)"

A pyramid of numbers counts organisms instead. Swap energy for head-counts and the shape can change. One box gum can feed hundreds of caterpillars, so the pyramid of numbers in Figure 8 starts narrow and widens — yet the pyramid of energy for the *same* web is still widest at the base, because the tree stores far more energy than all its caterpillars put together.



Two pyramids side by side for the same web. Left: a pyramid of numbers — 1 box gum, 500 caterpillars, 5 small birds, 1 powerful owl — narrow at the base. Right: a pyramid of energy — 8 000, 800, 80 and 8 energy units — widest at the base. A caption notes that numbers can give a narrow base, but energy never does

The same models work in water. In a billabong the producers are tiny plant-like organisms too small to see with the eye alone, drifting in the water (Figure 9). Counting them gives huge numbers at the base; the energy pyramid still shrinks by about a tenth per level, exactly as on land.



A billabong food chain drawn left to right: tiny plant-like organisms (shown enlarged in a drop of billabong water), water flea, small native fish and a heron, with arrows pointing from each food to its feeder and the Sun sending light to the tiny producers

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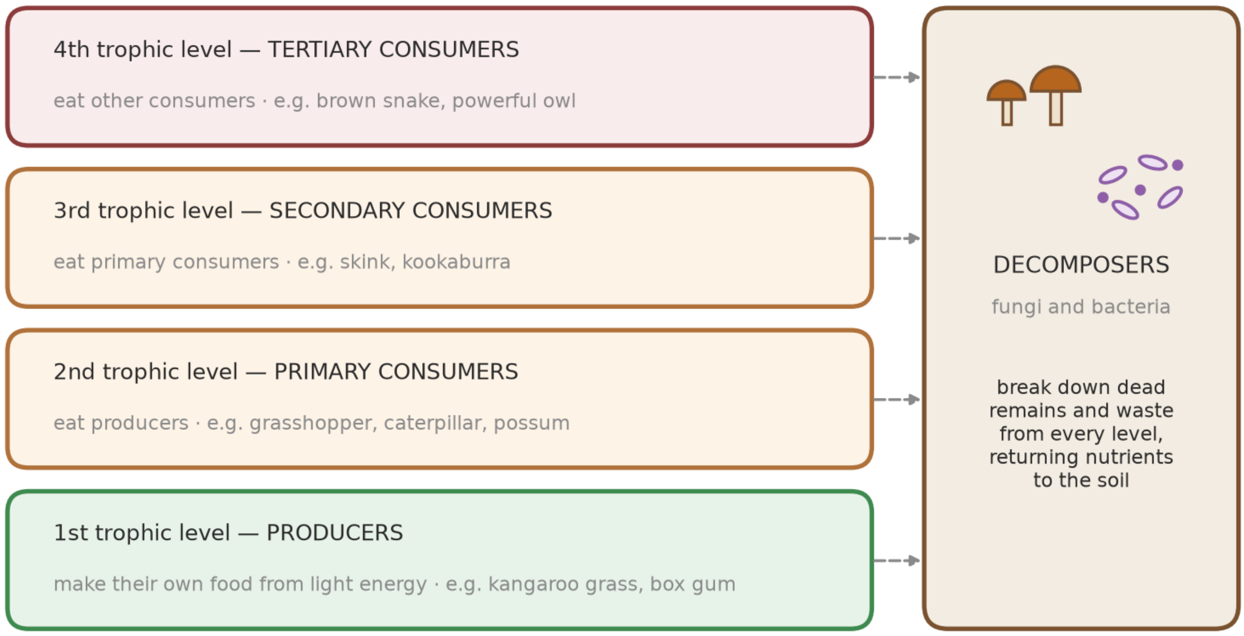
Trophic levels gather the roles together. Figure 10 lines up the roles from the food chain against their trophic levels, with the decomposers alongside — because they feed from *every* level, they sit outside the numbered steps.

The trophic levels and their jobs



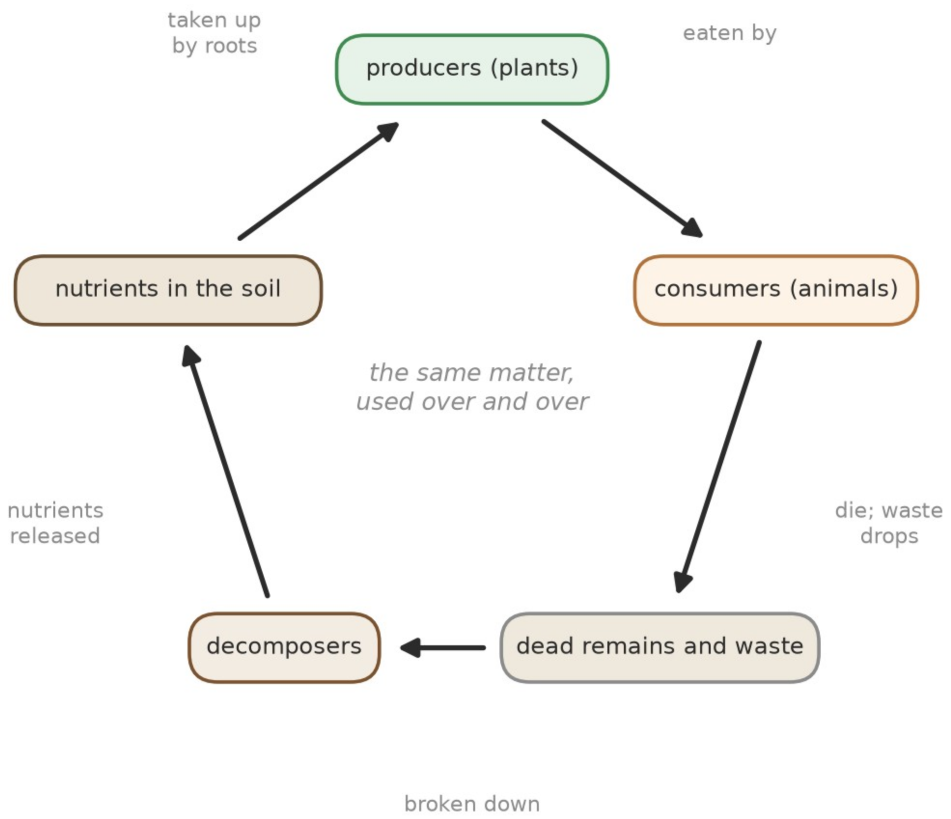
Levels are counted from the producers up. Decomposers feed from every level.

Four stacked level bars, bottom to top: 1st trophic level — producers (make their own food from light energy; e.g. kangaroo grass, box gum); 2nd — primary consumers (eat producers; e.g. grasshopper, caterpillar, possum); 3rd — secondary consumers (eat primary consumers; e.g. skink, kookaburra); 4th — tertiary consumers (eat other consumers; e.g. brown snake, powerful owl). A tall panel on the right labelled "decomposers — fungi and bacteria" receives dashed arrows from every level and notes that they break down dead remains and waste from every level, returning nutrients to the soil

One organism can sit at different levels in different chains: the kookaburra is a secondary consumer when it eats a grasshopper, but a tertiary consumer when it eats a skink.

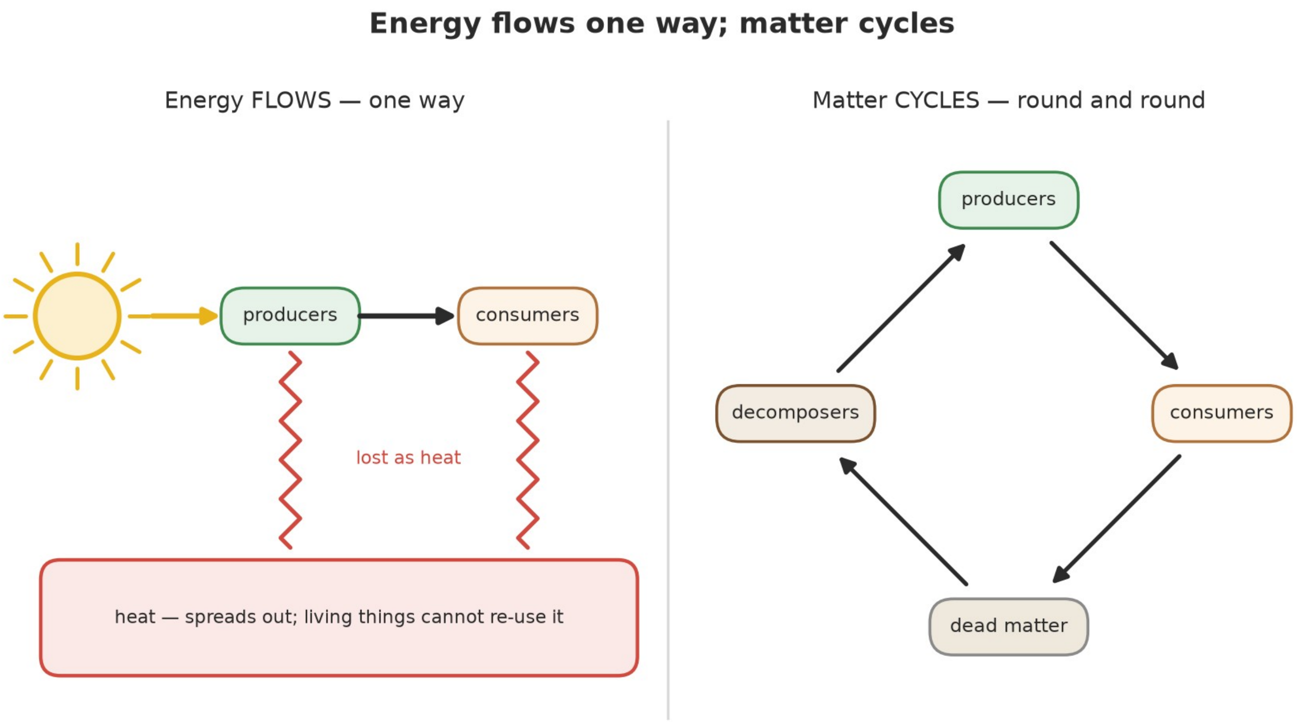
Matter cycles while energy flows. Energy and matter behave in different ways in an ecosystem, and the difference is worth fixing in your head (Figures 11 and 12).

Matter cycles round and round



Matter is never used up — it keeps cycling through living things, dead matter, decomposers and the soil.

A ring of five chips joined by arrows in a loop: producers (plants) to consumers (animals) with "eaten by"; consumers to dead remains and waste with "die; waste drops"; dead remains and waste to decomposers with "broken down"; decomposers to nutrients in the soil with "nutrients released"; nutrients in the soil back to producers with "taken up by roots". The centre text reads "the same matter, used over and over"



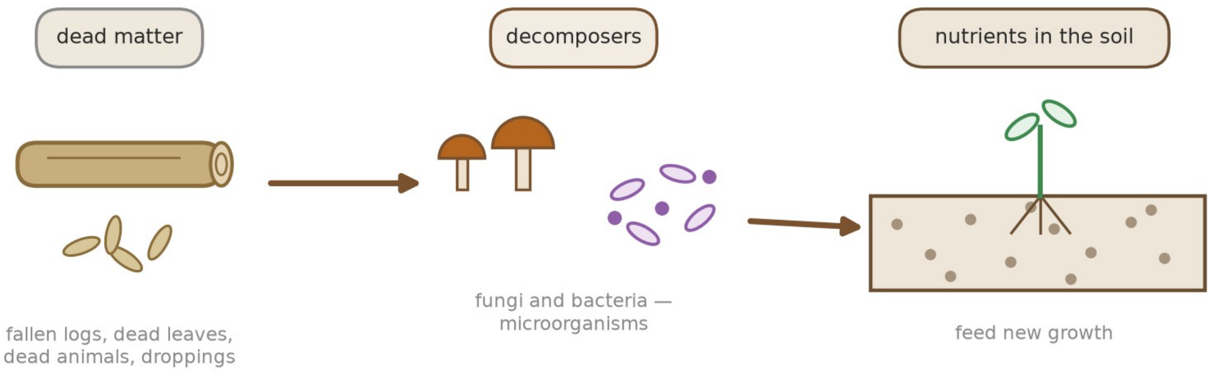
Energy must keep arriving from the Sun; the same matter keeps being re-used.

Two panels side by side. Left, "energy flows — one way": the Sun to producers to consumers, with red squiggles dropping from producers and consumers into a wide chip reading "heat — spreads out; living things cannot re-use it". Right, "matter cycles — round and round": a loop of producers, consumers, dead matter and decomposers with arrows going round

Energy **flows** one way: in as sunlight, out as heat. Heat spreads into the surroundings and living things cannot capture it again, so the supply must keep arriving from the Sun. Matter **cycles**: the same matter is used over and over, because decomposers hand it back to the soil for producers to take up again. Nothing is wasted and nothing needs replacing.

Microorganisms do the decomposing. A **microorganism** is a living thing too small to see with the eye alone, such as a bacterium. The decomposers of an ecosystem are mostly microorganisms — bacteria and many fungi — together with the visible fungi, like mushrooms, that you might spot on a rotting log (Figure 13).

Decomposers — nature's recyclers



Microorganisms break dead matter down and release nutrients back into the soil.

Without decomposers, dead matter would pile up and the soil would run out of nutrients.

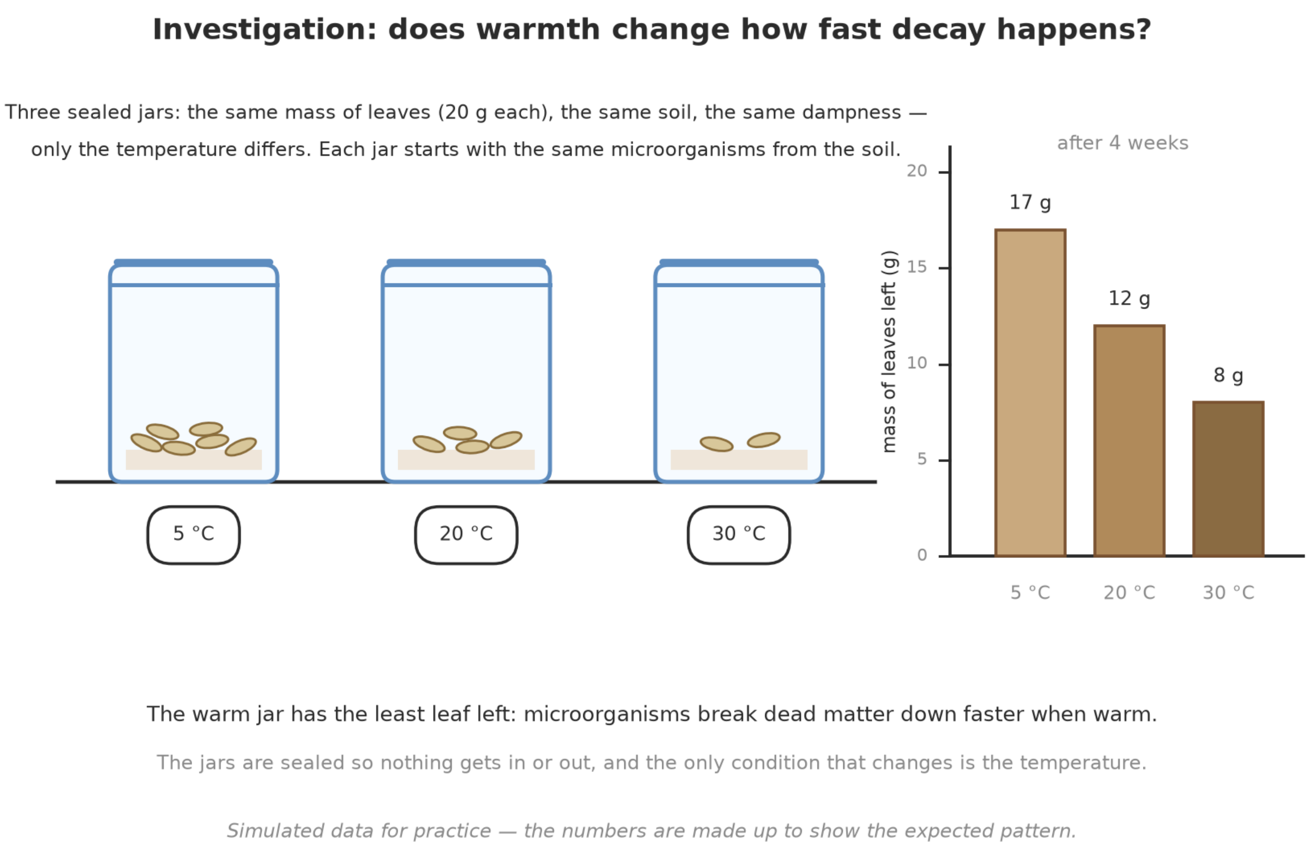
Three stages left to right: dead matter (a fallen log, dead leaves, dead animals, droppings) to decomposers (mushrooms and a cluster of bacteria, labelled "fungi and bacteria — microorganisms") to nutrients in the soil feeding new growth (a seedling in soil). The caption reads: microorganisms break dead matter down and release nutrients back into the soil; without decomposers, dead matter would pile up and the soil would run out of nutrients

Decomposers are not just "tidiers". Without them, dead matter and waste would pile up, and the nutrients locked inside them would never reach the soil — producers would run short and the whole web would slow down. That is the role of microorganisms in every food web you draw (E01): they close the matter cycle.

Investigation — does warmth change how fast dead leaves break down? A class sets up three sealed jars, each with 20 g of fresh leaf litter and a little soil, kept at three temperatures for four weeks (Figure 14). The dried leaves are then weighed. Results:

Jar	Temperature	Mass of leaves at start	Mass left after 4 weeks
A	5 °C	20 g	17 g
B	20 °C	20 g	12 g
C	30 °C	20 g	8 g

(Simulated data for practice.)



The investigation drawn with simulated data: three sealed jars kept at 5, 20 and 30 degrees, each starting with 20 grams of leaves, and a bar chart of the mass left after four weeks — 17 grams, 12 grams and 8 grams — showing that leaves break down faster where it is warmer

The pattern: the warmer the jar, the less leaf mass left — the microorganisms doing the breaking down work faster when warm. Handling soil and leaf litter is low-risk but not no-risk: wash hands after handling, and wear gloves if handling is needed, following the school's science risk guidance (Science ASSIST — see Sources).

Words to know in 9A

Word	What it means here
ecosystem	all the living things in a place, together with the non-living things around them, linked by flows of matter and energy
food chain	one feeding path, drawn with arrows from each food to its feeder
food web	many food chains joined together, showing the feeding relationships in an ecosystem
producer	a living thing (such as a green plant) that captures light energy and stores it in the food it makes
consumer	a living thing that eats other living things
primary consumer	a consumer that eats producers (second trophic level)
secondary consumer	a consumer that eats primary consumers (third trophic level)
tertiary consumer	a consumer that eats secondary consumers (fourth trophic level)
top consumer	a consumer that nothing else in the chain or web eats
trophic level	a feeding step counted up from the producers

Word	What it means here
decomposer	a living thing, such as a fungus or bacterium, that breaks down dead matter and waste and returns nutrients to the soil
microorganism	a living thing too small to see with the eye alone, such as a bacterium
pyramid of energy	a model with one bar per trophic level showing the energy stored at that level; producers form the base
pyramid of numbers	a model with one bar per trophic level showing the number of organisms at that level
nutrient	a substance that living things need to take in to grow and stay healthy
matter	the material living things are made of; it cycles through an ecosystem and is never used up

Worked examples

Example 1 — scaffolded

Read the box gum woodland food web (Figure 3).

Working	Comment
(a) One four-organism chain: kangaroo grass → grasshopper → skink → brown snake.	Follow arrows from a producer until you choose to stop; every arrow points food → feeder.
(b) Roles: kangaroo grass = producer (1st trophic level); grasshopper = primary consumer (2nd); skink = secondary consumer (3rd); brown snake = tertiary consumer (4th).	Count trophic levels up from the producers.
(c) Feeders of the caterpillar: skink and kookaburra.	Follow the arrows *leaving* the caterpillar — they point to its feeders.
(d) Dead matter and waste from every organism in the web pass to the decomposers (fungi and bacteria).	The dashed arrows into the grey strip: decomposers feed from every level.

Example 2 — scaffolded

In a grassy woodland the producers store 10 000 energy units. Using the 10 : 1 ratio, find the energy stored at each of the next three trophic levels.

Working	Comment
Level 2 (primary consumers): 10 000 ÷ 10 = 1 000 units.	The ratio 10 : 1 means “for every 10 units at one level, about 1 unit is stored at the next”.
Level 3 (secondary consumers): 1 000 ÷ 10 = 100 units.	Same ratio again — each step divides by 10.
Level 4 (tertiary consumers): 100 ÷ 10 = 10 units.	∴ the levels store 10 000, 1 000, 100 and 10 units — the pyramid of energy in Figure 6.

(Maths link `VC2M7N09` — applying a 10 : 1 ratio step by step.)

Example 3 — unscaffolded

A disease kills most of the caterpillars in the box gum woodland. Using only the web in Figure 3, name the animals that lose one of their foods, and state what other food each of them still has.

Following the arrows that leave the caterpillar, its feeders are the skink and the kookaburra — those are the two animals that lose a food. The skink also eats grasshoppers, and the kookaburra also eats grasshoppers, so both still have a food left in this web. The possum, the brown snake, the powerful owl and the wedge-tailed eagle do not eat caterpillars, so their foods are unchanged. ∴ the skink and the kookaburra each lose one food source but keep grasshoppers; no other feeder in the web loses a food.

Example 4 — unscaffolded

Using the model values in Figure 7, explain why most food chains have only three to five links.

Start with 10 000 units stored in the producers. Dividing by 10 at each step gives 1 000, then 100, then 10, then about 1 unit at a fifth level. A sixth level would receive about one-tenth of a unit per 10 000 captured — too little energy to support a population of feeders. ∴ each trophic level holds only about a tenth of the energy of the level below it, so after a few steps there is not enough energy left to support another level; that is why food chains are short.

Practice questions

Scaffolded

Q1. In your own words, define: (a) producer; (b) consumer; (c) decomposer; (d) trophic level.

Q2. (a) What does the arrow in a food chain show? (b) A student writes the link as "grasshopper → kangaroo grass". Explain what is wrong with it. (c) Rewrite the link correctly.

Q3. Using the box gum woodland food web (Figure 3): (a) name two organisms that eat box gum leaves; (b) name the organism that eats the possum; (c) name the two top consumers in this web.

Q4. (a) Which trophic level always forms the base of a pyramid of energy? (b) In the food chain of Figure 1, which trophic level is the brown snake? (c) Which trophic level is the wedge-tailed eagle in that chain?

Q5. In the model of Figure 5, a grasshopper eats 1 000 energy units of grass. (a) How many units are stored in its body? (b) Name the two ways energy leaves the grasshopper instead of being stored. (c) Hence state why the skink receives far less than 1 000 units when it eats the grasshopper.

Q6. The decay investigation in the Theory section produced its results table. *(Simulated data for practice.)* (a) What was changed from jar to jar? (b) What was measured at the end? (c) Name two things that were kept the same. (d) Describe the pattern in the results.

Unscaffolded

Q7. Explain why the arrow in a food chain must point from the food to the feeder, using the ideas of matter and energy.

Q8. From the box gum woodland food web (Figure 3), write two *different* food chains that end at the wedge-tailed eagle.

Q9. In the billabong chain (Figure 9) the producers are tiny plant-like organisms too small to see. Explain why the billabong's pyramid of energy still has the same shape as the woodland's.

Q10. In a food web, the primary consumers store 2 000 energy units. Using the about-one-tenth ratio, calculate the energy stored by the producers. Show your working. *(Maths link `VC2M7N09`.)*

Q11. The pyramid of numbers "1 box gum → 500 caterpillars → 5 small birds → 1 powerful owl" is narrow at the base, yet the pyramid of energy for the same web is widest at the base. Explain how the two models of the same web can have different shapes.

Q12. Predict two things that would happen in the woodland if the decomposers (fungi and bacteria) suddenly died.

Q13. Explain why an ecosystem needs energy from the Sun all the time, but does not need new matter to be supplied.

Q14. A student claims: "The wedge-tailed eagle sits at the top of the pyramid, so it has the most energy available of any organism in the chain." Evaluate the claim.

Answers

Q1. (a) A living thing that captures light energy and stores it in the food it makes. (b) A living thing that eats other living things. (c) A living thing that breaks down dead matter and waste, returning nutrients to the soil. (d) A feeding step counted up from the producers. **Q2.** (a) The direction matter and energy move — from the food to the feeder. (b) It points from the feeder to the food, so it says energy flows from the grasshopper to the grass. (c) kangaroo grass → grasshopper. **Q3.** (a) caterpillar and possum. (b) powerful owl. (c) powerful owl and wedge-tailed eagle. **Q4.** (a) The first trophic level — the producers. (b) Fourth. (c) Fifth. **Q5.** (a) About 100 units. (b) Heat from life processes; waste. (c) Most of the eaten energy has already left as heat and waste, so only the stored part is available to the skink. **Q6.** (a) The temperature. (b) The mass of leaves left after 4 weeks. (c) Any two of: mass of leaves at start (20 g); same time (4 weeks); same jar type; same soil. (d) The warmer the jar, the less leaf mass left — leaves break down faster when warmer. **Q7.** Matter and energy pass from the food into the feeder's body at a meal, so the arrow must point the way they travel — food to feeder. **Q8.** e.g. kangaroo grass → grasshopper → skink → brown snake → wedge-tailed eagle; and box gum → caterpillar → kookaburra → wedge-tailed eagle. **Q9.** The tiny producers still capture the light energy, and each level still passes on only about a tenth of its energy, so the bars still shrink from a wide base. **Q10.** 2 000 × 10 = 20 000 energy units. **Q11.** Numbers count organisms and ignore size: one huge tree feeds many small caterpillars. Energy counts stored energy, and the producers always store the most, so that pyramid is always widest at the base. **Q12.** Dead matter and waste would pile up; nutrients would not return to the soil, so producers (and the web above them) would run short. **Q13.** Energy flows one way and leaves as heat, which living things cannot re-use, so the supply must keep arriving. Matter cycles — decomposers return it to the soil and producers take it up again — so the same matter is re-used. **Q14.** The claim is wrong: the top level holds the *least* energy, because each level stores only about a tenth of the one below.

Fully-worked solutions

Q1. (a) A producer captures light energy and stores it in the food it makes, e.g. kangaroo grass. *(1 mark)* (b) A consumer eats other living things, e.g. a grasshopper. *(1 mark)* (c) A decomposer, e.g. a fungus or bacterium, breaks down dead matter and waste and returns nutrients to the soil. *(1 mark)* (d) A trophic level is a feeding step counted up from the producers, e.g. grasshoppers are at the second trophic level. *(1 mark)*

Q2. (a) The arrow shows the direction matter and energy move: from the food to the feeder. *(1 mark)* (b) "Grasshopper → kangaroo grass" points from the feeder to the food, which would mean matter and energy flow from the grasshopper into the grass — the reverse of what happens at a meal. *(1 mark)* (c) kangaroo grass → grasshopper. *(1 mark)*

Q3. (a) The arrows leaving the box gum point to the caterpillar and the possum. *(1 mark)* (b) The arrow leaving the possum points to the powerful owl. *(1 mark)* (c) Powerful owl and wedge-tailed eagle — no arrows leave them to another feeder. *(1 mark)*

Q4. (a) The first trophic level, the producers (E02: primary producers form the first trophic level). *(1 mark)* (b) Grass (1st) → grasshopper (2nd) → skink (3rd): the brown snake is at the fourth trophic level. *(1 mark)* (c) Counting on to the eagle gives the fifth trophic level. *(1 mark)*

Q5. (a) The 10 : 1 ratio gives 1 000 ÷ 10 = 100 units stored. *(1 mark)* (b) Lost as heat from life processes, and leaving as waste (undigested matter). *(1 mark)* (c) Of the 1 000 units eaten, about 900 have already left as heat and waste; only the ~100 units stored in the grasshopper's body are available when the skink eats it. *(1 mark)*

Q6. (a) The temperature the jar was kept at (5 °C, 20 °C, 30 °C). *(1 mark)* (b) The mass of dried leaves left after 4 weeks. *(1 mark)* (c) Any two of: the starting mass of leaves (20 g in every jar); the time (4 weeks); the same jar setup; the same soil and leaf type. *(2 marks)* (d) As temperature increases, the mass left decreases (17 g → 12 g → 8 g): leaves break down faster where it is warmer, because the decomposer microorganisms work faster when warm. *(1 mark)*

Q7. At a meal, the matter and the stored energy in the food pass into the feeder's body. *(1 mark)* The arrow is drawn to show that flow, so it must point from the food to the feeder; pointing the other way would show matter and energy flowing into the food, which never happens. *(1 mark)*

Q8. Any two correct chains with arrows food → feeder, e.g. kangaroo grass → grasshopper → skink → brown snake → wedge-tailed eagle *(1 mark)* and box gum → caterpillar → kookaburra → wedge-tailed eagle (also acceptable: kangaroo grass → grasshopper → kookaburra → wedge-tailed eagle). *(1 mark)*

Q9. The tiny plant-like organisms are still producers: they capture the light energy and form the first trophic level. *(1 mark)* At every level, only about a tenth of the energy is stored and passed on, so each bar is about a tenth of the one below and the pyramid is widest at the base, just as on land. *(1 mark)*

Q10. The ratio runs 10 : 1 going *up* the pyramid, so going *down* one level multiplies by 10: 2 000 × 10 = 20 000 energy units stored by the producers. *(Maths link `VC2M7N09`.) (2 marks)*

Q11. A pyramid of numbers counts organisms and ignores their size: a single box gum is one organism but is huge, so it can feed 500 caterpillars and the base bar is narrow. *(1 mark)* A pyramid of energy counts stored energy instead. *(1 mark)* The one tree stores far more energy than all its caterpillars, so the energy pyramid is widest at the base; energy can never give a narrow base. *(1 mark)*

Q12. Any two of: dead matter, droppings and waste would pile up instead of breaking down; *(1 mark)* nutrients would stay locked in that dead matter and not return to the soil, so producers would run short and the whole web would lose matter and energy. *(1 mark)*

Q13. Energy flows one way through an ecosystem and leaves as heat, which living things cannot capture again, so a fresh supply must keep arriving from the Sun. *(1 mark)* Matter is not used up: decomposers break dead matter and waste down and release the nutrients back into the soil. *(1 mark)* Producers take those nutrients up again, so the same matter keeps cycling and never needs replacing. *(1 mark)*

Q14. The claim is wrong. *(1 mark)* Each trophic level stores only about a tenth of the energy of the level below it, so energy shrinks going up the pyramid; the eagle at the top has the *least* energy available, not the most — the top bar of Figure 7 is the smallest. *(1 mark)*

Sources

Web sources below were retrieved 2026-08-21.

- Science ASSIST (Australian Science Teachers' Association), "Risk management", n.d. asta.edu.au

The decay investigation's results table is **simulated data for practice**; the pattern it shows (faster breaking down when warmer) is the real-world pattern the model represents. All food-web and pyramid values are simple model values for teaching the 10 : 1 ratio, not measured field data.

Elaboration contexts used: `VC2S8U04.E01` (analysing food webs to show feeding relationships between organisms in an ecosystem and the role of microorganisms) and `VC2S8U04.E02` (using food pyramids to represent the difference in the amount of energy at each trophic level in a food web, with primary producers forming the first trophic level). Elaborations E03–E06 are reserved to 9B; E05 and E06 carry First Nations contexts that are not taught under the estate's ICIP content-policy decision.

Populations under pressure: habitat loss, climate change, seasonal migration, and the introduction or removal of a species

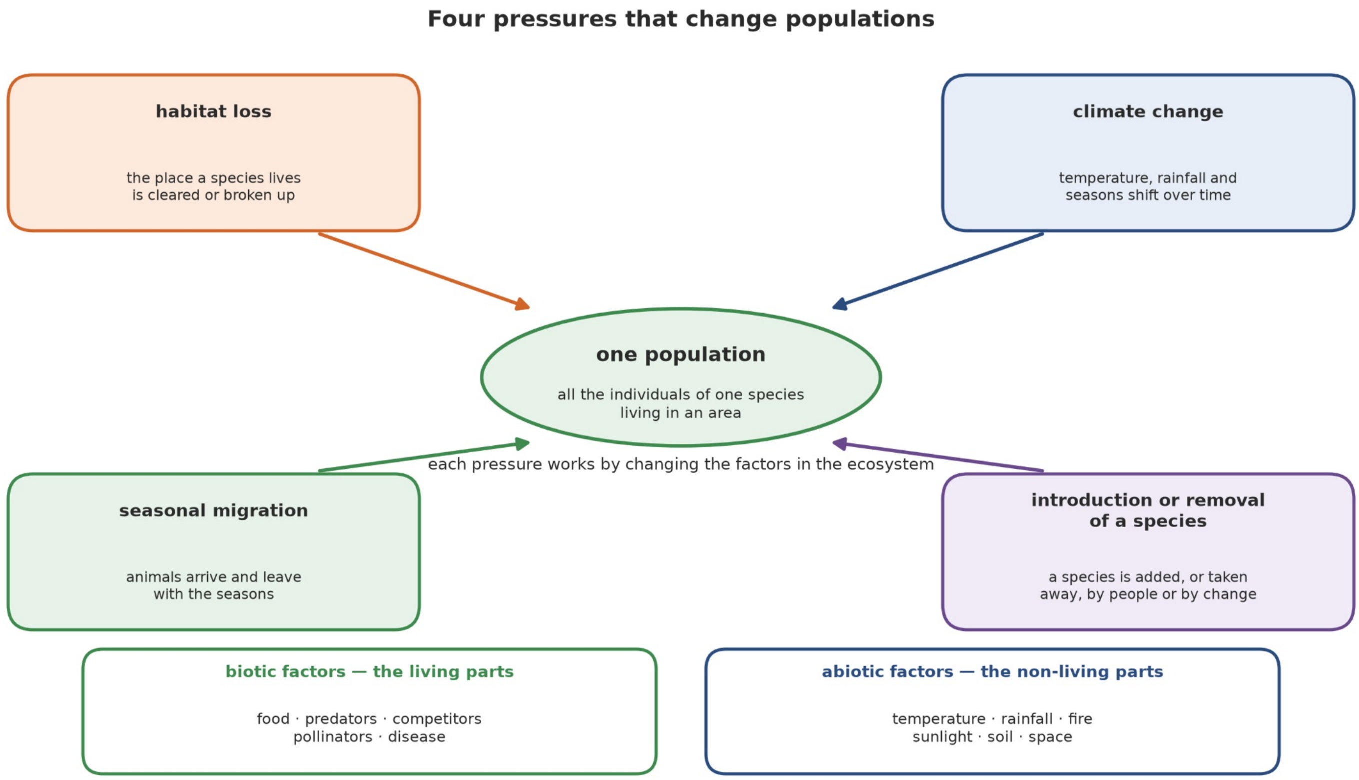
What we teach here — `VC2S8U04` (Victorian Curriculum F–10 Version 2.0, Science, Levels 7 and 8): *"matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids; populations will be affected by changing biotic and abiotic factors in an ecosystem including habitat loss, climate change, seasonal migration and introduction or removal of species"* **This subtopic owns the second clause** — that populations will be affected by changing biotic and abiotic factors in an ecosystem, including habitat loss, climate change, seasonal migration and introduction or removal of species — together with the four named pressures († split delivery, D6). The first clause — matter and energy flow, food webs and food pyramids — belongs to the partner subtopic **9A**. Elaborations E03–E06 are drawn on by this subtopic for its scientific contexts (see the ICIP note below). **In our words:** a population is the count of one kind of living thing in a place, and that count is never fixed. It moves up when births and arrivals outrun deaths and leaving, and down when the reverse happens. Four big pressures move it: the loss or breaking up of habitat, a changing climate, the seasonal comings and goings of migrating animals, and people adding or removing a species. Every pressure works by changing a biotic factor (something living, like food or predators) or an abiotic factor (something non-living, like water, heat or fire). **Achievement-standard extract served here (D13 — 9A is the owner of `VC2S8U04`):** *"They represent flows of matter and energy in ecosystems and use real and hypothetical scenarios and population data to interpret and predict the effects of environmental changes."* (The population-data half — interpreting and predicting from real and hypothetical scenarios — is served here; the representing-flows half is served in 9A.) **Elaborations drawn on:** `VC2S8U04.E03` (predicting the effects on an ecosystem when a pollinator or a predator is removed or dies out), `VC2S8U04.E04` (how seasonal change, habitat destruction and the introduction of a species shift the abiotic and biotic factors and change populations), `VC2S8U04.E05` and `VC2S8U04.E06` (drawn on for their wider science only — see ICIP note). **ICIP (D10):** no Aboriginal or Torres Strait Islander content is delivered here. The First Nations limbs of `VC2S8U04.E05` (the Kungarakan and Warai Peoples' collaboration with the Australian Government on gamba grass control) and `VC2S8U04.E06` (Aboriginal fire management over tens of thousands of years) are reserved under the ICIP decision and are not taught; see the teacher-facing note at the foot of this subtopic. The wider science those elaborations sit inside — introduced species, fuel and fire, and wildfires as habitat loss — is taught from the CD text and public sources. **Maths interlocks (D11):** population graphs are read qualitatively for shape, trend and turning points — there is no gradient and no line of best fit in this band. Numbers quoted from sources are read and compared; the only processing is the four operations with positive whole numbers (`VC2M7N06`). **Authored from the CD text and the elaboration contexts (D12):** all theory, figures, examples and questions below are original estate writing built from the quoted content description, with real Australian cases cited in Sources.

Word watch — *population*, *biotic*, *abiotic*. A **population** is all the individuals of one species living in a place at a time. A **biotic factor** is a living part of an ecosystem that affects a population — its food, its predators, its diseases. An **abiotic factor** is a non-living part — water, temperature, light, soil, fire.

Theory

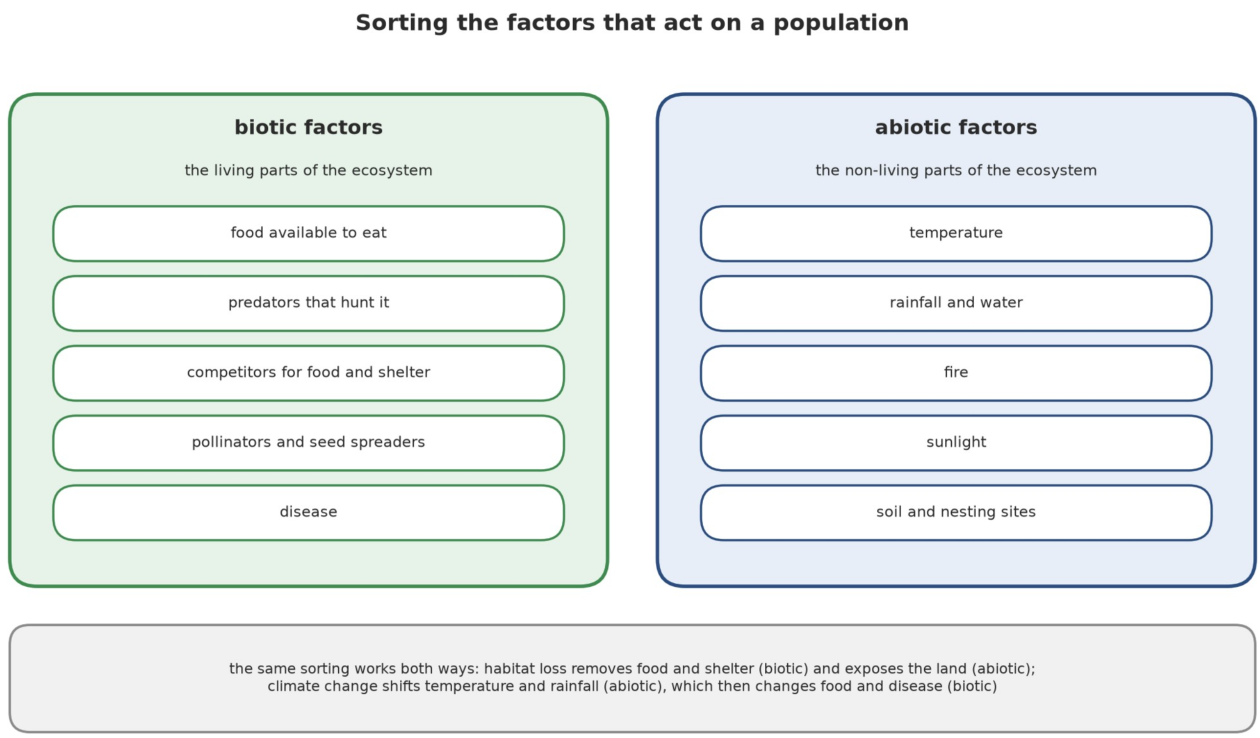
1. Populations move when their factors change (VC2S8U04)

The four pressures of this subtopic all act the same way: they change a factor, and the population follows (Figure 1).



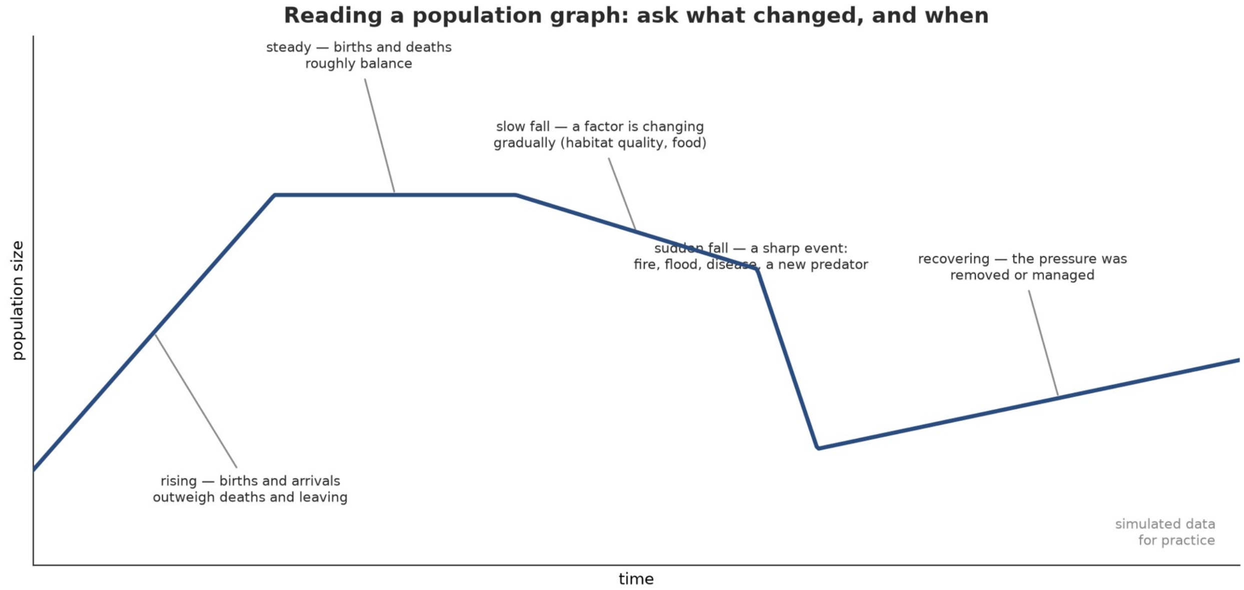
An overview diagram. A centre chip reads "the size of a population changes when its factors change". Four pressure boxes point into it: habitat loss (home is destroyed or broken into pieces), climate change (rain, heat and seasons shift), seasonal migration (animals leave and return with the seasons), and introduction or removal of a species (people add or take away a kind of living thing). Two strips below label the two kinds of factor the pressures work through: biotic factors (food, predators, disease, competition) and abiotic factors (water, temperature, light, soil, fire)

Every ecosystem holds many populations, and each one is pushed and pulled by its **biotic** and **abiotic** factors (Figure 2).



A two-panel sorting diagram. Left panel, "biotic — the living factors": chips for food plants, prey, predators, competitors, disease, pollinators and decomposers. Right panel, "abiotic — the non-living factors": chips for water, *temperature, light, soil, wind, fire and salinity. A caption notes that every pressure on a population works by changing at least one of these factors*

A population grows when **births plus arrivals** are more than **deaths plus leaving**, and shrinks when the balance flips. So a population graph is a story: the shape of the line tells you when the balance flipped, and your job is to ask which factor changed at that moment (Figure 3).



The habit: find where the shape changes, name the factor that could have changed there, then say whether it is biotic or abiotic.

A line graph of population size against time, labelled "simulated data for practice". The line rises, levels off, falls slowly, falls suddenly, then recovers. Call-outs name each shape: rising (births and arrivals outweigh deaths and leaving), steady (births and deaths roughly balance), slow fall (a factor is changing gradually, such as habitat quality or food), sudden fall (a sharp event such as fire, flood, disease or a new predator), recovering (the pressure was removed or managed). The caption gives the habit: find where the shape changes, name the factor that could have changed there, then say whether it is biotic or abiotic

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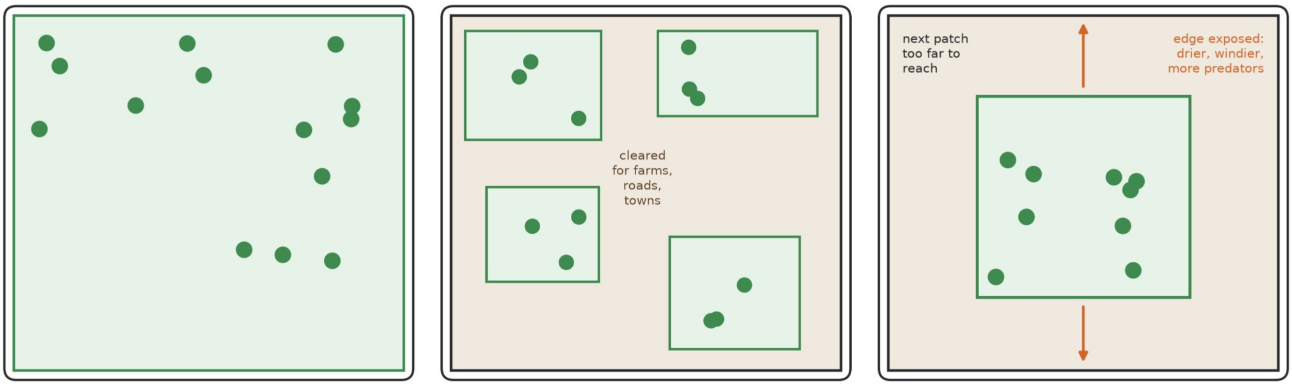
2. Pressure 1 — habitat loss (VC2S8U04.E04)

A **habitat** is the place where a species normally lives — the food, water and shelter it needs are all found there. **Habitat loss** removes that place outright, and it can also break one big habitat into small, separated patches. Both hit the population through biotic and abiotic factors (Figure 4).

Habitat loss: from one continuous home to isolated fragments



before clearing — habitat is continuous; animals can move, feed and breed across it

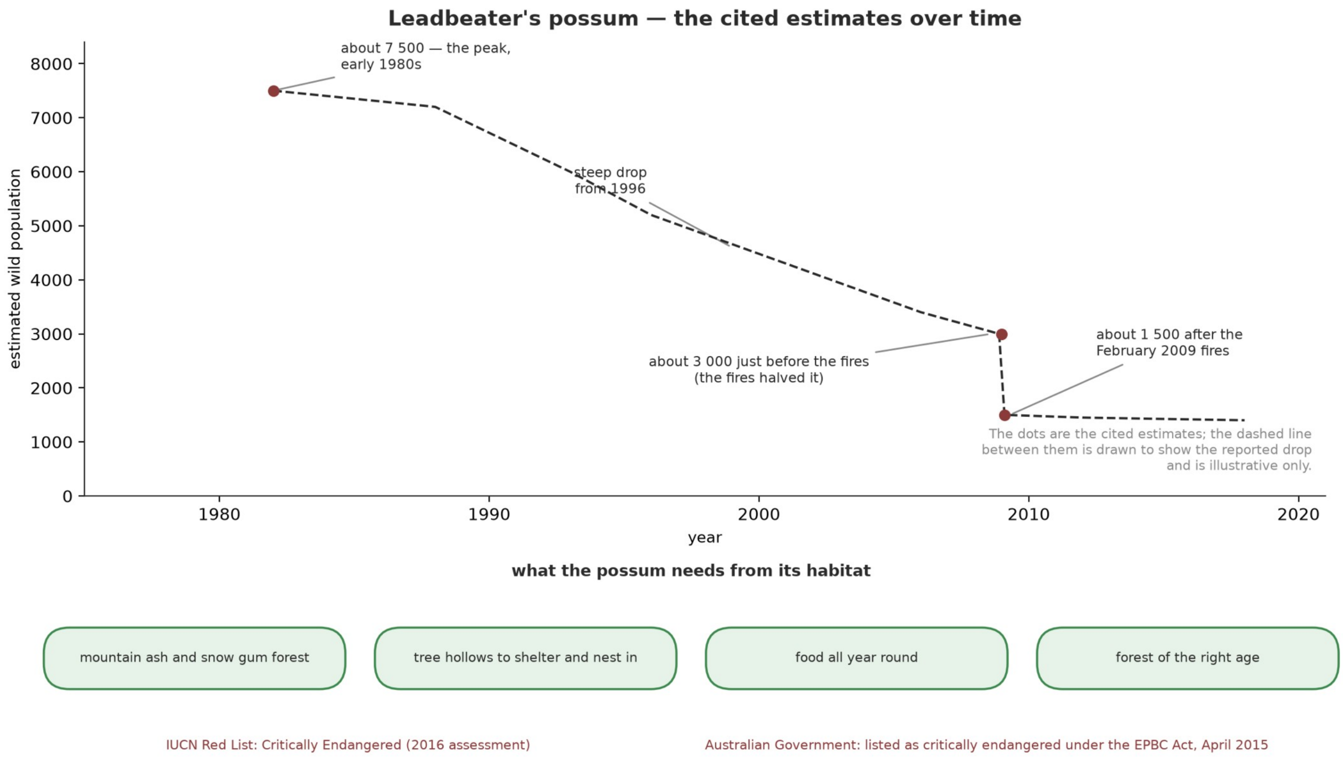
after clearing — patches of habitat remain, separated by land the species cannot live in

inside one fragment — the same number of animals in less space, and no way to reach new feeding grounds

A three-panel diagram of habitat breaking up. Panel 1: one large green block of habitat with many dots (individuals) spread through it. Panel 2: the same area cleared in parts, leaving three separated patches; the dots are now split into small groups. Panel 3: one small patch enlarged, with labels at its edge — "next patch too far to reach" on one side and "edge exposed: drier, windier, more predators" on the other — showing that a small patch has more edge than middle

The smaller and more separated the patches, the smaller the populations inside them, and the harder it is for young to move between patches to start new families.

A Victorian case: Leadbeater's possum. Leadbeater's possum lives only in the mountain ash and alpine ash forests of the Victorian Central Highlands, and it needs tree hollows in old trees for shelter and breeding. It sits in the top threat category on the IUCN Red List (2016 assessment) — the category one step above Endangered — and is listed the same way under the Commonwealth *EPBC Act* (22 April 2015) [S1]. Its population tells the habitat-loss story in real numbers (Figure 5).



A real-data population story in three panels. Panel 1: a bar for the early 1980s at about 7 500 animals, the estimated peak. Panel 2: a flame symbol for the February 2009 bushfires with the label "burnt about 43% of the possum's habitat". Panel 3: a bar at about 1 500 animals after the fires, roughly half the pre-fire population, with a note that the line joining the bars is illustrative because the possum is counted by surveys, not every year. A side panel lists what the possum needs: mountain ash and alpine ash forest, tree hollows in old trees, and food all year round. Sources for the numbers are cited in the text

The possum was already declining before 2009 as old forest was lost, and the February 2009 bushfires then burnt about 43% of its habitat, roughly halving the wild population to about 1 500 [S1]. Notice the double abiotic–biotic hit: fire (abiotic) removed the hollow-bearing trees, and with fewer trees there is less food and less shelter (biotic) for the possums that survived.

A second Victorian case keeps the same pattern: the helmeted honeyeater, listed in the top threat category under the *EPBC Act*, survives as fewer than 170 wild birds in about 5 kilometres of remnant bushland at Yellingbo [S9] — a population so small because its habitat is so small.

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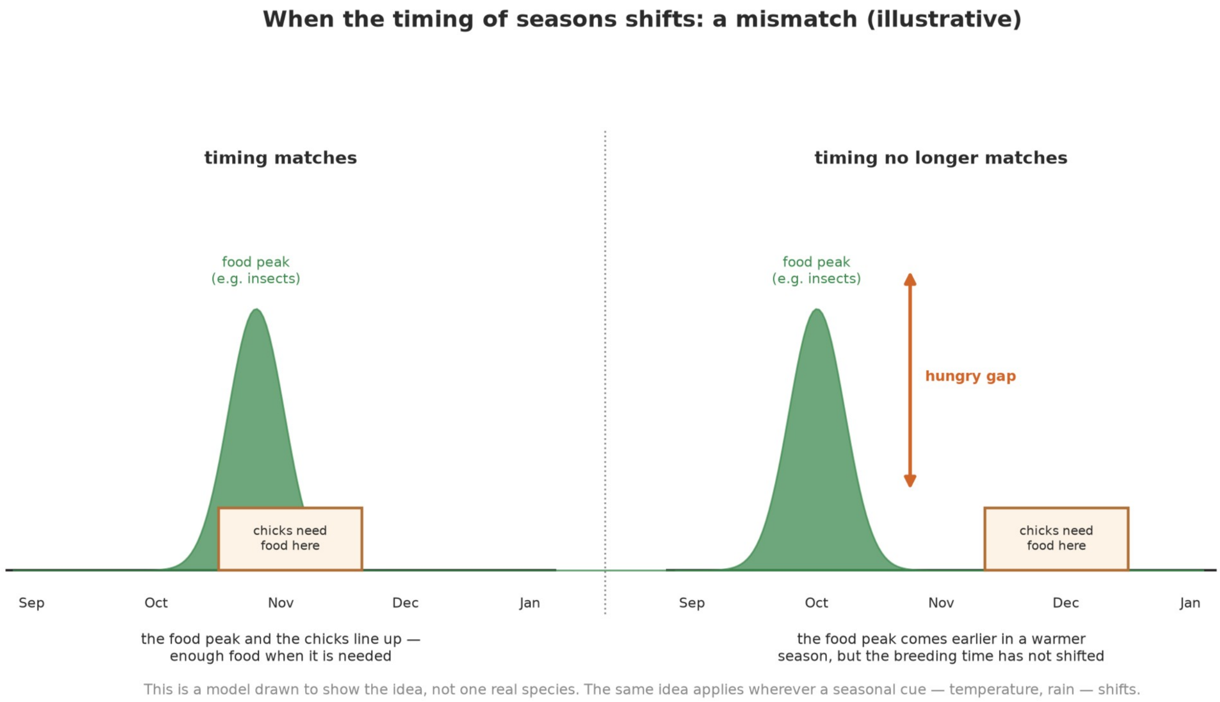
3. Pressure 2 — climate change as a driver (VC2S8U04.E04)

Climate change is a shift in the long-term weather patterns of a place — its average heat, its rain, its seasons. In this book it is named as a **driver** of population change: we track what a shifting climate does to populations, and we do not teach the mechanism that traps the heat (that belongs to Levels 9–10). The Australian record is clear: the climate has warmed by more than 1.5 °C since national records began in 1910, and south-west Australia's cool-season rainfall has fallen by 10–20% since the 1970s [S8]. Those are abiotic changes, and populations feel them through their biotic factors too.

When the timing slips. Many populations run on a timetable: breed when the food peaks. If warming moves the peak earlier but the breeding date does not move with it, the young hatch into a food supply that has already passed its best (Figure 6).



A two-panel mismatch diagram, simulated data for practice. Each panel plots "food available" and "chicks needing food" against the weeks of one breeding season. Left panel, "in step": the food peak lines up with the week the most chicks hatch. Right panel, "out of step": a warmer spring has moved the food peak earlier, so by hatching week the food curve is already falling; a shaded gap between the two curves is labelled "the mismatch — chicks hatch after the food peak has passed". The caption notes that fewer chicks are fed in the out-of-step year, so the population falls

When the place slips: Bramble Cay melomys. The Bramble Cay melomys was a small rodent living only on a tiny coral cay in the Torres Strait. Rising sea levels and storm surges repeatedly flooded the cay and killed the plants it fed on, and the species is now extinct — the Australian Government confirmed it in 2019, the first mammal extinction attributed to human-caused climate change [S7]. Its habitat was not cleared by anyone; the abiotic factor (sea level) simply removed it.

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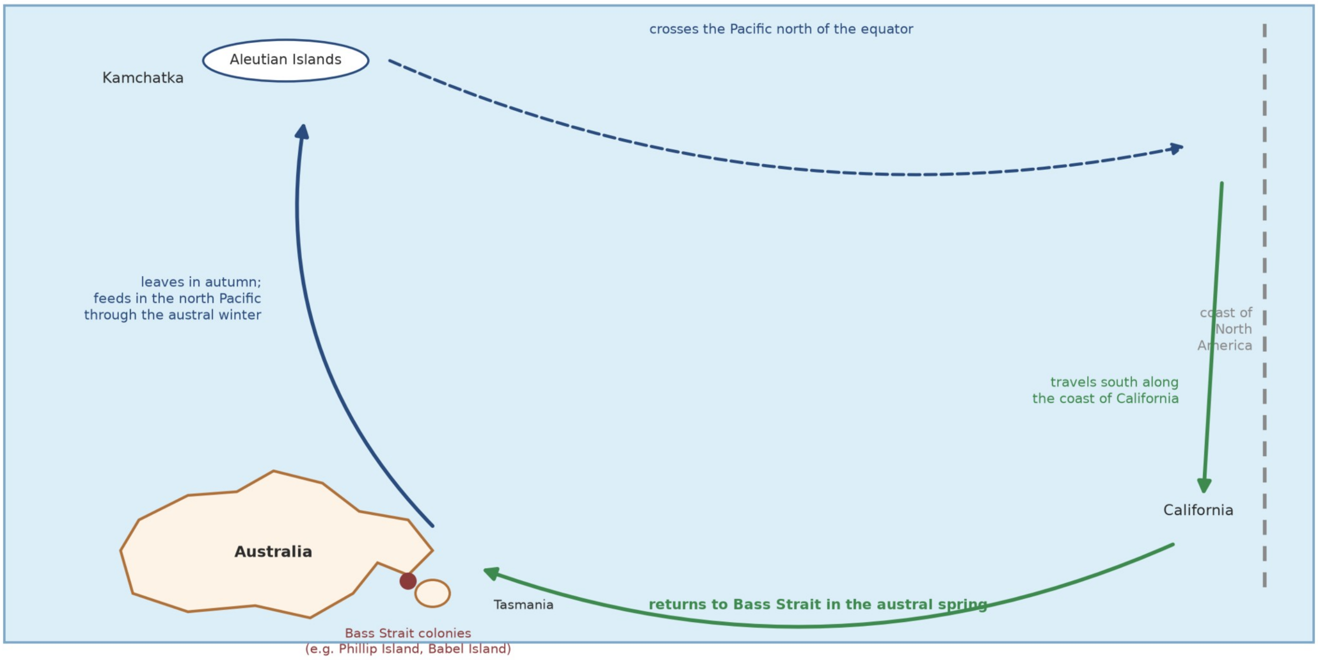
4. Pressure 3 — seasonal migration (VC2S8U04.E04)

Migration is a regular, seasonal movement of a population between two places, usually to feed in one and breed in the other. The short-tailed shearwater — the muttonbird — is Australia's most numerous seabird, and its year is a loop between hemispheres (Figure 7).

The short-tailed shearwater's yearly loop (schematic — not to scale)



Babel Island alone holds about 2.8 million breeding pairs — about 12% of the whole species; it is the most abundant seabird in Australian waters.

A map of the shearwater's year-long loop. Breeding colonies are marked on Bass Strait islands, including Babel Island and Phillip Island. An arrow labelled "leaves after breeding, austral autumn" runs north across the Pacific to feeding grounds in the North Pacific, near the Aleutian Islands and Kamchatka, where the birds spend the austral winter. A return arrow labelled "returns in austral spring to breed" runs back down the coast of North America and across to Bass Strait. A caption notes the timing is tied to the seasons in both hemispheres: the birds feed where the northern summer makes food abundant, then breed where the southern spring does

Babel Island alone holds about 2.8 million breeding pairs — about 12% of the whole species [S6]. Migration moves a population through **both** its biotic and abiotic factors: the birds follow the seasonal pulse of food (biotic), which is set by daylight and sea temperature (abiotic) in each hemisphere. That is also why migration is a pressure point: if the seasons or the food shift at either end of the loop — a climate-change effect from §3 — the whole population feels it, and a bad season at sea shows up as fewer chicks the next breeding season.

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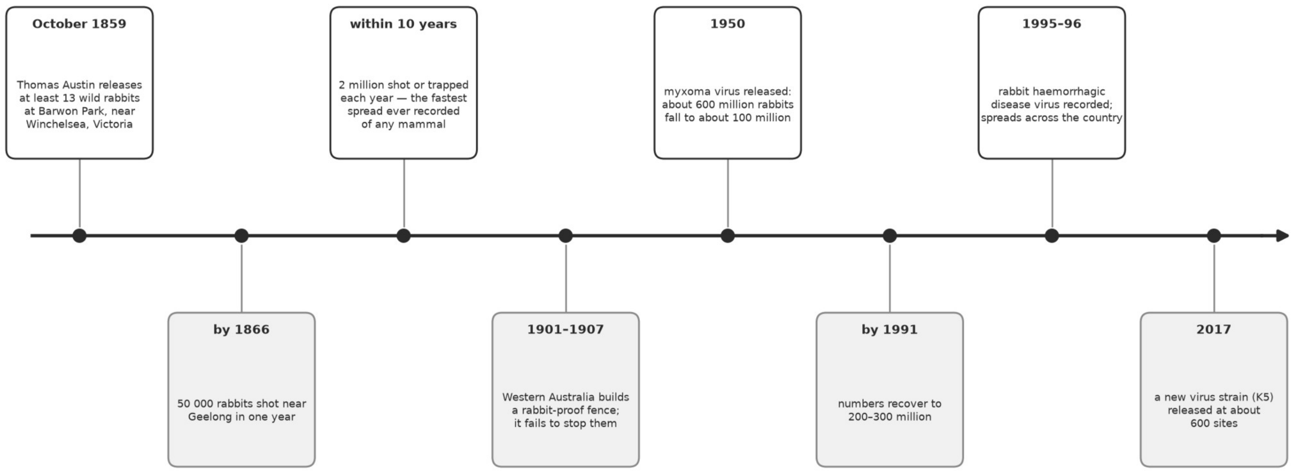
5. Pressure 4 — introducing a species (VC2S8U04.E04)

An introduced species is one that people bring to a place it has never lived in before, on purpose or by accident. Some introduced species stay few and harmless; a few become a problem, and Australia's history with the rabbit is the classic case (Figure 8).

One introduction, and the responses to it: the European rabbit in Australia

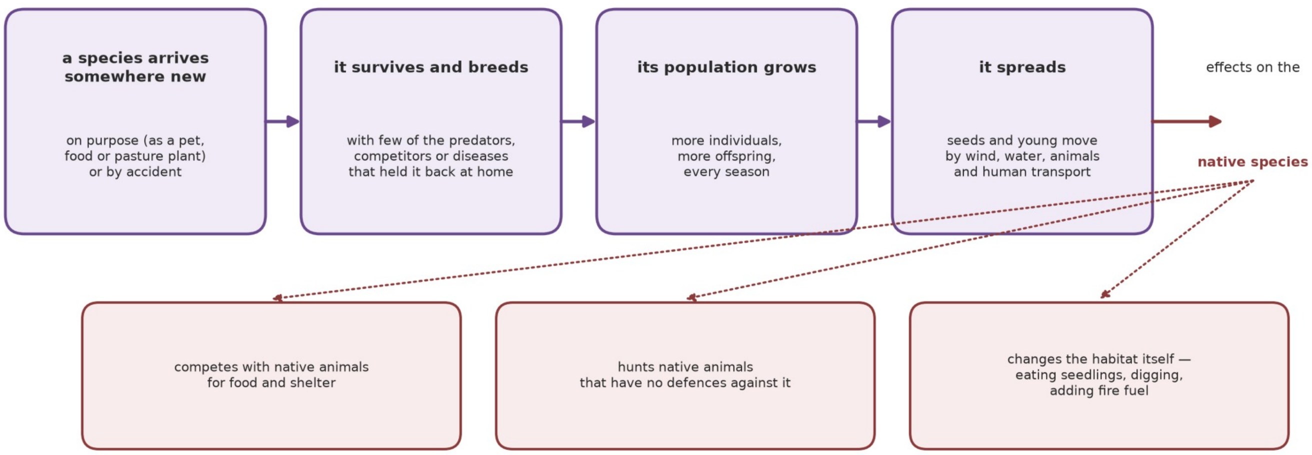


The rabbit's story runs through this subtopic: an introduction, its effects, and what people have tried in response.

A horizontal timeline of the rabbit in Australia, 1859 to 2017. 1859: Thomas Austin releases at least 13 wild rabbits at Barwon Park near Winchelsea, Victoria. 1866: about 50 000 rabbits shot near Geelong. 1870s: two million a year being shot or trapped, and the rabbit is spreading faster than any mammal on record. 1950: myxoma virus released; the population crashes from about 600 million to about 100 million. 1995: rabbit haemorrhagic disease virus escapes and spreads. 2017: the K5 virus strain released at about 600 sites. A caption notes that every control brought the numbers down for a while, and every time the survivors rebuilt the population

In October 1859, Thomas Austin released at least 13 wild rabbits on his property, Barwon Park near Winchelsea in Victoria [S4]. Within about 70 years the rabbit had spread across the continent — the fastest spread recorded for a mammal — and by 1950 the population stood at about 600 million [S4]. Why do introduced species grow like this? The causal chain is always the same (Figure 9).

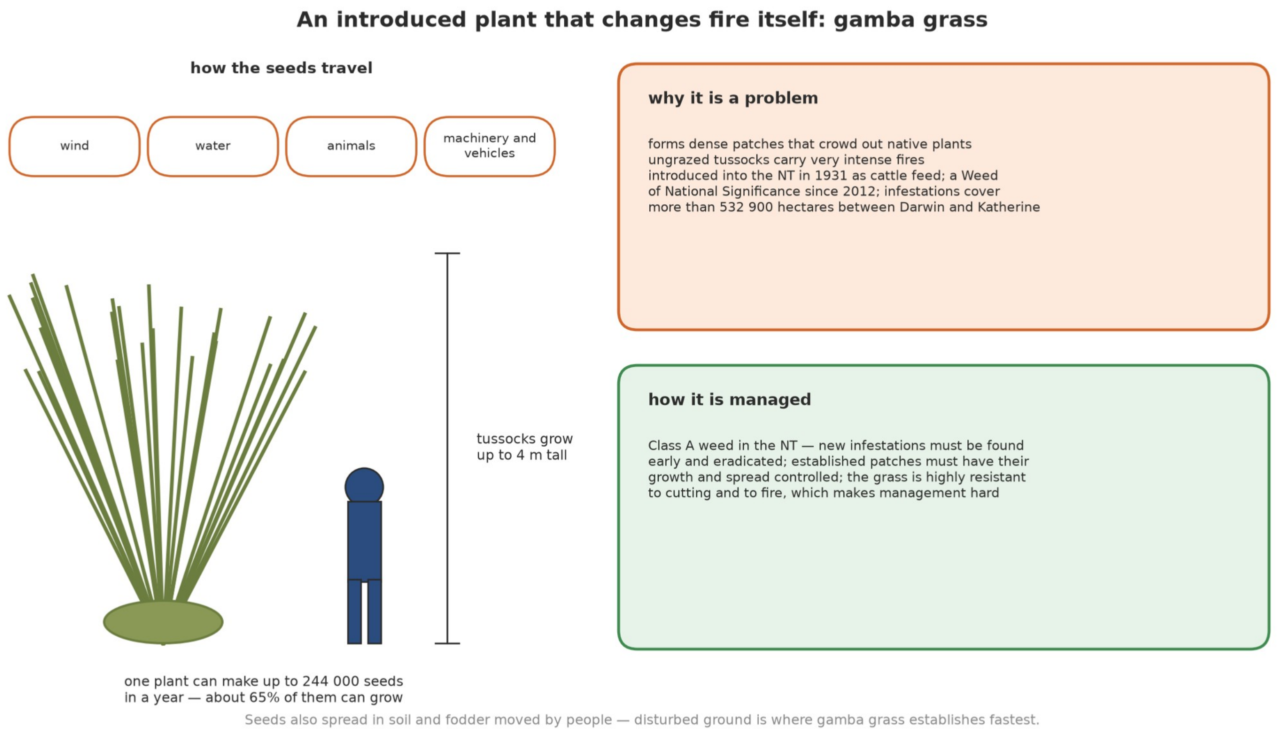
The causal chain of an introduced species



Not every introduced species becomes invasive — some stay few and harmless. Whether one becomes a problem depends on the species and on the ecosystem it enters.

A four-step causal chain in purple boxes: “a species arrives somewhere new” (on purpose, as a pet, food or pasture plant, or by accident) → “it survives and breeds” (with few of the predators, competitors or diseases that held it back at home) → “its population grows” (more individuals, more offspring, every season) → “it spreads” (seeds and young move by wind, water, animals and human transport). An arrow leads to “effects on the native species”, with three red boxes: competes with native animals for food and shelter; hunts native animals that have no defences *against it; changes the habitat itself — eating seedlings, digging, adding fire fuel. The caption notes that not every introduced species becomes invasive; whether one becomes a problem depends on the species and on the ecosystem it enters*

An introduced plant that changes an abiotic factor: gamba grass. Gamba grass was brought into the Northern Territory in 1931 to trial as cattle feed [S3]. It grows in tussocks — tall dense clumps — up to 4 m high, and one plant can make up to 244 000 seeds in a year, of which about 65% can grow [S3]. It is a Weed of National Significance (since 2012), and by 2024 infestations covered more than 532 900 hectares between Darwin and Katherine [S3]. Gamba grass is a double pressure: it crowds out native plants (a biotic change) and it carries much hotter fires than native grassland (an abiotic change), and those fires then kill native trees and shrink the populations that live under them (Figure 10).



A diagram of gamba grass. Left: a tall tussock drawn beside a person for scale, with a height bar labelled "tussocks grow up to 4 m tall", and a note that one plant can make up to 244 000 seeds in a year, about 65% of which can grow. Top: four chips under "how the seeds travel" — wind, water, animals, machinery and vehicles. Right, an orange box, "why it is a problem": forms dense patches that crowd out native plants; ungrazed tussocks carry very intense fires; introduced into the NT in 1931 as cattle feed; a Weed of National Significance since 2012; infestations cover more than 532 900 hectares between Darwin and Katherine. Right, a green box, "how it is managed": a Class A weed in the NT, so new infestations must be found early and eradicated and established patches must have their growth and spread controlled; the grass is highly resistant to cutting and to fire, which makes management hard

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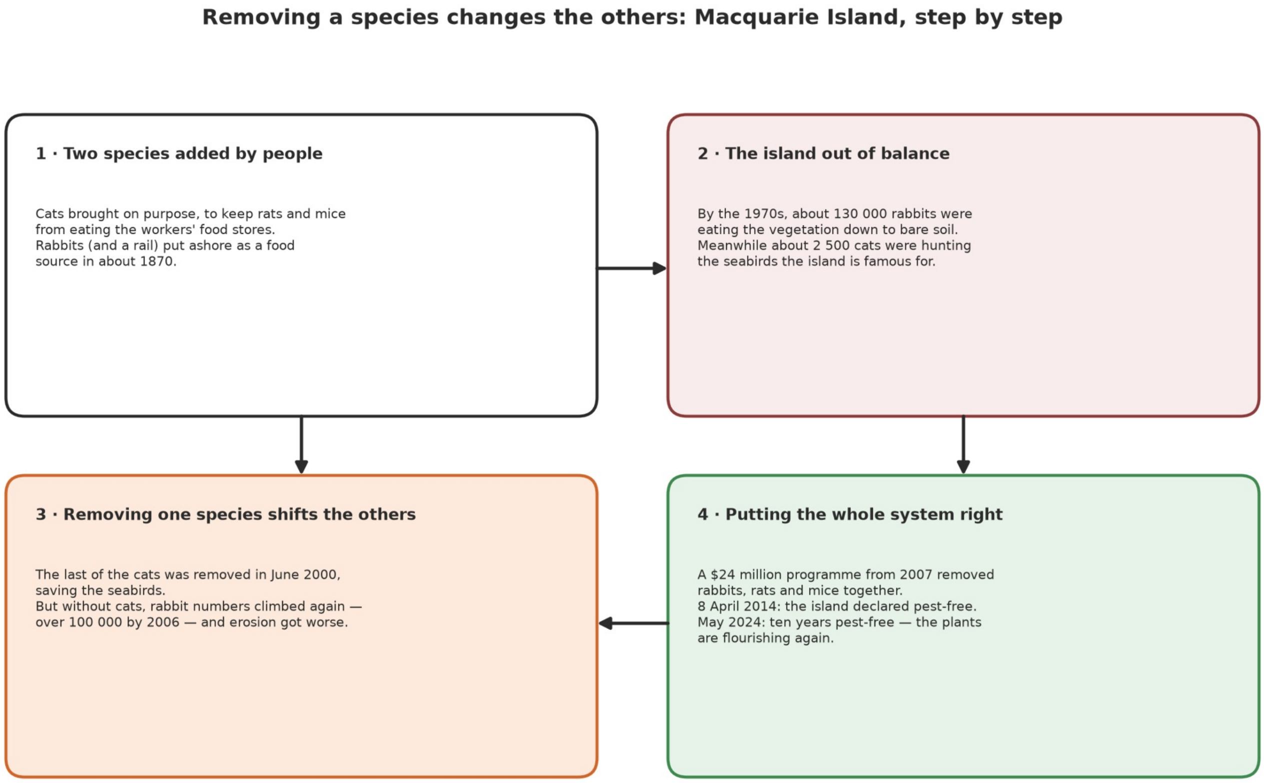
6. Removing a species (VC2S8U04.E03)

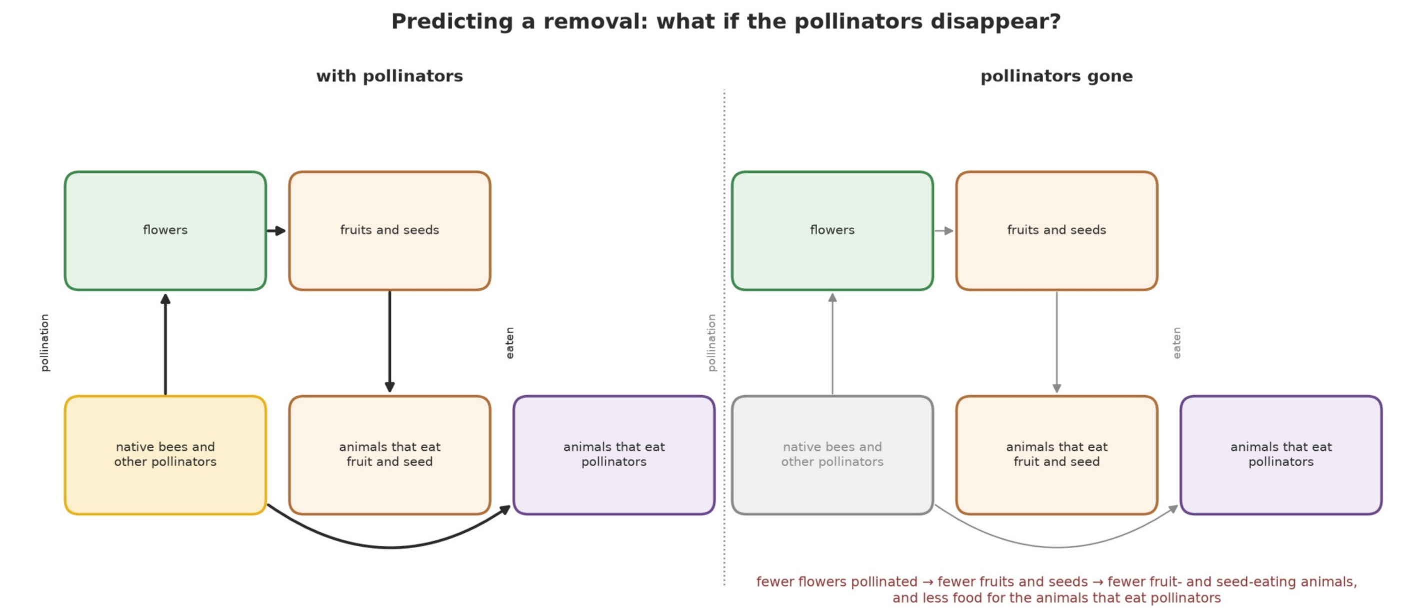
Taking a species away is not simply the introduction story played backwards: every species sits in a web of feeding links, so removing one moves several populations at once. Macquarie Island shows the whole cascade, step by step (Figure 11).



Macquarie Island has been on the World Heritage list since 1997. Each step changed more than the species people aimed at.

A four-step cascade for Macquarie Island. Step 1, "Two species added by people": cats brought on purpose to keep rats and mice from eating the workers' food stores; rabbits (and a rail) put ashore as a food source in about 1870. Step 2, "The island out of balance": by the 1970s about 130 000 rabbits were eating the vegetation down to bare soil, while about 2 500 cats were hunting the seabirds the island is famous for. Step 3, "Removing one species shifts the others": the last cat was removed in June 2000, saving the seabirds — but without cats, rabbit numbers climbed again to over 100 000 by 2006, and erosion got worse. Step 4, "Putting the whole system right": a $24 million programme from 2007 removed rabbits, rats and mice together; 8 April 2014 the island was declared pest-free; by May 2024, ten years pest-free, the plants are flourishing again. A caption notes that Macquarie Island has been on the World Heritage list since 1997, and that each step changed more than the species people aimed at

The lesson of step 3 is the one to hold onto: removing the cats was good for the seabirds, but it released the rabbits from their only predator on the island, and the rabbit population exploded onto the vegetation. **Removing a species changes the factors of every population it was linked to** — which is exactly the reasoning used to predict what happens when any link is taken out of a web (Figure 12).



The same reasoning works for removing a predator: ask what it used to eat, and what used to eat it (Worked example 2).

A worked reasoning web, simulated data for practice. A small food web is drawn with a native bee (pollinator) at its centre: the bee visits the flowering plants; the flowering plants feed seed-eating birds through their seeds; a native wasp hunts the bee; the plants also shelter small insects eaten by skinks. The bee is crossed out with a red cross, "the pollinator is removed". Arrows trace two predictions: fewer seeds are set, so the seed-eating bird population falls (a biotic effect), and the wasp loses its prey, so the wasp population falls too. A caption notes the habit for any removal: ask what the removed species fed on, and what used to feed on it

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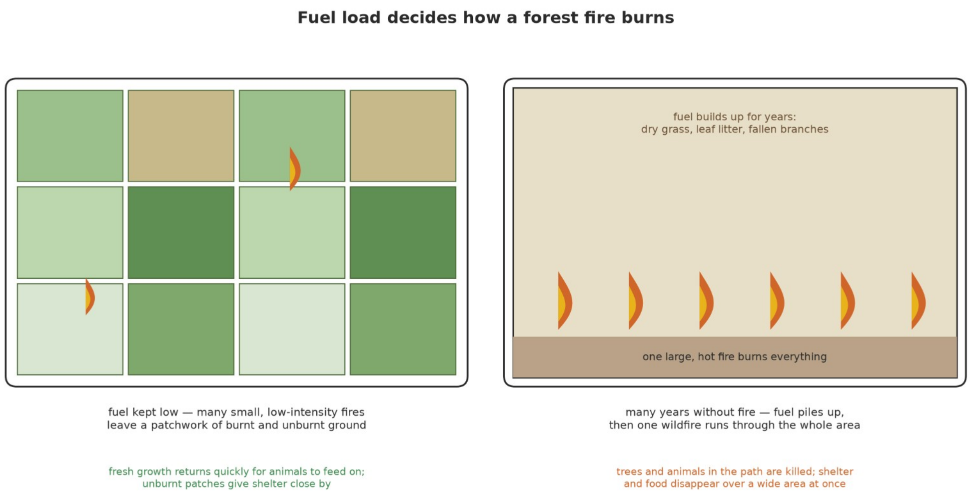
7. Fire as an abiotic pressure (VC2S8U04.E04)

Fire is an abiotic factor, and how hard it hits a population depends on the **fuel load** — the dry grass, leaf litter and fallen branches lying on the ground (Figure 13).



Where fuel is kept low, fires are smaller and cooler and more plants and animals survive. Where fuel builds for many years, one large hot fire can burn almost everything in its path — Black Thursday, February 1851, burnt about 50 000 square kilometres of Victoria.

A two-panel fuel-load diagram. Left panel: a patchwork of small squares in different shades of green and tan, with two tiny flames — fuel kept low, many small low-intensity fires leave a patchwork of burnt and unburnt ground; fresh growth returns quickly for animals to feed on, and unburnt patches give shelter close by. Right panel: one large tan block labelled "fuel builds up for years: dry grass, leaf litter, fallen branches", with a row of six large flames and a brown band reading "one large, hot fire burns everything" — many years without fire lets fuel pile up, then one wildfire runs through the whole area; trees and animals in the path are killed, and shelter and food disappear over a wide area at once. The caption notes that where fuel is kept low, fires are smaller and cooler and more plants and *animals survive; where fuel builds for many years, one large hot fire can burn almost everything in its path — Black Thursday, February 1851, burnt about 50 000 square kilometres of Victoria*

Now join this figure to Figure 5: the February 2009 bushfires were a fire event **and** a habitat-loss event in the same season — about 43% of Leadbeater's possum habitat burnt in one fire season [S1], which is why the possum population halved in a single step on the graph rather than sliding slowly. That is the habit this subtopic builds: one real event can act through several factors at once, and a population graph only makes sense when you can name them.

Worked examples

Example 1 — scaffolded

Read the simulated population graph in Figure 3.

(a) The line is level between the first rise and the slow fall. What does "level" say about births, deaths, arrivals and leaving? **(b)** At one point the line falls suddenly. Name one *sharp event* from the call-outs that could cause it, and say whether it is a biotic or an abiotic factor. **(c)** After the sudden fall the line climbs again. What does that climb say about the pressure?

Working. (a) Level means the population is steady, so births plus arrivals roughly balance deaths plus leaving. (b) A sharp event in the call-outs is "fire, flood, disease, a new predator". Choosing **a wildfire**: fire is non-living, so it is an **abiotic** factor (though the habitat it removes may be a biotic need, like food and shelter). (c) A climb means births plus arrivals now outweigh deaths plus leaving — the pressure that caused the fall has eased or been removed.

Example 2 — scaffolded

Use Figure 12 to predict the effects of removing the native bee from the web. (This is the `VC2S8U04.E03` habit: ask what the removed species fed, and what fed on it.)

(a) The bee pollinates the flowering plants. Predict the effect on the seed-eating bird. **(b)** The native wasp hunts the bee. Predict the effect on the wasp. **(c)** Name one factor type (biotic or abiotic) that is *not* changed for the plants by removing the bee.

Working. (a) Fewer visits mean fewer seeds are set, so the seed-eating birds lose food — a biotic factor for the birds — and their population falls. (b) The wasp loses its prey, a biotic factor, so the wasp population falls too. (c) The abiotic factors of the plants — water, light, soil, temperature — are untouched by the bee's removal.

Example 3 — unscaffolded

Leadbeater's possum: the February 2009 bushfires burnt about 43% of the possum's habitat, and the wild population fell from its pre-fire size to about 1 500 — roughly half [S1].

(a) Explain, using one biotic and one abiotic factor, why losing hollow-bearing trees in the fires shrank the possum population. **(b)** Old mountain ash trees take many decades to grow hollows big enough for possums. Use that fact to predict whether the population could bounce back within a few years of the fires, and justify your prediction.

Working. (a) Chain from an abiotic to a biotic factor: the fires (abiotic) burnt the old trees, so shelter sites (a biotic need) disappeared, and with less forest there is less food (biotic). With less shelter and food, deaths outran births and the population halved. (b) No quick bounce-back: even if every surviving possum bred successfully, the population cannot grow beyond the hollows and food the forest supplies, and those take many decades to return — so recovery is slow, over decades, not a few years.

Example 4 — unscaffolded

Macquarie Island: cats were removed by June 2000; rabbits then climbed to over 100 000 by 2006 and were eating the vegetation down further [S5].

Explain, in terms of biotic factors, why removing one species (the cat) made life *worse* for the island's plants, and say how Figure 11's step 4 was different.

Working. The cat was the rabbit's only predator on the island — a biotic factor holding the rabbit population down. Remove the cat and that factor disappears: rabbit deaths fall, the rabbit population grows, and the rabbits' own feeding (a biotic factor for the plants) intensifies, so the plants are grazed harder and erosion worsens. Step 4 removed rabbits, rats and mice **together**, so no released population was left to explode — the whole system was put right at once instead of one link at a time.

Practice questions

Scaffolded

Q1. Define, in your own words: (a) population; (b) habitat; (c) biotic factor; (d) abiotic factor.

Q2. Sort these factors affecting a possum population into biotic and abiotic: (i) the number of hollow-bearing trees; (ii) the temperature of the coldest week; (iii) a fungus that sickens possums; (iv) rainfall in a drought year.

Q3. Using the simulated graph in Figure 3: (a) describe what is happening to births and deaths during the "rising" part; (b) name the two call-outs that describe a *falling* line; (c) which of those two call-outs fits a line that drops in a single season, and why?

Q4. Figure 4 shows one habitat broken into patches. (a) What happens to the population living inside each patch compared with the original whole habitat? (b) Name the two problems the patch edges create, as labelled in panel 3.

Q5. From the rabbit timeline (Figure 8): (a) in what year, and where, were the rabbits released? (b) about how many rabbits were there by 1950? (c) name the two viruses that crashed the population, with their years.

Q6. Figure 7 shows the shearwater's year. (a) Where does the species breed, and where does it feed in the austral winter? (b) Name one biotic and one abiotic factor the birds are following on their loop.

Unscaffolded

Q7. The helmeted honeyeater survives as fewer than 170 wild birds in about 5 kilometres of remnant bushland at Yellingbo [S9]. Explain why a population this small, in a habitat this small, is at risk from a single fire or disease outbreak.

Q8. Figure 6 shows a breeding season "out of step" with its food peak. (a) Explain how a warmer spring can move the food peak earlier. (b) Predict the effect on the population if the mismatch repeats for several years in a row, and name the pressure from this subtopic that causes it.

Q9. A new disease kills most of the native bees in a woodland. Using the habit from Figure 12 (ask what the removed species fed, and what fed on it), predict one effect on a plant population and one effect on an animal population, and name the factor type changed in each case.

Q10. Introduced species often grow fast at first in their new home (Figure 9). Explain why, using two biotic factors that held the species back at home but are missing in the new place.

Q11. Gamba grass changes both a biotic and an abiotic factor where it spreads (Figure 10). Name one of each, and explain how the abiotic one then harms a native animal population that the grass never touches.

Q12. On Macquarie Island, removing the cats saved the seabirds yet the vegetation got worse [S5]. Explain this using the idea of a chain of factors, and identify the step that finally let the plants recover.

Q13. Figure 13 contrasts two fuel loads. Explain why the same spark can lead to a small cool fire in the left panel but a population-crashing fire in the right panel, and connect your answer to the February 2009 fires in Figure 5.

Q14. A student claims: "Removing an introduced species from an ecosystem always helps every other population." Evaluate the claim using evidence from Macquarie Island (Figure 11).

Answers

Q1. (a) All the individuals of one species living in a place at a time. (b) The place where a species normally lives, with the food, water and shelter it needs. (c) A living part of an ecosystem that affects a population (food, predators, disease). (d) A non-living part (water, temperature, light, soil, fire). **Q2.** Biotic: (i) hollow-bearing trees (a living resource), (iii) the fungus. Abiotic: (ii) temperature, (iv) rainfall. **Q3.** (a) Births plus arrivals outweigh deaths plus leaving. (b) "Slow fall" and "sudden fall". (c) Sudden fall — a sharp event such as fire or a new predator changes the balance in one season, while a slow fall is a gradual change such as habitat quality. **Q4.** (a) Each patch holds a smaller population than the whole habitat did, and the small groups are cut off from one another. (b) The next patch is too far to reach (young cannot move between patches), and the edge is drier, windier and open to more predators. **Q5.** (a) October 1859, at Barwon Park near Winchelsea, Victoria. (b) About 600 million. (c) Myxoma virus, 1950; rabbit haemorrhagic disease virus, 1995 (K5 strain released 2017). **Q6.** (a) Breeds on Bass Strait islands (e.g. Babel Island, Phillip Island); feeds in the North Pacific (near the Aleutian Islands and Kamchatka) in the austral winter. (b) Biotic: the seasonal pulse of food; abiotic: daylight or sea temperature in each hemisphere. **Q7.** With fewer than 170 birds in one small patch, a single fire or disease outbreak can kill a large share of the whole species at once, and there is no other population nearby to move back into the site — one abiotic or biotic shock can remove almost every individual. **Q8.** (a) Warmer springs make insects or plants develop earlier, so the food peak arrives before the chicks hatch. (b) If the gap repeats, fewer chicks are fed each year, deaths outrun births, and the population falls over several seasons; the pressure is climate change. **Q9.** Plant population: with fewer bees, fewer flowers are pollinated and fewer seeds are set, so the plant population falls — the changed factor (pollination, a living interaction) is biotic. Animal population: an animal that hunts bees (e.g. a native wasp) loses its food and falls — also a biotic factor. (Any sensible plant/animal pair with correct factor types accepted.) **Q10.** At home the species was held back by its predators and by its diseases (and competitors for food). In the new place those biotic factors are missing or weaker, so more individuals survive and breed each season and the population grows fast. **Q11.** Biotic: it crowds out native plants. Abiotic: it makes fires hotter and more intense. The hotter fires (abiotic) kill native trees and the animals living in them — e.g. small mammals and birds lose shelter and food — even though the grass never directly touches those animals. **Q12.** The cat was the only predator holding the rabbit population down; removing the cat removed that biotic factor, rabbits increased, and their grazing (a biotic factor for the plants) intensified, so the vegetation worsened. The step that finally let the plants recover was step 4: removing rabbits, rats and mice together (the 2007 programme, pest-free by 8 April 2014). **Q13.** With low fuel, a spark burns a small cool patch and the unburnt squares shelter the animals; with years of built-up fuel, the same spark runs one large hot fire through everything, killing trees and animals across a wide area. The February 2009 fires were the right-panel case at landscape scale: about 43% of Leadbeater's possum habitat burnt in one season, halving the population. **Q14.** The claim is wrong. Removing the cats helped the seabirds but released the rabbits from predation, and the rabbit explosion damaged the plants and the animals that depend on them; only when rabbits, rats and mice were removed together did the whole system recover. A removal changes the factors of every linked population, so "always helps every other population" fails.

Fully-worked solutions

Q1. (a) A population is all the individuals of one species living in a place at a time. *(1 mark)* (b) A habitat is the place where a species normally lives, with the food, water and shelter it needs. *(1 mark)* (c) A biotic factor is a living part of an ecosystem that affects a population, e.g. its food or its predators. *(1 mark)* (d) An abiotic factor is a non-living part, e.g. water, temperature or fire. *(1 mark)* **Q2.** Biotic: (i) the hollow-bearing trees — a living resource the possums need; *(1 mark)* (iii) the fungus — a living disease. *(1 mark)* Abiotic: (ii) temperature and (iv) rainfall — non-living parts of the environment. *(1 mark)* **Q3.** (a) During "rising", births plus arrivals are more than deaths plus leaving, so the count grows. *(1 mark)* (b) The "slow fall" and the "sudden fall". *(1 mark)* (c) The sudden fall — a sharp event (fire, flood, disease, a new predator) flips the balance in one season; a slow fall is a gradual change such as food or habitat quality. *(1 mark)* **Q4.** (a) The original population is split into smaller populations, one per patch, and each small group is cut off from the others. *(1 mark)* (b) Edge problems: the next patch is too far for young to reach, and the exposed edge is drier, windier and open to more predators. *(2 marks)* **Q5.** (a) October 1859 at Barwon Park, near Winchelsea in Victoria — at least 13 wild rabbits released by Thomas Austin. *(1 mark)* (b) About 600 million. *(1 mark)* (c) Myxoma virus in 1950 and rabbit haemorrhagic disease virus in 1995 (the K5 strain followed in 2017). *(1 mark)* **Q6.** (a) It breeds on Bass Strait islands such as Babel Island and Phillip Island, and feeds in the North Pacific — near the Aleutian Islands and Kamchatka — through the austral winter. *(1 mark)* (b) Biotic: the seasonal abundance of its food at sea; abiotic: the seasonal change in daylight or sea temperature that drives that abundance. *(2 marks)* **Q7.** A single fire (abiotic shock) or disease outbreak (biotic shock) can reach the whole species at once, because every bird lives in the same 5 kilometres; *(1 mark)* with fewer than 170 birds, losing even part of them can drop the population below recovery, and no separate population exists nearby to move in and rebuild it. *(1 mark)* **Q8.** (a) A warmer spring speeds up the insects or plants the chicks eat, so the food peak arrives earlier in the season while the breeding date stays put. *(1 mark)* (b) Repeated mismatches mean fewer chicks are fed each year, so deaths outrun births and the population declines over several seasons; *(1 mark)* the driver is climate change. *(1 mark)* **Q9.** Plant: fewer bees → fewer flowers pollinated → fewer seeds set → the plant population falls; the changed factor (pollination) is biotic. *(2 marks)* Animal: a bee-hunter such as the native wasp loses its prey and its population falls; the changed factor (food) is biotic. *(2 marks)* **Q10.** At home, predators and diseases (and competitors) kept the population in check — biotic factors. *(1 mark)* In the new place those factors are absent or weaker, so more individuals survive to breed each season; *(1 mark)* with more breeders every season, the population compounds upward — which is why the rabbit reached about 600 million in about 90 years. *(1 mark)* **Q11.** Biotic change: dense gamba patches crowd out the native plants. *(1 mark)* Abiotic change: ungrazed gamba tussocks carry much hotter, more intense fires. *(1 mark)* The hotter fires kill native trees and the animals sheltering in them — the animals lose food and shelter (biotic) through a fire (abiotic) the grass made worse, without the grass ever directly touching them. *(1 mark)* **Q12.** Chain of factors: the cat was a biotic factor (predator) holding the rabbit population down; *(1 mark)* removing the cat let the rabbit population grow, and rabbit grazing is a biotic factor on the plants, so the vegetation was eaten down further and erosion worsened. *(1 mark)* The plants recovered only after step 4 removed rabbits, rats and mice together — the island was declared pest-free on 8 April 2014 and the vegetation flourished again. *(1 mark)* **Q13.** Left panel: low fuel means a small, cool fire that burns a patch and stops; the unburnt squares keep shelter and food, so populations hold on. *(1 mark)* Right panel: years of fuel build-up mean one large hot fire that kills trees and animals across the whole area at once. *(1 mark)* February 2009 was the right panel at landscape scale — about 43% of Leadbeater's possum habitat burnt in one season, halving the population in a single sudden fall on the graph. *(1 mark)* **Q14.** The claim is wrong. *(1 mark)* On Macquarie Island, removing the cat helped the seabirds but removed the rabbit's only predator, and the rabbit population exploded onto the vegetation — one removal helped some populations and harmed others. *(1 mark)* Recovery needed the whole-system removal of rabbits, rats and mice together, which shows a removal must be judged by the factors it changes across the web, not by the target species alone. *(1 mark)*

Sources

Web sources below were retrieved 2026-08-21.

- **[S1]** Wikipedia, "Leadbeater's possum", 2026. https://en.wikipedia.org/wiki/Leadbeater%27s_possum — IUCN Red List top threat category (2016 assessment); *EPBC Act* top-category listing 22 April 2015; peak of about 7 500 in the early 1980s; February 2009 fires burnt about 43% of habitat and roughly halved the wild population to about 1 500.
- **[S2]** Wikipedia, "Black Thursday bushfires", 2026. https://en.wikipedia.org/wiki/Black_Thursday_bushfires — about 50 000 square kilometres of Victoria burnt in February 1851.
- **[S3]** Wikipedia, "Andropogon gayanus", 2026. https://en.wikipedia.org/wiki/Andropogon_gayanus — introduced into the NT in 1931 as trial cattle feed; tussocks to 4 m; up to 244 000 seeds per plant per year at about 65% viability; Weed of National Significance since 2012; over 532 900 ha between Darwin and Katherine by 2024; Class A (eradication) / Class B (control) status; highly resistant to cutting and fire.
- **[S4]** Wikipedia, "Rabbits in Australia", 2026. https://en.wikipedia.org/wiki/Rabbits_in_Australia — Thomas Austin's October 1859 release of at least 13 wild rabbits at Barwon Park near Winchelsea; fastest recorded mammal spread; about 600 million by 1950; myxoma virus 1950; RHDV 1995; K5 release 2017.
- **[S5]** Wikipedia, "Macquarie Island", 2026. https://en.wikipedia.org/wiki/Macquarie_Island — cats and rabbits introduced; about 130 000 rabbits by the 1970s; about 2 500 cats; last cat removed June 2000; rabbits over 100 000 by 2006; $24 million programme from 2007; pest-free declared 8 April 2014; ten years pest-free by May 2024; World Heritage listed 1997.
- **[S6]** Wikipedia, "Short-tailed shearwater", 2026. https://en.wikipedia.org/wiki/Short-tailed_shearwater — breeds on Bass Strait islands including Babel Island and Phillip Island; austral winter in the North Pacific near the Aleutians and Kamchatka; most abundant seabird in Australian waters; Babel Island about 2.8 million breeding pairs (about 12% of the species).

- **[S7]** Wikipedia, “Bramble Cay melomys”, 2026. https://en.wikipedia.org/wiki/Bramble_Cay_melomys — extinct; Australian Government confirmation 2019; first mammal extinction attributed to human-caused climate change; sea-level rise and storm surges removed its habitat and food plants.
- **[S8]** Wikipedia, “Climate change in Australia”, 2026. https://en.wikipedia.org/wiki/Climate_change_in_Australia — warming of more than 1.5 °C since 1910; south-west cool-season rainfall down 10–20% since the 1970s.
- **[S9]** Wikipedia, “Helmeted honeyeater”, 2026. https://en.wikipedia.org/wiki/Helmeted_honeyeater — top threat category under the *EPBC Act*; fewer than 170 wild birds in about 5 km of remnant bushland at Yellingbo.

Figure 3 and Figure 12 are **simulated data for practice**; the shapes and chains they show are the real-world patterns the models represent. Figure 5 uses sourced counts [S1] with the between-survey line illustrative. Figure 6 is a teaching model of a timing mismatch, not a measured data set. Conservation status is a moving fact: statuses above are quoted from the IUCN Red List and the *EPBC Act* list as recorded on the sources’ retrieval date (2026-08-21).

Elaboration contexts used: `VC2S8U04.E03` (predicting the effects when a pollinator or predator is removed — Worked example 2, Q9, Figure 12) and `VC2S8U04.E04` (seasonal change, habitat destruction and introduced species shifting biotic and abiotic factors — §§2–5, 7). The First Nations limbs of `VC2S8U04.E05` and `VC2S8U04.E06` are reserved under the ICIP decision and are not taught (see teacher-facing note).

Teacher-facing note — reserved elaborations (not student text). `VC2S8U04.E05` (the Kungarakan and Warai Peoples, Traditional Owners of the Rum Jungle area near Darwin, collaborating with the Australian Government to mitigate gamba grass seed dispersal through seed eradication and foliage spraying) and `VC2S8U04.E06` (Aboriginal fire management over tens of thousands of years shaping flora and fauna distribution, and the disruption of cultural burning, e.g. wildfires in Leadbeater’s possum habitat in the Victorian Central Highlands) are reserved under the ICIP decision (D10; CONTENT_POLICY rule 1): no Aboriginal or Torres Strait Islander content is delivered in this book. The wider science those elaborations sit inside — introduced-species dynamics (gamba grass as a Weed of National Significance), fuel-load and fire-severity dynamics, and wildfire as habitat loss — is taught here from the CD text and the public sources cited above.

Test A

Topic test 4 — Biological sciences: from cells to ecosystems

Science understanding and science inquiry · Chapters 7–9 · Subtopics 7A, 7B, 8A, 8B, 8C, 8D, 9A and 9B · Codes VC2S8U01, VC2S8U02, VC2S8U03, VC2S8U04, VC2S8I02, VC2S8I03, VC2S8I05 and VC2S8I06

Total: 40 marks · Section A (multiple choice): 10 marks · Section B (short/structured response): 30 marks

6 of the 40 marks are science inquiry marks (codes `VC2S8I02`, `VC2S8I03`, `VC2S8I05` and `VC2S8I06`).

Planned for about 45 minutes. This paper is untimed — there is no time to beat.

This is a school-designed paper. It is not a VCAA instrument. Achievement at Levels 7 and 8 is reported against the Victorian Curriculum achievement standard on teacher judgement; the marks here are one source of evidence towards that judgement.

Conditions

- Completion is **untimed**. The 45 minutes is planning guidance only; take as long as you need.
- **Reading support** is permitted. Your teacher may read any question out to you if you need it. Reading is not what is being looked at, and your teacher will not help with the answer.
- **No calculator is required.** Nothing on this paper needs one. No formula sheet. No reading time.
- Answer every question. For multiple-choice questions, circle the letter of the best answer. There is only one best answer for each question.

In this test you will:

- explain how classification orders and organises biological diversity, and use and repair a dichotomous key (Q1–Q3, Q11, Q15)
- distinguish cells and their organelles, and link cell structures to what they do (Q4–Q6, Q13)
- relate structure to function in a plant and an animal organ system (Q7, Q8, Q14)
- represent flows of matter and energy in a food web and predict the effects of a change (Q9, Q10, Q12)
- identify variables, read a pattern and judge a method in investigations from Chapters 7–9 (Q16, Q17)

Section A — Multiple choice (10 marks)

Each question is worth 1 mark. Circle the letter of the best answer.

Q1 *(1 mark · VC2S8U01)* A primary purpose of biological classification is:

A. Ranking organisms from most to least useful to humans. B. Identification and communication about organisms. C. Reducing the actual number of species on Earth. D. Replacing all local common names with one global word.

Q2 *(1 mark · VC2S8U01)* How does a binomial naming system (Genus species) reduce ambiguity?

A. Adds complexity. B. Limits research. C. Is just tradition. D. Provides a unique scientific name independent of vernacular.

Q3 *(1 mark · VC2S8U01)* A bacterium and a tree both display ‘respiration’. This means:

A. Both release energy from food via respiration. B. Both have lungs. C. Both move. D. Both photosynthesise.

Q4 *(1 mark · VC2S8U02)* Typical bacterial cells are roughly how big compared to typical animal cells?

A. Same size. B. Larger (about 10x). C. Smaller (about 10x). D. Same shape and size.

Q5 *(1 mark · VC2S8U02)* Why does a multicellular organism need cells specialised for different functions?

A. Specialised cells can each perform every body function on their own. B. Different cell types can perform specific jobs (transport, defence, sensing) more efficiently. C. Specialisation reduces the total number of cells the organism needs. D. Specialisation only matters in plants, not in animals.

Q6 *(1 mark · VC2S8U02)* Total magnification with eyepiece 10x and objective 40x is:

A. 400x. B. 50x. C. 4x. D. 4000x.

Q7 *(1 mark · VC2S8U03)* Which animal system most closely parallels a plant's vascular tissue (xylem/phloem)?

A. Digestive system. B. Nervous system. C. Excretory system only. D. Circulatory system.

Q8 *(1 mark · VC2S8U03)* How does the structure of villi in the small intestine relate to their function?

A. They produce most of the digestive enzymes that break down food. B. They contract to push food along the intestine. C. Their large surface area increases the absorption of nutrients into the blood. D. They neutralise stomach acid as food enters the intestine.

Q9 *(1 mark · VC2S8U04)* In a food web, an arrow points FROM the prey TO the predator. What does the arrow show?

A. The direction in which the predator chases or attacks the prey. B. The direction in which energy flows from one organism to another. C. Which of the two organisms is the larger species. D. Which species appeared first in the ecosystem.

Q10 *(1 mark · VC2S8U04)* Why does the energy passed between trophic levels drop by about 90% at each level?

A. Animals higher in the chain are larger, so each individual stores more energy. B. Some energy travels back down the chain to the producers. C. Predators are more efficient hunters than herbivores are at grazing. D. Much energy is lost as heat, used in respiration, and not all biomass is eaten or digested.

Section B — Short/structured response (30 marks)

Q11 *(5 marks · VC2S8U01)* The provided key below names six animals of a school dam survey *(a simulated survey, written for practice)*. A dichotomous key offers exactly two choices at every step; start at couplet 1, follow the statement that matches the specimen, and repeat until you reach a name.

1.
   (a) The animal has feathers. … **go to 2**
   (b) The animal has no feathers. … **go to 3**
2.
   (a) There is webbing between the toes. … **Pacific black duck**
   (b) There is no webbing between the toes. … **Australian magpie**
3.
   (a) There is a shell on the back. … **common garden snail**
   (b) There is no shell on the back. … **go to 4**
4.
   (a) The animal has eight legs. … **flat huntsman spider**
   (b) The animal does not have eight legs. … **go to 5**
5.
   (a) The animal has four legs and scaly skin. … **bobtail (shingleback lizard)**
   (b) The animal has no four legs and no scaly skin. … **grey field slug**

(a) A surveyor's notes for one specimen read: *no feathers; no shell on the back; not eight legs; no four legs with scaly skin.* Use the key to name the specimen and give the full path through the key. *(2 marks)*
(b) A white-faced heron — a bird with feathers, long legs and a long dagger-like bill, but *no* webbing between the toes — is surveyed at the dam. State the wrong name the key reaches for the heron, and explain why the key can give a wrong name even when its rules are followed correctly. *(2 marks)*
(c) Write the modification — the edit to one existing statement and the new couplet — that would let the key tell the white-faced heron apart from the Australian magpie. *(1 mark)*

Q12 *(6 marks · VC2S8U04)* The box gum woodland food web below shows the feeding links in that ecosystem. Each line reads *food → feeder*, so every arrow points from the organism that is eaten to the organism that eats it. The decomposers (fungi and bacteria) break down the dead remains and waste of every organism in the web.

- box gum → caterpillar
- box gum → possum
- kangaroo grass → grasshopper
- caterpillar → skink
- caterpillar → kookaburra
- grasshopper → skink
- grasshopper → kookaburra
- skink → kookaburra
- skink → brown snake
- kookaburra → powerful owl
- kookaburra → wedge-tailed eagle
- brown snake → wedge-tailed eagle
- possum → powerful owl

(a) Write one food chain of four organisms from the web that ends at the powerful owl. Draw each arrow pointing the correct way. *(2 marks)*

(b) Name the two top consumers in this web. *(1 mark)*

(c) When a kookaburra eats a grasshopper, state the kookaburra's role (which type of consumer) and its trophic level. *(1 mark)*

(d) A disease kills most of the caterpillars in this woodland. Name the two animals that lose one of their foods, and state one food each of them still has in this web. *(2 marks)*

Q13 *(5 marks · VC2S8U02)* (a) Name the organelle where respiration releases energy from food. *(1 mark)* (b) State what the nucleus of a cell holds, and state the job of the cell membrane. *(2 marks)* (c) State two structures that are found in a plant cell but *not* in an animal cell. *(2 marks)*

Q14 *(5 marks · VC2S8U03)* (a) Define *tissue* and define *organ*, as these words are used in this topic. *(2 marks)* (b) A red blood cell is biconcave (a disc with a dip in the middle), has no nucleus, and is small and flexible. Choose *one* of these three structures and explain how it suits the red blood cell's function. *(2 marks)* (c) Name the animal organ system that does the same overall job as a plant's transport system, and state the job the two systems share. *(1 mark)*

Q15 *(3 marks · VC2S8U01)* (a) The eastern grey kangaroo has the genus *Macropus* and the species *giganteus*. Write its scientific (binomial) name correctly. *(1 mark)* (b) State one reason scientists use binomial names instead of common names. *(1 mark)* (c) List the seven Linnaean ranks in order, from largest to smallest. *(1 mark)*

Q16 *(3 marks · VC2S8I02 and VC2S8I05)* In subtopic 8B a class investigated diffusion. They placed a drop of dye into water kept at 5 °C, 22 °C and 40 °C, and timed how long the dye took to spread through the water. The results were 14 minutes, 8 minutes and 4 minutes. *(Simulated data for practice.)* (a) State (i) the variable that was changed and (ii) the variable that was measured. *(2 marks)* (b) Describe the pattern the results show. *(1 mark)*

Q17 *(3 marks · VC2S8I03 and VC2S8I06)* In subtopic 9A a class set up three sealed jars, each with 20 g of fresh leaf litter and a little soil, kept at 5 °C, 20 °C and 30 °C for four weeks. The dried leaves left in each jar were then weighed: 17 g, 12 g and 8 g. *(Simulated data for practice.)* (a) Name the instrument used to measure the mass of the leaves. *(1 mark)* (b) Only one jar was set up at each temperature. State one reason the class should repeat each temperature and average the results. *(1 mark)* (c) The results are labelled "simulated data". State what that label means. *(1 mark)*

Test B

Topic test 4 — Biological sciences: from cells to ecosystems

Science understanding and science inquiry · Chapters 7–9 · Subtopics 7A, 7B, 8A, 8B, 8C, 8D, 9A and 9B · Codes VC2S8U01, VC2S8U02, VC2S8U03, VC2S8U04, VC2S8I02, VC2S8I03, VC2S8I05 and VC2S8I06

Total: 40 marks · Section A (multiple choice): 10 marks · Section B (short/structured response): 30 marks

6 of the 40 marks are science inquiry marks (codes `VC2S8I02`, `VC2S8I03`, `VC2S8I05` and `VC2S8I06`).

Planned for about 45 minutes. This paper is untimed — there is no time to beat.

This is a school-designed paper. It is not a VCAA instrument. Achievement at Levels 7 and 8 is reported against the Victorian Curriculum achievement standard on teacher judgement; the marks here are one source of evidence towards that judgement.

Conditions

- Completion is **untimed**. The 45 minutes is planning guidance only; take as long as you need.
- **Reading support** is permitted. Your teacher may read any question out to you if you need it. Reading is not what is being looked at, and your teacher will not help with the answer.
- **No calculator is required.** Nothing on this paper needs one. No formula sheet. No reading time.
- Answer every question. For multiple-choice questions, circle the letter of the best answer. There is only one best answer for each question.

In this test you will:

- explain how classification orders and organises biological diversity, and use and judge a dichotomous key (Q1–Q3, Q11, Q15)
- distinguish cells and their organelles, and compare cell sizes (Q4–Q6, Q13)
- relate structure to function in a plant and an animal organ system (Q7, Q8, Q14)
- read the arrows and the models in a food web and predict the effects of a change (Q9, Q10, Q12)
- identify variables, read a pattern and judge a method in investigations from Chapters 7–9 (Q16, Q17)

Section A — Multiple choice (10 marks)

Each question is worth 1 mark. Circle the letter of the best answer.

Q1 *(1 mark · VC2S8U01)* Without classification, two scientists in different countries discussing 'the same' bird might:

A. Always agree. B. Speak different languages. C. Mean different species due to inconsistent names. D. Find no common ground.

Q2 *(1 mark · VC2S8U01)* Which is NOT one of the seven characteristics of life (MRS GREN)?

A. Photosynthesis. B. Movement. C. Respiration. D. Excretion.

Q3 *(1 mark · VC2S8U01)* Why is 'sensitivity' considered a characteristic of all living things?

A. Only animals respond. B. All organisms respond to stimuli in their environment. C. Plants do not respond. D. Stimuli are rare.

Q4 *(1 mark · VC2S8U02)* Which cell type has a rigid cell wall?

A. Animal cell. B. Human red blood cell. C. Sperm cell. D. Plant cell.

Q5 *(1 mark · VC2S8U02)* A light microscope is used to view cells primarily because:

A. It uses a beam of electrons to image internal structures. B. It records the cell's chemical activity over time. C. It magnifies them to a size the eye can see. D. It causes the cells to grow larger so they become visible.

Q6 *(1 mark · VC2S8U02)* Why might photomicrographs be used to supplement direct microscope observation?

A. They let people compare, share and re-examine features that may not be seen live. B. They have higher resolution than any modern microscope. C. They are needed because microscopes alone cannot magnify enough. D. They show the inside of cells in true three dimensions.

Q7 *(1 mark · VC2S8U03)* Plant 'roots' are most analogous to which animal organ in function?

A. Lungs (gas exchange). B. Digestive system (absorbs nutrients). C. Heart. D. Brain.

Q8 *(1 mark · VC2S8U03)* Red blood cells are specialised for:

A. Fighting infection from bacteria and viruses. B. Helping blood to clot at wounds. C. Producing antibodies during illness. D. Carrying oxygen around the body.

Q9 *(1 mark · VC2S8U04)* If a predator at the top of a food web is removed, what often happens?

A. Prey populations also fall because they relied on the predator for survival. B. Producers quickly die out because consumers are no longer eaten. C. Prey populations rise and effects cascade through other levels of the web. D. Decomposer numbers collapse across the whole ecosystem.

Q10 *(1 mark · VC2S8U04)* In an energy pyramid, the base level represents:

A. Primary producers. B. Top predators. C. Decomposers. D. Consumers.

Section B — Short/structured response (30 marks)

Q11 *(5 marks · VC2S8U01)* The built key below names six leaves of a schoolyard survey *(a simulated survey, written for practice)*. A dichotomous key offers exactly two choices at every step; start at couplet 1, follow the statement that matches the specimen, and repeat until you reach a name.

1.
    - (a) The leaf is divided into leaflets. … **go to 2**
    - (b) The leaf is a single blade, not divided. … **go to 3**
2.
    - (a) Three rounded leaflets on one stalk. … **white clover**
    - (b) Many leaflets in pairs along a middle stalk. … **silky oak**
3.
    - (a) A long strap-like blade with parallel veins. … **kangaroo grass**
    - (b) A broader blade. … **go to 4**
4.
    - (a) The edge of the blade has teeth. … **silver banksia**
    - (b) The edge of the blade is smooth, without teeth. … **go to 5**
5.
    - (a) The blade is heart-shaped. … **ivy-leaf violet**
    - (b) The blade is long and narrow, not heart-shaped. … **red gum**

(a) A student finds a leaf that is a single blade (not divided), is broader, and has teeth along its edge. Use the key to name the leaf and give the full path through the key. *(2 marks)*

(b) Another student offers "Is the leaf longer than 6 cm?" as the first couplet of a key to these plants. Evaluate this offer, giving two reasons. *(2 marks)*

(c) State the word used to describe a key that offers exactly two choices at every step. *(1 mark)*

Q12 *(6 marks · VC2S8U04)* The box gum woodland food web below shows the feeding links in that ecosystem. Each line reads *food → feeder*, so every arrow points from the organism that is eaten to the organism that eats it. The decomposers (fungi and bacteria) break down the dead remains and waste of every organism in the web.

- box gum → caterpillar
- box gum → possum

- kangaroo grass → grasshopper
- caterpillar → skink
- caterpillar → kookaburra
- grasshopper → skink
- grasshopper → kookaburra
- skink → kookaburra
- skink → brown snake
- kookaburra → powerful owl
- kookaburra → wedge-tailed eagle
- brown snake → wedge-tailed eagle
- possum → powerful owl

(a) In a food chain or food web, what does an arrow show, and which way must it point? *(1 mark)*

(b) A student writes one link as "grasshopper → kangaroo grass". Explain what is wrong with it, and rewrite the link correctly. *(2 marks)*

(c) Name the organism that eats the possum, and name the two top consumers in this web. *(2 marks)*

(d) Predict two things that would happen in this woodland if the decomposers (fungi and bacteria) suddenly died. *(1 mark)*

Q13 *(5 marks · VC2S8U02)* (a) State one difference between a unicellular organism and a multicellular organism, and give one example of each. *(2 marks)* (b) Name the organelle that holds the DNA of a cell. *(1 mark)* (c) Arrange these from smallest to largest: a typical human cell (20 µm), a bacterium (2 µm), a human egg cell (120 µm), a red blood cell (8 µm). *(1 mark)* (d) A human egg cell is about 120 µm across and a typical human cell about 20 µm across. How many times as wide as a typical human cell is the egg cell? *(1 mark)*

Q14 *(5 marks · VC2S8U03)* (a) Name the five levels of organisation, from smallest to largest. *(2 marks)* (b) Xylem carries water up a plant. State one feature of xylem's structure and explain how that feature suits this job. *(2 marks)* (c) State what phloem carries, and state the direction(s) it moves its load. *(1 mark)*

Q15 *(3 marks · VC2S8U01)* (a) Respiration is one of the seven characteristics of life. State what respiration means, and explain why it is not the same as breathing. *(2 marks)* (b) State one way a common name can mislead scientists, and state how binomial naming fixes this. *(1 mark)*

Q16 *(3 marks · VC2S8I02 and VC2S8I05)* In subtopic 8C a class measured their pulse. They sat quietly and counted their pulse, then walked on the spot for one minute and counted again, then jogged on the spot for one minute and counted again. The results were 72, 90 and 120 beats per minute. *(Simulated data for practice.)* (a) State (i) the variable that was changed and (ii) the variable that was measured. *(2 marks)* (b) Describe the pattern the results show. *(1 mark)*

Q17 *(3 marks · VC2S8I03 and VC2S8I06)* In subtopic 8A a class made an onion wet mount and viewed it under a light microscope. (a) Name two pieces of equipment used to make and view the wet mount. *(1 mark)* (b) State why the cover slip is lowered at an angle rather than dropped flat onto the slide. *(1 mark)* (c) State one reason it is important to use only a thin slice of onion. *(1 mark)*

Marking guide

This guide is written for a teacher marker — no specialist science background beyond Chapters 7–9 of this book is needed. Award a mark when the student's answer matches an acceptable response below or says the same idea in other words. Do not award half marks. The marks are a record that evidence was seen; they are not used to rank students.

Test A — Section A — Multiple choice

Q	Answer	Code	Source
Q1	**B**	`VC2S8U01`	bank item `VC2S8U01.E01.S01.D1.V01`
Q2	**D**	`VC2S8U01`	bank item `VC2S8U01.E01.S01.D3.V01`
Q3	**A**	`VC2S8U01`	bank item `VC2S8U01.E02.S01.D2.V01`
Q4	**C**	`VC2S8U02`	bank item `VC2S8U02.E01.S01.D1.V01`
Q5	**B**	`VC2S8U02`	bank item `VC2S8U02.E01.S01.D3.V01`
Q6	**A**	`VC2S8U02`	bank item `VC2S8U02.E02.S01.D2.V01`
Q7	**D**	`VC2S8U03`	bank item `VC2S8U03.E01.S01.D1.V01`
Q8	**C**	`VC2S8U03`	bank item `VC2S8U03.E02.S01.D3.V01`
Q9	**B**	`VC2S8U04`	bank item `VC2S8U04.E01.S01.D1.V01`
Q10	**D**	`VC2S8U04`	bank item `VC2S8U04.E02.S01.D2.V01`

All ten items are drawn from the MCQ bank under the four codes assessed on this paper; none is drawn from a neighbouring code. Items mix easy (D1), medium (D2) and hard (D3) bank difficulties. Items are printed with their stem and options word for word; only the positions of the options have changed for this paper (the bank stores correct answers weighted toward position A, and a printed paper needs the answers spread out).

Why each answer is correct, in brief:

- **Q1 B** — classification exists so organisms can be identified and so people can communicate about them unambiguously; it does not rank, reduce or rename species out of existence.
- **Q2 D** — a binomial name is a single unique label shared worldwide, so it does not depend on local (vernacular) names that change from place to place.
- **Q3 A** — respiration is the release of energy from food; both a bacterium and a tree do this, even though neither has lungs and only the tree photosynthesises.
- **Q4 C** — a typical bacterium is about 2 μm long while a typical animal cell is about 20 μm, so the bacterium is roughly ten times smaller.
- **Q5 B** — specialised cells each do particular jobs (transport, defence, sensing) well; no single cell can do every job for a large organism.
- **Q6 A** — total magnification is eyepiece × objective, so 10 × 40 = 400.
- **Q7 D** — both the circulatory system and a plant's vascular tissue move materials around the organism.

- **Q8 C** — villi are finger-like projections giving a large surface area, which increases absorption of nutrients into the blood.
- **Q9 B** — an arrow shows the direction energy (and matter) flows, from the organism eaten to the organism that eats it.
- **Q10 D** — at each level most energy is lost as heat, used in respiration, or leaves uneaten or undigested, so only about a tenth passes on.

Test A — Section B — Short/structured response

Q11 *(5 marks · VC2S8U01)* (a) grey field slug. *1 mark* Path: 1b → 3b → 4b → 5b. *1 mark* Award the path mark for the correct sequence of statements even if arrow notation is omitted. (b) The key reaches Australian magpie (1a → 2b). *1 mark* A key only names the organisms it was built for; the heron was not in the set, so it matched the magpie on the two features the key asks about (feathers, no webbing) and was given the magpie's name. *1 mark* Accept any response that says the key has no branch for an organism outside its set. (c) Edit statement 2b to "… go to 6" and add a new couplet 6, for example: (a) long legs and a long dagger-like bill → white-faced heron; (b) short legs and a small bill → Australian magpie. *1 mark* Award the mark for an edit plus a new couplet that separates the two birds on a visible feature. Marker note: this item assesses using a provided key (E03) and modifying a key when new evidence turns up (E04). The heron mirrors the pelican/turtle modifications taught in 7B but is a new organism, so it tests transfer.

Q12 *(6 marks · VC2S8U04)* (a) Any correct four-organism chain ending at the powerful owl, for example box gum → caterpillar → kookaburra → powerful owl, or kangaroo grass → grasshopper → kookaburra → powerful owl. *2 marks* — 1 mark for a valid four-organism chain, 1 mark for every arrow pointing from food to feeder. (b) powerful owl and wedge-tailed eagle. *1 mark* (c) secondary consumer; third trophic level. *1 mark* (d) The skink and the kookaburra lose the caterpillar. *1 mark* Each still has the grasshopper as a food. *1 mark* Marker note: the web is the box gum woodland web taught in 9A, restated here so the paper stands alone. Arrows are printed food → feeder throughout.

Q13 *(5 marks · VC2S8U02)* (a) mitochondria. *1 mark* (b) The nucleus holds the DNA. *1 mark* The cell membrane controls what enters and leaves the cell (it is selectively permeable). *1 mark* Accept "gatekeeper" wording. (c) Any two of: cell wall, chloroplasts, large central vacuole. *2 marks* (1 mark each).

Q14 *(5 marks · VC2S8U03)* (a) A tissue is a group of similar cells working together at one job. *1 mark* An organ is a structure made of different tissues working together. *1 mark* (b) Any one correct structure–function link, for example: no nucleus leaves more room for haemoglobin, so the cell carries more oxygen; or the biconcave shape gives a large surface area so oxygen passes in and out fast; or being small and flexible lets it squeeze through capillaries. *2 marks* — 1 mark for naming the structure, 1 mark for linking it to the function. (c) The circulatory system. *1 mark* The shared job is moving materials around the organism (transport). Accept the transport job stated in other words. Marker note: (b) draws on the red blood cell taught in 8C; award the mark for any one of the three correct links.

Q15 *(3 marks · VC2S8U01)* (a) *Macropus giganteus* — genus capitalised, species lowercase, written in italics (or underlined). *1 mark* Accept the name with correct capitalisation even if italics are not shown by hand. (b) Any one: common names vary from place to place; one common name can be used for different organisms; a binomial name is unique and shared worldwide. *1 mark* (c) kingdom, phylum, class, order, family, genus, species. *1 mark* Award the mark only if all seven are present and in order.

Q16 *(3 marks · VC2S8I02 and VC2S8I05)* (a) (i) The temperature of the water (5 °C, 22 °C, 40 °C). *1 mark* (ii) The time taken for the dye to spread. *1 mark* (b) The higher the temperature, the shorter the time — diffusion is faster in warmer water. *1 mark* Accept any wording that states the inverse relationship between temperature and time. Marker note: this item attaches the inquiry marks to the diffusion investigation taught in 8B. Part (a) is planning/variables (`VC2S8I02`, subtopic 3A); part (b) is reading a pattern (`VC2S8I05`, subtopic 4C).

Q17 *(3 marks · VC2S8I03 and VC2S8I06)* (a) A balance. *1 mark* Accept "scale" or "electronic balance". (b) Any one: repeating improves reliability; repeating lets the class spot and remove an anomalous result; an average is a better estimate than a single reading. *1 mark* (c) The numbers were made up for practice; the pattern they show (faster breakdown when warmer) is real behaviour, but the exact values are not measured data. *1 mark* Marker note: this item attaches the inquiry marks to the decay investigation taught in 9A. Part (a) is selecting equipment (`VC2S8I03`, subtopic 3C); parts (b) and (c) are evaluating the method and the data (`VC2S8I06`, subtopic 5A).

Test B — Section A — Multiple choice

Q	Answer	Code	Source
Q1	**C**	`VC2S8U01`	bank item `VC2S8U01.E01.S01.D2.V01`
Q2	**A**	`VC2S8U01`	bank item `VC2S8U01.E02.S01.D1.V01`
Q3	**B**	`VC2S8U01`	bank item `VC2S8U01.E02.S01.D3.V01`
Q4	**D**	`VC2S8U02`	bank item `VC2S8U02.E01.S01.D2.V01`
Q5	**C**	`VC2S8U02`	bank item `VC2S8U02.E02.S01.D1.V01`
Q6	**A**	`VC2S8U02`	bank item `VC2S8U02.E02.S01.D3.V01`
Q7	**B**	`VC2S8U03`	bank item `VC2S8U03.E01.S01.D2.V01`
Q8	**D**	`VC2S8U03`	bank item `VC2S8U03.E02.S01.D1.V01`
Q9	**C**	`VC2S8U04`	bank item `VC2S8U04.E01.S01.D3.V01`
Q10	**A**	`VC2S8U04`	bank item `VC2S8U04.E02.S01.D1.V01`

All ten items are drawn from the MCQ bank under the four codes assessed on this paper; none is drawn from a neighbouring code. Items mix easy (D1), medium (D2) and hard (D3) bank difficulties. Items are printed with their stem and options word for word; only the positions of the options have changed for this paper (the bank stores correct answers weighted toward position A, and a printed paper needs the answers spread out).

Why each answer is correct, in brief:

- **Q1 C** — without a shared classification the same common name can mean different species in different places, so the scientists could be talking about different birds.
- **Q2 A** — MRS GREN is movement, respiration, sensitivity, growth, reproduction, excretion and nutrition; photosynthesis is how some organisms make food, not a requirement of life shared by all organisms.
- **Q3 B** — sensitivity means responding to stimuli; every organism, plant included, responds to changes around it.
- **Q4 D** — a rigid cell wall is a feature of plant cells (and fungi and bacteria), not animal cells.
- **Q5 C** — cells are too small to see unaided; a light microscope magnifies them to a size the eye can see.
- **Q6 A** — photomicrographs let features be compared, shared and re-examined later, which direct observation through the eyepiece does not allow.
- **Q7 B** — roots take in water and minerals, as the digestive system takes in (absorbs) nutrients; the two are analogous in function.

- **Q8 D** — red blood cells carry oxygen around the body; fighting infection and clotting are jobs of other blood cells.
- **Q9 C** — removing a top predator lets its prey increase, and the effects cascade down through the web (as the cats–rabbits example on Macquarie Island showed).
- **Q10 A** — the base of an energy pyramid is always the first trophic level, the primary producers.

Test B — Section B — Short/structured response

Q11 *(5 marks · VC2S8U01)* (a) silver banksia. *1 mark* Path: 1b → 3b → 4a. *1 mark* Award the path mark for the correct sequence of statements even if arrow notation is omitted. (b) The offer is weak. *Any two reasons, 1 mark each:* the size ranges of the plants overlap, so a leaf could land on either side; leaf size changes with age and weather; "long" has no fixed line, so two users could sort the same leaf two ways. *2 marks* Award 1 mark for the judgement plus up to 2 marks for reasons, capped at 2 for the part. (c) dichotomous. *1 mark* Marker note: this item assesses using a built key and judging a first couplet (E04). Part (b) mirrors the "weak first split" reasoning taught in 7B.

Q12 *(6 marks · VC2S8U04)* (a) The arrow shows the direction matter and energy move, and it must point from the food to the feeder. *1 mark* (b) It points from the feeder to the food, which would mean energy flows from the grasshopper into the grass — the reverse of what happens. *1 mark* Correct link: kangaroo grass → grasshopper. *1 mark* (c) The powerful owl eats the possum. *1 mark* The two top consumers are the powerful owl and the wedge-tailed eagle. *1 mark* (d) Any two of: dead matter and waste would pile up; nutrients would stay locked in the dead matter and not return to the soil; producers would run short and the web above them would lose matter and energy. *1 mark* Award the mark for any two correct consequences stated together. Marker note: the web is the box gum woodland web taught in 9A, restated here so the paper stands alone.

Q13 *(5 marks · VC2S8U02)* (a) A unicellular organism is a single cell that carries out all the processes of life; a multicellular organism has many cells, often specialised. *1 mark* One correct example of each, for example bacterium or yeast (unicellular) and a human, animal or tree (multicellular). *1 mark* (b) nucleus. *1 mark* (c) bacterium (2 µm), red blood cell (8 µm), typical human cell (20 µm), egg cell (120 µm). *1 mark* Award the mark only if all four are in order. (d) 120 ÷ 20 = 6 times as wide. *1 mark* Marker note: sizes are the values taught in 8A. Part (d) is a simple division with no calculator needed.

Q14 *(5 marks · VC2S8U03)* (a) cell, tissue, organ, organ system, organism. *2 marks* Award 1 mark for all five present, 1 mark for the correct order. (b) Any one correct feature–function link, for example: xylem cells die and lose their end walls, leaving one long hollow tube so water flows up freely; or the walls are reinforced with rings so the tube does not squash shut. *2 marks* — 1 mark for the feature, 1 mark for the link to the job. (c) Phloem carries food (sugar) and moves it both ways — down to the roots and up to growing parts. *1 mark* Marker note: (b) draws on the xylem tissue taught in 8C; award the mark for any one correct link.

Q15 *(3 marks · VC2S8U01)* (a) Respiration is the release of energy from food. *1 mark* Breathing is only the movement of air in and out of the body; respiration is the chemical process that releases the energy, so the two are not the same. *1 mark* (b) Any one way a common name misleads, for example it varies by region or one name is used for different organisms, *and* the fix: binomial naming gives one unique scientific name shared worldwide. *1 mark*

Q16 *(3 marks · VC2S8I02 and VC2S8I05)* (a) (i) The activity (resting, walking on the spot, jogging on the spot). *1 mark* (ii) The pulse rate in beats per minute. *1 mark* (b) The harder the activity, the faster the pulse — the heart beats faster when the body works harder. *1 mark* Marker note: this item attaches the inquiry marks to the pulse investigation taught in 8C. Part (a) is planning/variables (`VC2S8I02`, subtopic 3A); part (b) is reading a pattern (`VC2S8I05`, subtopic 4C).

Q17 *(3 marks · VC2S8I03 and VC2S8I06)* (a) Any two of: light microscope, slide, cover slip, iodine stain, forceps or a dropper. *1 mark* (b) Lowering the cover slip at an angle avoids trapping air bubbles under it, which would obscure the cells. *1 mark* (c) Any one: a thin slice lets light pass through so the cells can be seen; or a thin slice is only one or two cells thick, so individual cells can be made out instead of a dark, overlapping mass. *1 mark* Marker note: this item attaches the inquiry marks to the onion wet mount taught in 8A. Part (a) is selecting equipment (`VC2S8I03`, subtopic 3C); parts (b) and (c) are evaluating steps in the method (`VC2S8I06`, subtopic 5A).

Tracing the items to the achievement standard

Every item traces to the achievement-standard extract of the subtopic that owns its code (§4.1 of the plan of record). The extracts are quoted as the authority file gives them. `VC2S8U01`, `VC2S8U02`, `VC2S8U03` and `VC2S8U04` are split-delivered, so each cites the extract held by its owner subtopic (7A, 8A, 8C and 9A respectively). The inquiry items attach to the chapter block's own practical work (D7) and trace to the inquiry CDs that own the subtopics the practicals cite.

Code	Subtopic	Achievement-standard extract	Test A items	Test B items
VC2S8U01	7A and 7B	"Students explain how biological diversity is ordered and organised."	Q1, Q2, Q3, Q11, Q15	Q1, Q2, Q3, Q11, Q15
VC2S8U02	8A and 8B	"They explain the role of specialised cell structures and organelles in cellular function, and distinguish between cells in selected examples of plants and animals, and unicellular and multicellular organisms."	Q4, Q5, Q6, Q13	Q4, Q5, Q6, Q13
VC2S8U03	8C and 8D	"They analyse the relationship between structure and function at organ and body system levels for a selected plant and an animal, and explain how a disorder in the cells, tissues or organs of these systems affects the survival of each organism."	Q7, Q8, Q14	Q7, Q8, Q14
VC2S8U04	9A and 9B	"They represent flows of matter and energy in ecosystems and use real and hypothetical scenarios and population data to interpret and predict the effects of environmental changes."	Q9, Q10, Q12	Q9, Q10, Q12
VC2S8I02	3A and 3B	"They plan a range of reproducible scientific investigations, document procedures and identify potential ethical issues and intercultural considerations required for fieldwork or use of	Q16 (a)	Q16 (a)

Code	Subtopic	Achievement-standard extract	Test A items	Test B items
		secondary data.”		
VC2S8I03	3C	“They select and use equipment to generate and record data with precision.”	Q17 (a)	Q17 (a)
VC2S8I05	4C	“They analyse and connect data and information to identify and explain patterns, trends, relationships and anomalies.”	Q16 (b)	Q16 (b)
VC2S8I06	5A	“They identify assumptions and sources of error in methods and analyse conclusions and claims with reference to conflicting evidence and unanswered questions.”	Q17 (b), Q17 (c)	Q17 (b), Q17 (c)

Inquiry weighting: 6 of the 40 marks on each paper sit on the inquiry strand (Section B Q16 and Q17) — above the required minimum of 5 inquiry-strand marks per topic test (D7). In T4–T7 the inquiry marks attach to the chapter block’s own practical work rather than to a separate scenario: on Test A the diffusion investigation (8B) and the decay investigation (9A); on Test B the pulse investigation (8C) and the onion wet mount (8A).

Mark record — Test A

Question	Code	Worth	Given
Q1 — purpose of classification	`VC2S8U01`	1	
Q2 — binomial names reduce ambiguity	`VC2S8U01`	1	
Q3 — respiration in a bacterium and a tree	`VC2S8U01`	1	
Q4 — bacterial versus animal cell size	`VC2S8U02`	1	
Q5 — why cells specialise	`VC2S8U02`	1	
Q6 — total magnification	`VC2S8U02`	1	
Q7 — plant transport and circulation	`VC2S8U03`	1	
Q8 — villi structure and absorption	`VC2S8U03`	1	
Q9 — what a food-web arrow shows	`VC2S8U04`	1	
Q10 — why energy drops between levels	`VC2S8U04`	1	
Q11 — using and repairing a dichotomous key	`VC2S8U01`	5	
Q12 — the box gum woodland food web	`VC2S8U04`	6	
Q13 — cells and organelles	`VC2S8U02`	5	
Q14 — structure suits function	`VC2S8U03`	5	
Q15 — binomial naming and the hierarchy	`VC2S8U01`	3	
Q16 — the diffusion investigation	`VC2S8I02` and `VC2S8I05`	3	
Q17 — the decay investigation	`VC2S8I03` and `VC2S8I06`	3	
Total		**40**	

Mark record — Test B

Question	Code	Worth	Given
Q1 — classification avoids mixed-up names	`VC2S8U01`	1	
Q2 — the seven characteristics of life	`VC2S8U01`	1	
Q3 — sensitivity in all living things	`VC2S8U01`	1	
Q4 — which cell has a rigid wall	`VC2S8U02`	1	
Q5 — why a light microscope is used	`VC2S8U02`	1	
Q6 — photomicrographs for sharing and checking	`VC2S8U02`	1	
Q7 — roots and the digestive system	`VC2S8U03`	1	
Q8 — red blood cells carry oxygen	`VC2S8U03`	1	
Q9 — removing a top predator	`VC2S8U04`	1	
Q10 — the base of an energy pyramid	`VC2S8U04`	1	
Q11 — using and judging a dichotomous key	`VC2S8U01`	5	
Q12 — reading the food-web arrows and models	`VC2S8U04`	6	
Q13 — cells, sizes and one versus many	`VC2S8U02`	5	
Q14 — levels of organisation and transport tissues	`VC2S8U03`	5	
Q15 — respiration and naming	`VC2S8U01`	3	
Q16 — the pulse investigation	`VC2S8I02` and `VC2S8I05`	3	
Q17 — the onion wet mount	`VC2S8I03` and `VC2S8I06`	3	
Total		**40**	