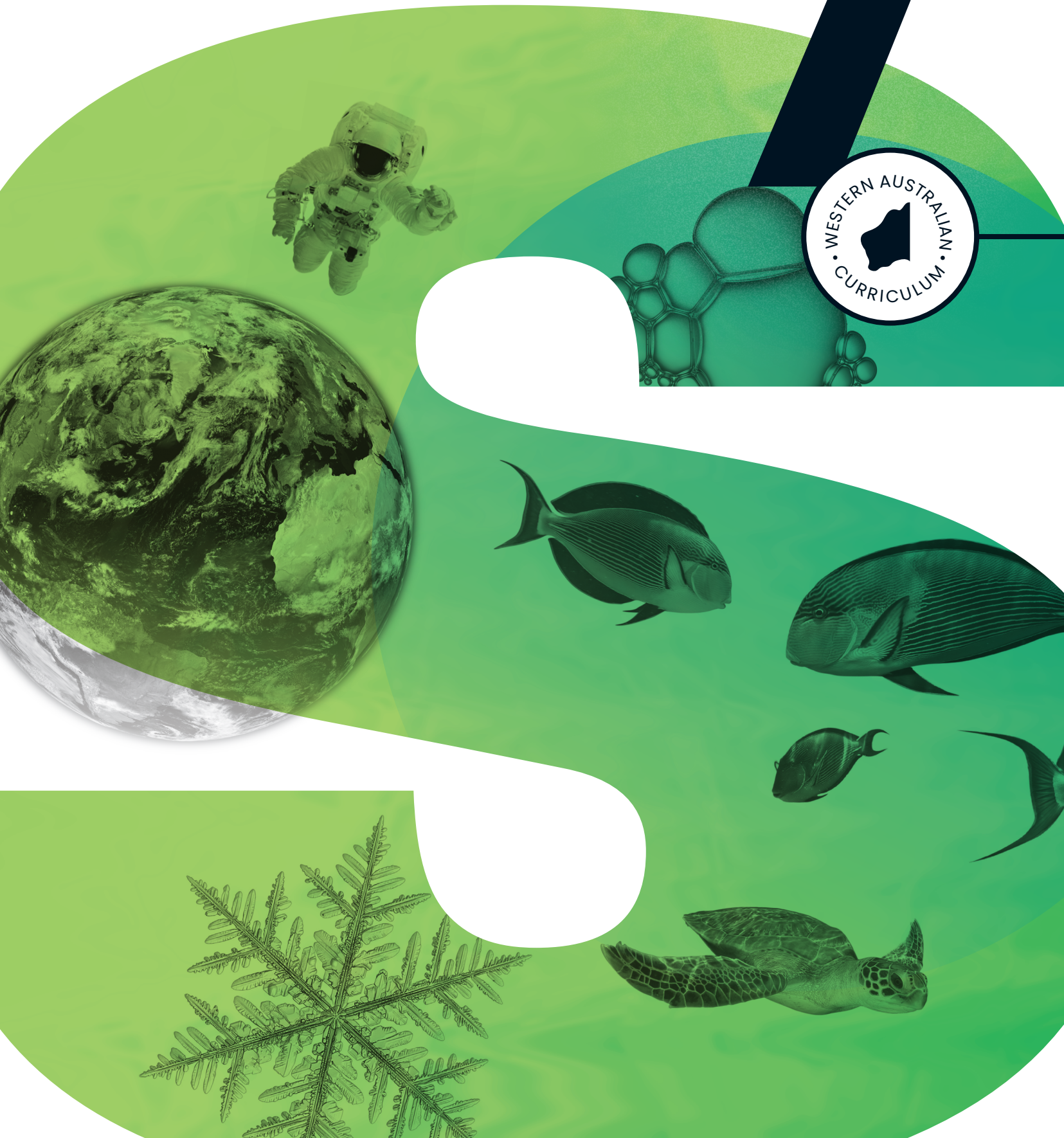
PEARSON

Science

STUDENT BOOK | WESTERN AUSTRALIA

7

WESTERN AUSTRALIAN CURRICULUM



Topic 6 Matter and energy in ecosystems

Prior knowledge

Survival needs of organisms and their interactions

1 D. All the above

2 Environments are considered to have biodiversity if it contains a variety of organisms, exhibits a variety of different characteristics among those organisms, and supports a healthy ecosystem.

3 The energy flow shows the amount of energy that moves along the food chain. Energy flows from the organism being eaten towards the organism that is doing the eating.

4 grass → rabbit → snake → kookaburra

Australian habitats and First Nations' perspectives

5 Answers may include: desert, rainforest and coral reef.

6 One impact is human construction of buildings and housing. This has destroyed the natural habitat and forces native organisms to relocate to other environments. Another impact is chemical pollution, which enters waterways, harming native aquatic species and promoting the growth of non-native species.

7 First Nations peoples use traditional farming techniques like cultural burning, to increase crop growth and seed germination in native plants. They also use Creation stories to pass down information to future generations as guidelines for sustainable practices.

6.1 Survival needs

Check your understanding

SC 1: I can describe the basic survival needs of plants and animals in Australia

The six basic requirements for survival are:

- nutrition or food sources
- a water source
- a place to live and shelter
- mating partners for reproduction
- gases including oxygen, carbon dioxide and nitrogen
- suitable living conditions.

SC 2: I can describe a range of habitats in the Australian environment

Plants and animals need water for various vital processes including digestion, temperature regulation and transporting nutrients.

SC 3: I can explain the requirements for the maintenance of populations within an ecosystem

Any three of:

- a lack of food sources
- competition for shelter
- significant changes in temperature
- introduction of disease-causing organisms
- soil erosion.

 ISBN 978 0 6557 2063 8

Lesson review

1 Biotic factors are the living components of an environment or ecosystem.

2 Three abiotic factors (non-living components) of an arid environment could include sand, rocks and sunlight.

3 Rainforests have more water and more variety of organisms. Rainforests also have many more plants that produce shade, keeping the forest floor cooler and more humid. In contrast, deserts have little water and much more sunlight with little shade. As a result, deserts support fewer species compared to rainforests.

4 A kangaroo survives by eating other organisms for nutrition. Kangaroos also need water, shelter and mating partners for reproduction. In comparison, a eucalyptus tree makes its own food via photosynthesis. Eucalyptus trees also require sunlight, water and nutrients from the soil to grow and survive.

5 Maintaining predator-prey relationships is important because predators help control the population of prey, preventing them from eating too much of their food and damaging their habitat. By balancing predators and prey, the environment will continue to be healthy, and biodiversity is maintained.

6 Seawater temperature is a key abiotic factor that can significantly affect the biodiversity of the Ningaloo Reef. When water temperatures rise too high, it can cause coral bleaching, where corals lose the colourful algae that live inside them. This impacts not only the corals but also many species that rely on coral reefs for food and shelter, leading to a decline in overall biodiversity in the area. If the corals struggle to survive or die, the entire ecosystem suffers, reducing the number of different species that can thrive there.

6.2 The Australian environment today

Plan

1 Examples of Australian endangered species include:

- Lord Howe Island stick insect
- northern or southern corroboree frog
- helmeted honeyeater
- Leadbeater's possum
- alpine she-oak skink
- Baw Baw frog
- brush-tailed rock wallaby
- eastern barred bandicoot
- golden-rayed blue butterfly
- grassland earless dragon
- mountain pygmy possum
- orange-bellied parrot
- hawksbill sea turtle
- Wollemi pine.

2 Sample answers:

Orange-bellied Parrot (*Neophema chrysogaster*)

Range and population: Found in Tasmania, South Australia and Victoria; fewer than 30 mature individuals in the wild.

Breeding: Lays 3–6 eggs annually; chicks fledge at 4–5 weeks; reaches sexual maturity at 12 months.

Diet: Seeds, fruits, flowers, berries and saltmarsh plants.

Causes of decline: Habitat loss due to agriculture, competition for nesting sites and predation by cats and foxes.

 ISBN 978 0 6557 2063 8

Conservation strategies: Captive breeding at Zoos Victoria, Moonlit Sanctuary, Adelaide Zoo and Priam Parrot Breeding Centre; releases into the wild have had mixed success.

Mountain Pygmy Possum (*Burramys parvus*)

Range and population: Found in Victoria and New South Wales; fewer than 2000 individuals in the wild.

Breeding: Has one litter per year of up to four joeys; joeys wean at about 10 weeks; sexually mature at 12 months.

Diet: Feeds on bogong moths, spiders, insects and seeds.

Causes of decline: Habitat fragmentation, tourism in alpine regions, bushfires, predation by cats and foxes, and chemical exposure.

Conservation strategies: Captive breeding programs at Zoos Victoria and the Lithgow Burramys Project.

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Range and population: Found in coastal Australia, common in tropical and subtropical waters of the Atlantic, Pacific and Indian oceans; an estimated 20 000–23 000 nesting females.

Breeding: Lays an average of 160 eggs per nest, with 3–6 nesting events in one year; nesting occurs every 2–4 years; reaches sexual maturity at 25–35 years.

Diet: Feeds on sponges, anemones, squid and shrimp.

Causes of decline: Egg predation, habitat loss and entanglement in ghost nets.

Conservation strategies: No captive breeding in Australia; use of turtle exclusion devices to prevent capture in fishing nets.

Southern Corroboree Frog (*Pseudophryne corroboree*)

Range and population: Found in New South Wales; fewer than 100 individuals remain in the wild.

Breeding: Lays 16–38 eggs per clutch; reaches sexual maturity at 4 years.

Diet: Feeds on beetles, mites, ants and insect larvae.

Causes of decline: Habitat loss, bushfires, chytrid fungus and pollution.

Conservation strategies: Captive breeding at Zoos Victoria, Taronga Zoo and the Amphibian Research Centre; more than 2000 captive-bred eggs have been introduced into Kosciuszko National Park.

Lord Howe Island Stick Insect (*Dryococelus australis*)

Range and population: Found on Ball's Pyramid near Lord Howe Island; only 20–30 individuals remain in the wild.

Breeding: Can reproduce both sexually and asexually; females produce up to 300 eggs in their lifetime; reaches sexual maturity at 6 months.

Diet: Herbivorous, feeding on various plants; on Ball's Pyramid, it only eats the leaf tips of *Melaleuca howeana*.

Causes of decline: Small population size, habitat disturbance, invasive species and illegal collection.

Conservation strategies: Captive breeding at Zoos Victoria, as well as in San Diego, Toronto and Bristol zoos; rat eradication on Lord Howe Island aims to reintroduce the species.

Wollemi Pine (*Wollemia nobilis*)

Range and population: Found in a rainforest gorge in Wollemi National Park, Blue Mountains, NSW; fewer than 100 mature trees exist in the wild.

Breeding: Little is known about its reproductive system; male and female cones grow on the same tree; wind pollinated; pollen is shed in spring and fertilisation occurs a year later.

 ISBN 978 0 6557 2063 8

Diet: Not applicable (a plant species).

Causes of decline: Climate change, habitat loss and infection by *Phytophthora cinnamomi*.

Conservation strategies: Propagation through tissue culture; a secure, large captive population exists; sales of propagated Wollemi pines fund conservation efforts.

Design

Designs should include most, if not all of, these headings:

- Habitat
- Current population
- Breeding habits
- Survival needs
- Current threats
- Current conservation strategies
- Risks to the ecosystem caused by decline or extinction of species

Notes may include images that students will use, the order and presentation of information, headings and key information.

Some students may need a template to get started. You could use the prompts given under 'Plan' in the book and create a box for each one under a large picture of the animal to be researched.

Improve

Posters and pamphlets could be displayed in the classroom or school so students can easily look at others' work and reflect on their own. Encourage open discussion, sharing of ideas and constructive, thoughtful feedback.

Evaluate

1 Responses could include the following factors.

Abiotic factors:

- sunlight/UV radiation (too much or not enough)
- available nutrients
- clean air
- water movement/currents
- temperature
- tide levels
- humidity
- pH of soil or water
- salinity/salt levels in the soil or water.

Biotic factors:

- parasites
- diseases
- predators
- prey
- competition for resources
- availability of suitable mates
- number of producers.

 ISBN 978 0 6557 2063 8

2 Sample answer:

When a species becomes extinct it is removed from the ecosystem and the food chain. Organisms that were feeding on the extinct species need to find alternative food sources or they too will die. This can then cause a reduction in the populations of organisms that are now a primary food source.

If a predator becomes extinct then the organisms it was consuming, its prey, will increase in number. This has flow on effects for the organisms that compete with or are consumed by that prey species. For example, competition for resources will increase, and the populations of organisms on which the prey species feeds would probably be reduced.

3 Responses may include:

- habitat loss due to natural disasters (e.g. fire or flood), human activity and urbanisation
- the introduction of a predator to the area
- pollution
- climate change – as temperature and rainfall changes, so does the ecosystem
- overharvesting – if too many organisms are taken from the wild population, population growth can be affected.

6.3 Scientific communication

Plan

1 Some examples include publishing papers in peer-reviewed scientific journals, presenting their findings at conferences and workshops, and communicating with policy-makers and members of the public through popular media and educational outreach programs. Additionally, many scientists collaborate with conservation organisations, providing them with the scientific data and information they need to make informed decisions about conservation practices and policies.

2 Jane Goodall communicates her finding from her research through scientific publications including journals, articles and books. She also gives talks and lectures and media appearances. Jane Goodall also has an online presence, engages in strong public advocacy and is involved with many foundations and initiatives.

3 Jane Goodall has pioneered research on chimpanzees and their social behaviour. She has used her research to raise awareness about protecting natural habitats for primates and chimpanzees. She has used her platform to advocate for conservation policies, particularly those that address habitat loss, climate change and the illegal wildlife trade. She founded the Jane Goodall Institute, which is dedicated to protecting chimpanzees and their habitats, and promoting conservation and sustainable development in Africa. She also actively participates in other global conservation campaigns and initiatives.

Jane Goodall actively participates in the United Nations Environment Programme's Great Apes Survival Partnership (GRASP), the Roots & Shoots youth program and the TACARE community-based conservation and development program. She was appointed as a UN Messenger of Peace and has received numerous awards for her contributions to conservation and animal welfare.

Design

1 Possible topics to explore include:

- The impact of climate change on native species and ecosystems
- The preservation and management of biodiversity in threatened ecosystems, such as coral reefs and wetlands
- The control and management of invasive species, which can have a significant impact on native flora and fauna
- The study and conservation of Australia's unique and endangered mammal species, such as the Tasmanian devil, koala and numbat

 ISBN 978 0 6557 2063 8

- The use of technology and data to monitor and manage wildlife populations, such as using drones and cameras for wildlife surveys
- The role of First Nations Australians in conservation, including the use of traditional knowledge in conservation planning and management
- The impacts of human activities, such as land clearing and development, on native species and ecosystems
- The restoration and rehabilitation of degraded ecosystems, such as mine reclamation and reintroduction of native species to restore biodiversity.

2 Possible platforms/communication methods include:

- oral presentation
- digital presentation
- poster
- video.

Possible headings include:

- Topic
- Importance of this topic for conservation
- Key scientific evidence
- Benefits to conservation
- Policies that have been informed by and developed because of scientific evidence

Improve

1 Students will review and listen to other peers' work to gain new ideas and insights. Encourage open discussion among the class with sharing of ideas and constructive thoughtful feedback. Responses should include ways to make the information more engaging and accessible for the specific audience that it is aimed at.

2 Responses should include a rationale for any changes; for example, to prioritise key areas, avoid duplication and to 'chunk' the content to make it easier to understand.

3 Responses should include evidence from feedback from peers and/or the teacher.

Evaluate

1 Answers should be relevant to a current conservation topic.

2 Answers may include: research, analysis, communication, critique and creativity.

6.4 Organisms and habitats in the school grounds

Results

1 Results should include a description and sketch of the sample area, including the date and time. The results table should include headings for place, type of organism, appearance and numbers of organisms. The table should also include the time and date of data collection.

2 Results should include a prediction of the other class members' results in relation to their own results.

3 Results will vary, but should clearly mark locations and organisms present in the areas.

Conclusion

1 Results will vary, but should use a variety of comparative statements that relate to the areas with most and least biodiversity.

2 Differences between sites may include plant types, presence of flowers, depth of soil, amount of shade, temperature and moisture.

 ISBN 978 0 6557 2063 8

3 **a** Temperature, moisture and humidity vary throughout the day, and this will affect which animals are present. Weather conditions and life cycles of plants, such as flowering and the presence of leaves, will vary throughout the year and these will also affect which animals are present.

b The investigation would need to be repeated in the exact same way (same equipment, same sample sites, and so on) at different times of day and year to test the predictions.

Evaluation

Answers may include reference to only sampling a small area of ground, taking photographs and returning any organisms carefully to the place where they were captured.

6.5 Food chains

Check your understanding

SC 1: I can construct a food chain based on an Australian ecosystem

D. Needs to capture sunlight to manufacture its own energy.

SC 2: I can identify producers and primary, secondary and tertiary consumers in a food chain

a The producer is the plankton.

b The primary consumers are the sardines.

c The secondary consumers are the sea lions.

d Students may identify a shark or an orca (killer whale) as an apex predator in the food web.

SC3: I can describe specific feeding relationships, including predator-prey, in Australian terrestrial and aquatic ecosystems

In a food chain a herbivore would be closer to the start as it consumes the plants that produce energy from the Sun through photosynthesis.

Lesson review

1 Producers, such as plants, are essential because they convert sunlight into energy, forming the base of the food chain and supporting all other feeding levels.

2 Primary consumers are herbivores that eat producers, while secondary consumers are carnivores or omnivores that eat primary consumers.

3 producer: eucalyptus tree; primary consumer: koala; secondary consumer: dingo; tertiary consumer: eagle

4 A predator-prey relationship is an interaction where one organism (the predator) hunts and eats another organism (the prey).

5 The organism is a consumer and an omnivore. It is a consumer because it eats other organisms to survive. It is an omnivore because it eats both plants, insects and small mammals.

6 An example of a predator-prey relationship in an Australian aquatic ecosystem: a great white shark (predator) preys on seals (prey), helping to regulate seal populations and maintain ecological balance.

7 The food chain would start with a producer such as seagrass, followed by a primary consumer such as a sea urchin, a secondary consumer such as a fish, and a tertiary consumer such as a sea eagle. In a diagram it would look as follows:

seagrass → sea urchin → fish → sea eagle

 ISBN 978 0 6557 2063 8

6.6 Biomass pyramids

Check your understanding

SC 1: I can explain how ecological pyramids can be used to represent the flow of energy between populations in a food chain

Biomass pyramids represent the total mass of organisms at each feeding level of an ecosystem, whereas pyramids of numbers show the total number of organisms at each feeding level of an ecosystem.

SC 2: I can describe the flow of energy through a biomass pyramid

a 10%

b 90%

SC 3: I can measure and compare the flow of energy within biomass pyramids using provided data

Fox to snake:

$$\text{efficiency of biomass transfer} = \frac{\text{amount of biomass transferred to the next level}}{\text{biomass that was available at the previous level}} \times 100\%$$

$$= \frac{1.2\,\text{kg}}{14\,\text{kg}} \times 100\%$$

$$= 8.6\%$$

Snake to grasshopper:

$$\text{efficiency of biomass transfer} = \frac{\text{amount of biomass transferred to the next level}}{\text{biomass that was available at the previous level}} \times 100\%$$

$$= \frac{14\,\text{kg}}{122\,\text{kg}} \times 100\%$$

$$= 11.5\%$$

Grasshopper to grass:

$$\text{efficiency of biomass transfer} = \frac{\text{amount of biomass transferred to the next level}}{\text{biomass that was available at the previous level}} \times 100\%$$

$$= \frac{122\,\text{kg}}{1200\,\text{kg}} \times 100\%$$

$$= 10.2\%$$

Lesson review

1 A biomass pyramid is a diagram showing the relative biomass (total mass of living organisms) at each trophic level in an ecosystem.

2 The primary source of energy for most biomass pyramids is sunlight, which is captured by producers and used in photosynthesis.

3 A rainforest biomass pyramid typically has a large base due to high plant biomass and multiple trophic levels with significant biomass at each level. A desert biomass pyramid has a smaller base and fewer trophic levels, reflecting less producers as well as less biomass at each level due to harsher conditions and limited resources.

 ISBN 978 0 6557 2063 8

4 Use the formula:

$$\text{efficiency of biomass transfer} = \frac{\text{amount of biomass transferred to the next level}}{\text{biomass that was available at the previous level}} \times 100\%$$

$$= \frac{2\,\text{kg of kookaburras}}{60\,\text{kg of eastern brown snakes}} \times 100\%$$

$$= 3.33\%$$

6.7 Food webs

Check your understanding

SC 1: I can create a food web from information about feeding relationships in an ecosystem

a Producer: grass or grain or carrot

b Primary consumer: grasshopper or rabbit or bird or mouse

c Secondary consumer: bird or fox or owl

d Tertiary consumer: fox or owl

SC 2: I can explain the energy pathways in a food web, including identifying producers, different levels of consumers and apex predators

The primary energy source is the Sun.

SC 3: I can use relationships from a food web, and the concept of competition, to predict the effect of population changes within an ecosystem

If the owl (predator) population increased, the mouse (prey) population would decrease.

Lesson review

1 A food web shows the feeding relationships between different organisms and flow of energy.

2 Rainforest food webs are typically more complex due to higher biodiversity and numerous feeding relationships, whereas desert food webs are simpler with fewer species and feeding interactions due to harsher conditions and limited resources.

3 Competition in an ecosystem is the interaction between organisms or a species for the same resource such as food, space or mates.

4 **a** Steps include identifying all organisms, categorising them into trophic levels, and mapping their feeding relationships.

b Key producers: seagrasses and algae; Primary consumers: small fish and crustaceans; Secondary consumers: larger fish; Tertiary consumers: seabirds and sharks.

c Draw arrows from producers to primary consumers, primary to secondary consumers, and secondary to tertiary consumers, showing all connections.

d Each trophic level plays a crucial role in transferring energy and nutrients, supporting the next level, and regulating population sizes, all of which help maintain ecosystem balance.

5 An increase in primary consumers (such as rabbits) could lead to overgrazing of producers (grasses), reducing food availability for other herbivores and increasing competition. This could also attract more secondary consumers (predators), potentially altering the balance of the food web.

 ISBN 978 0 6557 2063 8

6.8 Food web in an Australian ecosystem

Materials and safety

- Suggested materials: camera (e.g. mobile phone camera), notebook/data sheet, pen/pencil, binoculars (if available), covered shoes, hat, sunscreen, gloves, internet access (for research after fieldwork observation) or local organism identification sheets.
- Safety: Wear sun protection and gloves for handling any soil; avoid contact with any living organism.

Method

Sample response:

1. Identify a suitable location for the ecosystem survey.
2. Decide on roles within the group (e.g. data recorder, photographer, researcher).
3. Prepare a data sheet for recording the ecosystem survey data.
4. Go to the survey location and record all the organisms that are observed. Identify the organism by name if possible or take a picture of it for identification in class.
5. Record if the organism was observed eating anything. Otherwise, research the diet of the organism when back in the classroom.

Note: It is useful to have a list of species endemic to your local area to help students identify the species they have observed and to complete their results table.

Results

1. Sample results based on an outback ecosystem from northern Australia:

Trophic level	Organism
producer	spinifex grass, woollybutt gum tree, boab tree, pandanus
herbivore (primary consumer)	moth, ant, finches, galah, fruit dove, agile wallaby
carnivore (secondary consumer)	quoll, green tree frog, olive python, echidna
carnivore (tertiary consumer)	wedge-tailed eagle, dingo
omnivore	human, bilby, lizard
decomposer	bacteria, fungi

2. Check that:
   - arrows point in correct direction (up the food chain, towards the next consumer)
   - organisms at the same trophic level are aligned if possible
   - decomposers are included where appropriate
   - students understand that omnivores can occupy different trophic levels
   - some organisms will consume a single food source, while others have multiple food sources.

Conclusion

1. A food web is an effective way to visually represent the complex interactions between organisms in an ecosystem. It helps in understanding how changes to one organism or group of organisms might affect others.
2. Answers should include a statement about how food webs can be used to predict impacts in an ecosystem, as well as a logical explanation of the effect of a human intervention in an ecosystem.

 ISBN 978 0 6557 2063 8

An example statement about how food webs can be used to predict impacts:

- A food web is a useful predictor of which organisms will be directly and/or indirectly affected by changes to any part of the ecosystem.

Some examples of explanations of effects of human interventions:

- In a food web from far north Australia, if quolls are poisoned by eating introduced cane toads, fewer bandicoots will be eaten by quolls. The bandicoot population would then increase, causing greater competition with lizards for insects.
- A decline in insect population (due to insecticide use) could reduce plant pollination, affecting plant availability in the future.
- Human use of fire can reduce food availability for herbivores at first and, unless carefully managed, lead to a shortage of food for all animals in the ecosystem.

Evaluation

1 Responses will vary depending on the food web.

2 Responses should follow through possible scenarios in the ecosystem; for example:

An example based on the northern Australia food web is the cane toad, which was introduced into the ecosystem. The cane toad is mainly a secondary consumer, eating insects and small lizards. It competes with the bilby, which also has insects and small lizards as its diet. The toad will be eaten by the quoll and eagle but instead of increasing their food supply, cane toads (even as tadpoles) poison them so the whole balance of the food web will be disrupted.

3 Responses should include at least one problem and one improvement. Problems should identify problems with the procedure, not with the group work itself. Improvements should directly relate to the suggested problems with the procedure. For example:

Problems

- The time taken to observe the area was very short and not many organisms were identified.
- The observation was only undertaken during the day so species active at night (nocturnal) were not observed.
- The area was loud and there was a lot of vibration which may have prevented animals being seen.
- The study was not systematic – there was no order to the observations.

Improvements

- Observe the area over a longer time and record all organisms observed.
- Observations could be made of a local area at different times of day to capture more of the species that live there.
- Increase the time over which observations are made so that other variables will have less impact on the data.
- The observation area could be split up along a line or into specific zones, with each student in the group observing one area and then pooling their results with their group members.

6.9 Habitat destruction and pollution

Check your understanding

SC 1: I can explain how farming practices can affect ecosystems

a Intensive farming practices are those that uses large amounts of labour and investment to increase the yield of the land.

b The use of pesticides, fertilisers and other chemicals that boost yield, as well as the use of machinery to aid planting and picking.

 ISBN 978 0 6557 2063 8

SC 2: I can explain how First Nations Australians' traditional knowledge can inform sustainable harvesting practices

Two examples of First Nations farming practices are cultural burning (or firestick farming) and the cultivation of large grain areas to harvest seeds and grain to use in bread making.

SC 3: I can describe examples of chemical pollution caused by agriculture, industry and urbanisation

Chemicals can accumulate in soil, water and organisms. This can lead to species decline over time as chemicals are toxic to animals and plants. Eventually this will lead to less biodiversity as animals and plants will not be able to survive the increase in toxic chemicals in their environment.

Lesson review

1 Sample answer: One intensive farming practice that can damage ecosystems is utilising tractors to prepare the land. Using tractors can have adverse effects on soil structure, water supplies and the integrity of the environment.

2 **a** Main features include high use of chemical fertilisers and pesticides and heavy machinery.

b These practices can lead to damaged soil structure, water pollution, habitat destruction and a decrease in species.

c Local animals may reduce in number due to reduction in habitat, poisoning from chemicals and lack of food resources.

3 Sample answers:

The runoff of pesticides and fertilisers into nearby water bodies, causing water pollution.

The use of herbicides being linked to soil degradation causing long-term damage to crops.

4

	Source	Effect
Agricultural pollution	pesticides and fertilisers	eutrophication and harmful algal blooms
Urban pollution	runoff from roads, sewage, and industrial waste, introducing heavy metals and toxic chemicals	degrade water quality, harm aquatic life, and disrupt ecosystem balance

6.10 Detergents in waterways

Hypothesis

Sample, testable hypothesis:

"If detergent damages plant cells, then plants exposed to detergent will show reduced mass compared to plants that are not exposed to detergent."

It is important that students identify the independent and dependent variables before attempting to write the hypothesis. In the example above, exposure to detergent is the independent variable and plant mass is the dependent variable.

An easier option for students who need more practice with investigation skills is to use one detergent versus no detergent.

Method

Students should collaborate to discuss and decide on a method for the experiment. Methods will vary between groups but should include clear, numbered steps that test the hypothesis stated at the beginning of the investigation.

 ISBN 978 0 6557 2063 8

Sample method:

1. Label four containers/beakers as follows: 0% detergent, 2% detergent, 4% detergent, 6% detergent. Include your group's name on each container/beaker.
2. Pour 1 L of room-temperature water into each container.
3. Measure out 20 mL, 40 mL and 60 mL of liquid detergent and pour into the 2%, 4% and 6% containers, respectively, with the water.
4. Stir the detergent through the water until completely dissolved.
5. Place aquatic plants in each container, ensuring that each container has an equal amount of plant material. You can use the scale to ensure the starting mass of the plant material in each container is the same.
6. Leave the plants in a sunny position for 7 days. On days 1, 3, 5 and 7, check and record the mass of the plant material in each container. Do this by carefully removing the plant material and placing it on a scale balance to weigh it before returning it to the water.

Materials

Answers should include all materials that they will need to conduct the experiment, such as:

- aquatic plants (students may choose one or more species depending on their availability; it is useful to provide a list of available plants to the students prior to the investigation)
- plastic containers/beakers
- water
- scale balance (to 2 decimal places) for determining the mass of the plants
- detergent (students may choose one or more types of detergent, e.g. phosphate-free, 'eco-friendly', standard; teachers may limit the detergent, choosing what will be available to students or asking students to bring a sample from home)
- measuring cylinder (for liquid detergent) or measuring cup (for powder detergent).

Safety notes

Some detergents can be irritating to skin and eyes. Ensure safety precautions are followed when preparing the experiment, such as using safety glasses and avoiding skin contact by using gloves.

Results

Results tables should include:

- a descriptive title that includes the independent and dependent variables
- a heading for the independent variable, including units if appropriate
- a heading for the dependent variable, including units if appropriate.

Results will vary depending on whether students collected quantitative or qualitative data but should include a summary of their observations over the 7 days.

Observations may include:

- The control group (0% detergent) maintained good plant health/increased in mass throughout the experiment.
- The health/mass of plants in the 2% detergent treatment group remained the same/showed little to no change throughout the experiment.
- Plant health/mass declined over the 7-day period in the detergent treatments of 4% or higher.

 ISBN 978 0 6557 2063 8

Conclusion

1 Example of a conclusion:

An experiment was conducted that aimed to test the effect of detergent on aquatic plant health (as measured by plant mass). Aquatic plant material (species name) was placed in water at various detergent concentrations (0%, 2%, 4% and 6%). The plants' mass was measured and recorded over 7 days (on days 0, 1, 3, 5 and 7). The results of the experiment indicate that detergent has a negative effect on plant growth, with plant mass declining in the 4% and 6% detergent treatments compared to the control group (0%).

2 Answers should clearly indicate whether their results did or did not support the hypothesis. For example:

The hypothesis 'If detergent damages plant cells, then plants exposed to detergent will show reduced mass compared to plants that are not exposed to detergent' was supported by the data.

Evaluation

Discussion and ideas for improvement should focus on the procedure, rather than on how the group worked together. For example:

Three strengths:

- There was a clear procedure with steps.
- The procedure was achievable with the time and resources available.
- A control group was used.

Areas for improvement:

- A larger sample size could be used.
- The independent variable could be tested over more intervals.
- Different types of aquatic plant could be tested.
- Different types of detergent (e.g. phosphate and phosphate-free) could be tested.
- The method for quantifiably measuring plant health could be refined.

6.11 Desalination

Check your understanding

SC 1: I can describe the process of desalination and how waste is produced

The process of desalination involves screening and pre-treating seawater, high pressure pumping through semi-permeable membranes, desalination and post treatment.

SC 2: I can describe the effects desalination plants have on local marine ecosystems

Desalination plants can harm aquatic seagrasses by disrupting photosynthesis and preventing the plants from obtaining energy and food. Noise pollution from water pumps can disrupt the mating behaviour, feeding behaviour and communication of marine mammals such as dolphins and whales.

Lesson review

1 Desalination is the process of removing salt and other impurities from seawater to produce fresh water.

2 Seawater concentrate or waste brine, which is highly concentrated saltwater, can increase salinity levels in the ocean, harming marine life and disrupting ecosystems.

3 Desalination plants are becoming more popular because they can provide a more reliable source of freshwater that is not dependent on rainfall alone.

4 Water produced from the desalination process can be used in agriculture and for drinking.

 ISBN 978 0 6557 2063 8

5 Select sites at varying distances from the desalination plant; conduct regular surveys of aquatic organisms; measure water salinity and quality; compare the health and diversity of populations of aquatic species of plants and animals across these sites to observe the impact.

6.12 Cultural understandings and sustainable practices

Check your understanding

SC 1: I can explain how First Nations Australians' deep ecological understanding can inform sustainable practices

First Nations Australians' deep ecological understanding is based on thousands of years of observation and interaction with the environment, providing valuable insights into sustainable resource management and ecosystem health.

SC 2: I can name various sustainable practices used by First Nations Australians

Traditional practices are considered sustainable as they limit the greater impacts on the environments including both animal and plant populations.

SC 3: I can explain how First Nations Australians' practices have influenced scientific knowledge about ecosystems

Answers may include:

- Indigenous practices providing insights into the benefits of controlled burning for ecosystem management and fire prevention through their understanding of cool burning (or fire stick farming).
- Having deep knowledge of ecosystems and how to re-introduce endangered species back into natural environments.
- Understanding long-term effects of climate change as they had passed down understandings through generational stories over thousands of years.
- Implementing sustainable agriculture through understanding how plants grow, including the management of weeds.
- Using traditional medicines that are based on native resources to manage illness and disease.

Lesson review

1 Practices used by First Nations Australians could include: use of stone walls for fishing, seasonal harvesting of plants and animals for eating, and rotation of agricultural land and crops.

2 Answers may include:

Using stone walls to catch larger fish and encourage breeding to reduce the impact on wild fish populations.

Seasonal harvesting is used to ensure that only food that is plentiful is taken, leaving enough to regenerate (or reproduce) for the future.

Crop rotations in agriculture, where different crops are planted each season to prevent overuse of the land.

3 Creation stories place a strong emphasis on respect for all species. These stories guide land management, resource conservation, the use of natural materials, and a commitment to living in harmony with the environment.

4 Traditional Lore explains how humans have a significant impact on the environment; it guides behaviour and sustainability principles to maintain a balanced relationship with the environment.

5 Answers may include: The use of stone wall fishing traps to catch only larger fish is similar to how western commercial fisheries farm fish. Wild crop rotations compared to western farming practices for food cultivation.

 ISBN 978 0 6557 2063 8

Topic review

Remember

1 The basic survival needs of plants in Australia include sunlight, water, air (carbon dioxide), nutrients (from soil) and suitable temperature.

2 Examples could include any three: forests, woodlands, freshwater, rainforests, arid (or deserts) and coastal areas.

3 Examples could include any three: deforestation, climate change, invasive species and disease.

4 Biodiversity is the variety of all living organisms, including plants, animals, fungi, microorganisms, and the ecosystems they form.

5 A food chain is a diagram that shows the flow of energy from organism to organism in a series of feeding relationships.

Understand

6 Answers may include:

grasses → mouse → owl → fox

grasses → grasshopper → bird → snake

grasses → rabbit → hawk

7 Sample answers:

a An abiotic factor that can affect the mouse is sunlight; if there is too much sunlight it will get too hot and need to cool down.

b A biotic factor that can affect the mouse is the owl; it will need to hide from the owl to survive.

8 Sample answer: Factors that contribute to species decline include habitat loss, bush fires and disease.

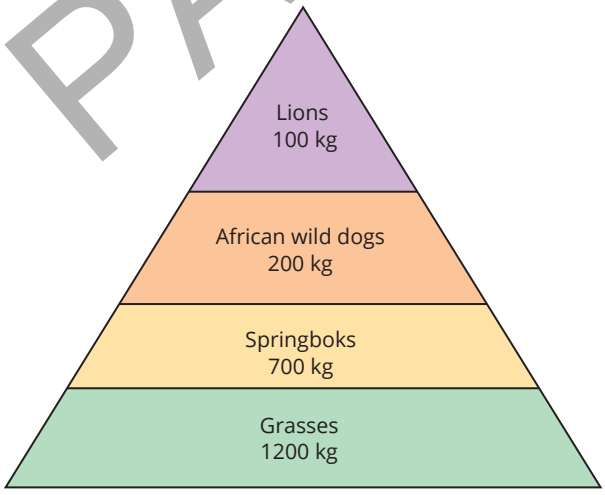
9 Sample answer: Dame Jane Goodall's research highlighted the complex social behaviours of chimpanzees, leading to enhanced protection measures and policies aimed at preserving their habitats and preventing illegal wildlife trade.

10 Transects are a length of string or tape that are used to mark a line through the area being studied. Organisms that are found along the line are counted and identified.

Apply

11 The producer is the grass, the primary consumers are grasshopper, mouse, rabbit; the secondary consumers are the frog, bird, fox and owl; and the tertiary consumers are the fox, owl, hawk and snake.

12



 ISBN 978 0 6557 2063 8

Analyse

13 Answers may include: Farming practices can have negative impacts on local ecosystems. Fertilisers and pesticides used can enter water ways and affect the aquatic organisms by introducing chemical pollution and killing native species. Modern tractors can damage the soil structure which decreases the quality of the soil that native plants require to survive.

14 a The independent variable is the type of laundry detergent used.

b The dependent variable is the number of insects in the sample.

15 Sample answers:

a An Australian native animal is a koala. A koala needs eucalyptus leaves (food), water, shelter (trees), and oxygen.

b The organisms require water. Drought would reduce water availability for the koala and plants it feeds on. This could cause a food shortage for the koala by affecting its food source, the eucalyptus tree.

Extension: Research and create

16 Students may wish to use digital or craft materials to create the poster. Medicines used could include: tea tree oil (antiseptic), smoke bush (treats cuts and increases the healing process) or Kakadu plum (vitamin C).

 ISBN 978 0 6557 2063 8