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Contents

UNIT 4: HEREDITY AND CONTINUITY OF LIFE

How to use this book

The *Pearson Biology 12 Queensland Skills and Assessment* book takes an intuitive, self-paced approach to science education that ensures every student has opportunities to practise, apply and extend their learning through a range of supportive and challenging activities.

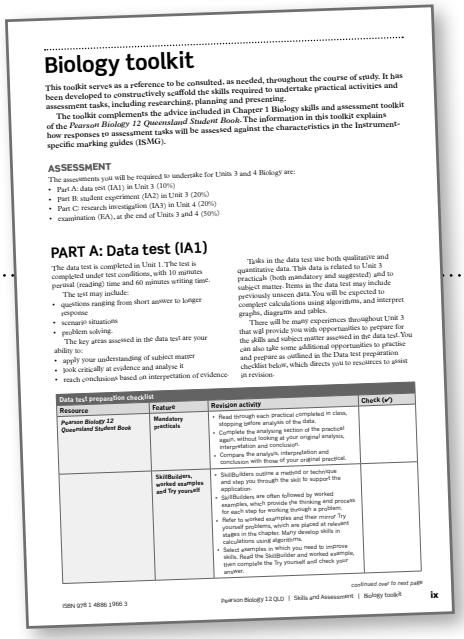
This resource has been developed by highly experienced and expert author teams, with leading Queensland specialists who have a working understanding of what teachers are looking for to support teaching and learning across the new Queensland Certificate of Education (QCE).

Fully written to the new QCAA Biology 2019 General Senior Syllabus, the skills and assessment book is organised into units, with the unit openers outlining the unit objectives that are addressed. The skills and assessment book is further organised into topics. Each topic addresses all of the subject matter and mandatory practicals from the syllabus.

All activities integrate into the *Pearson Biology 12 Queensland Student Book* for a complete teaching, learning and assessment program. At the same time, the skills and assessment book has been designed so that it can be used independently of the student book, providing flexibility in when and how students and teachers are able to engage with it.

Toolkit

A complementary toolkit supports development of the skills and techniques needed to undertake practical investigations, the data test, the student experiment and research investigation. It also includes checklists and helpful hints to assist in fulfilling all assessment requirements and to support further development of study skills.



Biology toolkit

This toolkit serves as a reference to be consulted, as needed, throughout the course of study. It has been developed to constructively scaffold the skills required to undertake practical activities and assessment tasks, including researching, planning and presenting.

The toolkit complements the advice included in Chapter 1 Biology skills and assessment toolkit of the *Pearson Biology 12 Queensland Student Book*. The information in this toolkit explains how responses to assessment tasks will be assessed against the characteristics in the instrument-specific marking guides (ISMG).

ASSESSMENT

The assessments you will be required to undertake for Units 3 and 4 Biology are:

- Part A: data test (IA1) in Unit 3 (10%)
- Part B: student experiment (IA2) in Unit 3 (20%)
- Part C: research investigation (IA3) in Unit 4 (20%)
- examination (EA), at the end of Units 3 and 4 (50%)

PART A: Data test (IA1)

The data test is completed in Unit 1. The test is completed under test conditions, with 10 minutes perusal (reading) time and 60 minutes writing time.

The test may include:

- questions ranging from short answer to longer response
- scenario situations
- problem solving.

The key areas assessed in the data test are your ability to:

- apply your understanding of subject matter
- look critically at evidence and analyse it
- reach conclusions based on interpretation of evidence.

Tasks in the data test use both qualitative and quantitative data. This data is related to Unit 3 practicals (both mandatory and suggested) and to subject matter. Items in the data test may include previously unseen data. You will be expected to complete calculations using algorithms, and interpret graphs, diagrams and tables.

There will be many experiences throughout Unit 3 that will provide you with opportunities to prepare for the skills and subject matter assessed in the data test. You can also take some additional opportunities to practise and prepare as outlined in the Data test preparation checklist below, which directs you to resources to assist in revision.

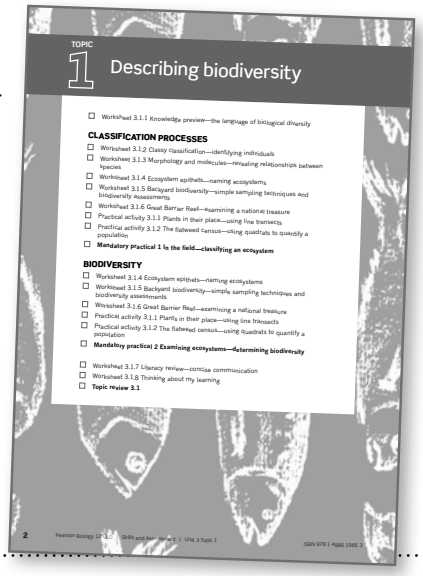
Data test preparation checklist

Resource	Feature	Revision activity	Check (✓)
Pearson Biology 12 Queensland Student Book	Mandatory practicals	• Read through each practical completed in class, stopping before analysis of the data. • Complete the analysing section of the practical again, without looking at your original analysis, interpretation and conclusion. • Compare the analysis, interpretation and conclusion with those of your original practical.	
	SkillBuilders, worked examples and Try yourself	• SkillBuilders outline a method or technique and step you through the skill to support the application. • SkillBuilders are often followed by worked examples, which provide the thinking and process for each step for working through a problem. • Refer to worked examples and their many Try yourself problems, which are placed at relevant points in the chapter. Many develop skills in calculations using algorithms. • Select examples in which you need to improve skills. Read the SkillBuilder and worked example, then complete the Try yourself and check your answer.	

continued over to next page

Topic opener

The book is split into two units with two topics per unit, as per the syllabus. While the unit opener provides an overview of the syllabus outcomes for each unit, the topic opener gives a succinct overview of the content in the book for each topic, organised by key content area. Each topic opener is presented in a handy checklist format to allow you to track your progress.



TOPIC 1 Describing biodiversity

- ☐ Worksheet 3.1.1 Knowledge preview—the language of biological diversity

CLASSIFICATION PROCESSES

- ☐ Worksheet 3.1.2 Classy classification—identifying individuals
- ☐ Worksheet 3.1.3 Morphology and molecules—revealing relationships between species
- ☐ Worksheet 3.1.4 Ecosystem epithets—naming ecosystems
- ☐ Worksheet 3.1.5 Backyard biodiversity—simple sampling techniques and biodiversity assessments
- ☐ Worksheet 3.1.6 Great Barrier Reef—examining a national treasure
- ☐ Practical activity 3.1.1 Plants in their place—using line transects
- ☐ Practical activity 3.1.2 The flatbread census—using quadrats to quantify a population
- ☐ **Mandatory practical 1 In the field—classifying an ecosystem**

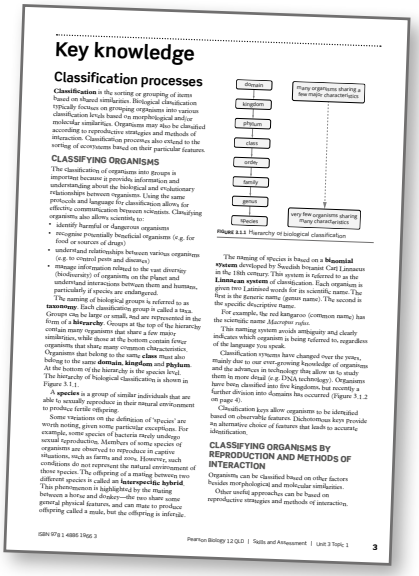
BIODIVERSITY

- ☐ Worksheet 3.1.4 Ecosystem epithets—naming ecosystems
- ☐ Worksheet 3.1.5 Backyard biodiversity—simple sampling techniques and biodiversity assessments
- ☐ Worksheet 3.1.6 Great Barrier Reef—examining a national treasure
- ☐ Practical activity 3.1.1 Plants in their place—using line transects
- ☐ Practical activity 3.1.2 The flatbread census—using quadrats to quantify a population
- ☐ **Mandatory practical 2 Examining ecosystems—determining biodiversity**

- ☐ Worksheet 3.1.7 Literacy review—concise communication
- ☐ Worksheet 3.1.8 Thinking about my learning
- ☐ **Topic review 3.1**

Key knowledge

Each topic begins with a key knowledge section. The key knowledge consists of a set of succinct summary notes that cover the subject matter for each topic of the syllabus. This section is highly illustrative and written in a straightforward style to assist students of all abilities to focus on the salient points. Key terms are in bold for ease of navigation and are reflected in the student book glossary. The key knowledge also serves as a ready reference when completing worksheets and practical activities, and provides a handy set of revision and study notes.



Key knowledge

Classification processes

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

CLASSIFYING ORGANISMS

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

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

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

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

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

FIGURE 3.1.1 Hierarchy of biological classification

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

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

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

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

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

CLASSIFYING ORGANISMS BY REPRODUCTION AND METHODS OF INTERACTION

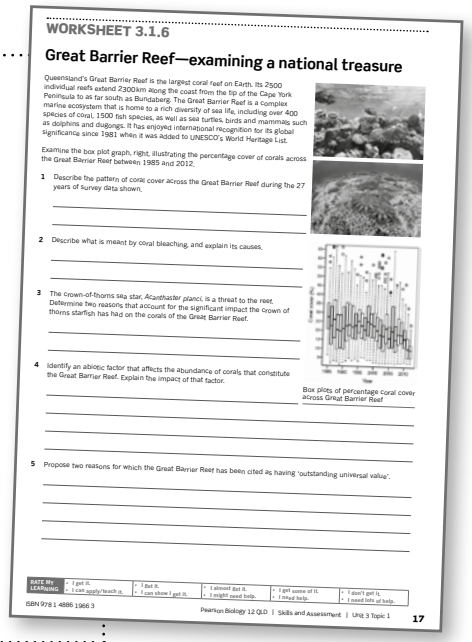
Organisms can be classified based on other factors besides morphological and molecular similarities.

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

Worksheets

A diverse offering of instructive and self-contained worksheets is included in each topic. Common to all topics are the initial 'Knowledge preview' worksheets to activate prior knowledge; a 'Literacy review' worksheet to explicitly build language and application of scientific terminology; and finally a 'Thinking about my learning' worksheet, which encourages students to reflect on their learning and identify areas for improvement. Other worksheets, with their range of activities and tasks, help consolidate learning and the making of connections between subject matter.

Worksheets may be used for formative assessment and are clearly aligned to the syllabus. A range of questions building from foundation to challenging is included in the worksheets, which are written to reflect the Marzano and Kendall taxonomy of instructional verbs.



WORKSHEET 3.1.6

Great Barrier Reef—examining a national treasure

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

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

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

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

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

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

Box plots of percentage coral cover across Great Barrier Reef

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

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

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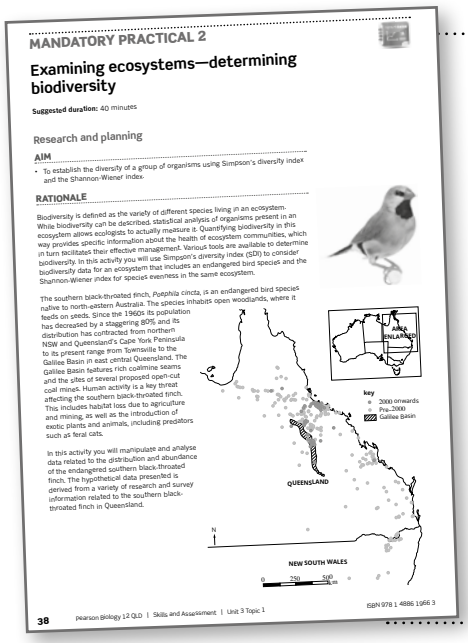

MANDATORY PRACTICAL 2

Examining ecosystems—determining biodiversity

Suggested duration: 40 minutes

Research and planning

AIM

- To establish the diversity of a group of organisms using Simpson's diversity index and the Shannon-Wiener index.

RATIONALE

Biodiversity is defined as the variety of different species living in an ecosystem. While biodiversity can be described, statistical analysis of organisms present in an ecosystem allows ecologists to actually measure it. Quantifying biodiversity in this way provides specific information about the health of ecosystem communities, which in turn facilitates their effective management. Various tools are available to determine biodiversity. In this activity you will use Simpson's diversity index (SDI) to consider biodiversity data for an ecosystem that includes an endangered bird species and the Shannon-Wiener index for species evenness in the same ecosystem.

The southern black-throated finch, *Poephila cincta*, is an endangered bird species native to north-eastern Australia. The species inhabits open woodlands, where it feeds on seeds. Since the 1960s its population has decreased by a staggering 80% and its distribution has contracted from northern NSW and Queensland's Cape York Peninsula to its present range from Townsville to the Galilee Basin in east central Queensland. The Galilee Basin features rich coalmine seams and the sites of several proposed open-cut coal mines. Human activity is a key threat affecting the southern black-throated finch. This includes habitat loss due to agriculture and mining, as well as the introduction of exotic plants and animals, including predators such as feral cats.

In this activity you will manipulate and analyse data related to the distribution and abundance of the endangered southern black-throated finch. The hypothetical data presented is derived from a variety of research and survey information related to the southern black-throated finch in Queensland.

AREA ENLARGED

key
2000 onwards
Pre–2000
Galilee Basin

QUEENSLAND

NEW SOUTH WALES

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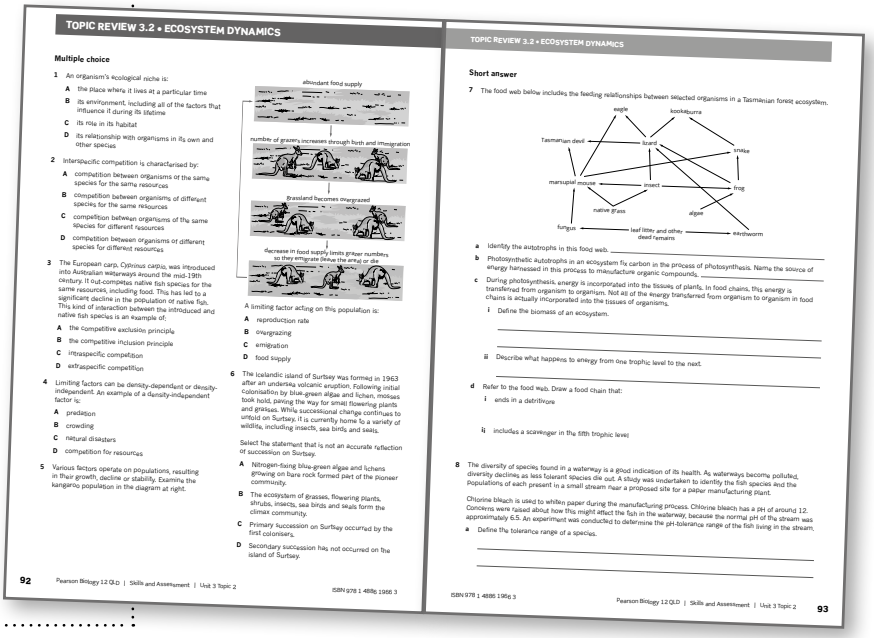
Practical activities

Practical activities take a highly scaffolded approach from beginning to completion and give students the opportunity to complete practical work related to the subject matter covered in the syllabus. Practical activities include a rich assortment of tasks that maximise learning opportunities and build experience in performing calculations and analysis of data, which are necessary for the data test. Every mandatory practical in the syllabus is featured, as well as many suggested practicals. As with the worksheets, the practical activities include a range of questions building from foundation to challenging, written to reflect the Marzano and Kendall taxonomy of instructional verbs.

Topic review questions

Each topic concludes with a comprehensive set of questions requiring multiple-choice and short-answer responses. Topic reviews provide an experience of subject matter and skills across the breadth of the topic. They also reflect the cognitive verbs used in the syllabus subject matter dot points. These items indicate the highest level of thinking that will be assessed on the external examination.



TOPIC REVIEW 3.2 • ECOSYSTEM DYNAMICS

Multiple choice

1 An organism's ecological niche is:
A the place where it lives at a particular time
B its environment, including all of the factors that influence it during its lifetime
C its role in its habitat
D its relationship with organisms in its own and other species

2 Interspecific competition is characterised by:
A competition between organisms of the same species for the same resources
B competition between organisms of different species for the same resources
C competition between organisms of the same species for different resources
D competition between organisms of different species for different resources

3 The European carp, *Cyprinus carpio*, was introduced into Australian waterways around the mid-19th century. It out-competes native fish species for the same resources, including food. This has led to a significant decline in the population of native fish. This kind of interaction between the introduced and native fish species is an example of:
A the competitive exclusion principle
B the competitive inclusion principle
C intraspecific competition
D extraspecific competition

4 Limiting factors can be density-dependent or density-independent. An example of a density-independent factor is:
A predation
B crowding
C natural disasters
D competition for resources

5 Various factors operate on populations, resulting in their growth, decline or stability. Examine the kangaroo population in the diagram at right.

abundant food supply

number of grazers increases through both and immigration

grassland becomes overgrazed

decrease in food supply limits grazer numbers so they emigrate (leave the area) or die

A limiting factor acting on this population is:
A reproduction rate
B overgrazing
C emigration
D food supply

6 The Icelandic island of Surtsey was formed in 1963 after an undersea volcanic eruption. Following initial colonisation by blue-green algae and lichen, mosses took hold, paving the way for small flowering plants and grasses. While successional change continues to unfold on Surtsey, it is currently home to a variety of wildlife, including insects, sea birds and seals.

Select the statement that is not an accurate reflection of succession on Surtsey.
A Nitrogen-fixing blue-green algae and lichens growing on bare rock formed part of the pioneer community.
B The ecosystem of grasses, flowering plants, shrubs, insects, sea birds and seals form the climax community.
C Primary succession on Surtsey occurred by the first colonisers.
D Secondary succession has not occurred on the island of Surtsey.

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TOPIC REVIEW 3.2 • ECOSYSTEM DYNAMICS

Short answer

7 The food web below includes the feeding relationships between selected organisms in a Tasmanian forest ecosystem.

eagle, kookaburra, Tasmanian devil, lizard, snake, marsupial mouse, insect, frog, native grass, algae, fungus, leaf litter and other dead remains, earthworm

a Identify the autotrophs in this food web.
b Photosynthetic autotrophs in an ecosystem fix carbon in the process of photosynthesis. Name the source of energy harnessed in this process to manufacture organic compounds.
c During photosynthesis, energy is incorporated into the tissues of plants. In food chains, this energy is transferred from organism to organism. Not all of the energy transferred from organism to organism in food chains is actually incorporated into the tissues of organisms.
i Define the biomass of an ecosystem.
ii Describe what happens to energy from one trophic level to the next.
d Refer to the food web. Draw a food chain that:
i ends in a detritivore
ii includes a scavenger in the fifth trophic level

8 The diversity of species found in a waterway is a good indication of its health. As waterways become polluted, diversity declines as less tolerant species die out. A study was undertaken to identify the fish species and the populations of each present in a small stream near a proposed site for a paper manufacturing plant.

Chlorine bleach is used to whiten paper during the manufacturing process. Chlorine bleach has a pH of around 12. Concerns were raised about how this might affect the fish in the waterway, because the normal pH of the stream was approximately 6.5. An experiment was conducted to determine the pH tolerance range of the fish living in the stream.
a Define the tolerance range of a species.

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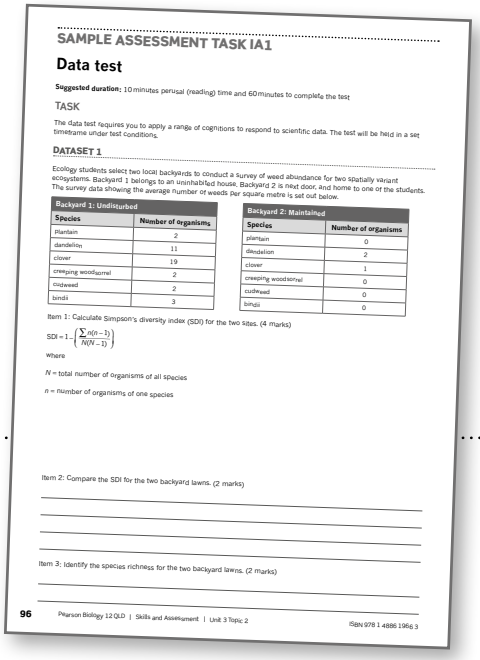
Sample assessment tasks

Sample assessment tasks for the data test, student experiment and research investigation provide opportunities for students to practise responding to these assessment tasks. The activities are designed to support students by guiding them through and scaffolding each aspect of these assessments.



SAMPLE ASSESSMENT TASK IA1

Data test

Suggested duration: 10 minutes perusal (reading) time and 60 minutes to complete the test

TASK

The data test requires you to apply a range of cognitions to respond to scientific data. The test will be held in a set timeframe under test conditions.

DATASET 1

Ecology students select two local backyards to conduct a survey of weed abundance for two spatially variant ecosystems. Backyard 1 belongs to an uninhabited house. Backyard 2 is next door, and home to one of the students. The survey data showing the average number of weeds per square metre is set out below.

Backyard 1: Undisturbed	
Species	Number of organisms
plantain	2
dandelion	11
clover	19
creeping woodsorrel	2
cudweed	2
bindii	3

Backyard 2: Maintained	
Species	Number of organisms
plantain	0
dandelion	2
clover	1
creeping woodsorrel	0
cudweed	0
bindii	0

Item 1: Calculate Simpson's diversity index (SDI) for the two sites. (4 marks)

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

where

N = total number of organisms of all species

n = number of organisms of one species

Item 2: Compare the SDI for the two backyard lawns. (2 marks)

Item 3: Identify the species richness for the two backyard lawns. (2 marks)

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Icons and features

Every mandatory practical is supported by a complementary SPARKlab alternative practical.

The *Pearson Biology Skills and Assessment* book icons in the student book indicate the best time to engage with an activity from the skills and assessment book. These activities can be used for practice, application and revision of subject matter.

The type of activity is indicated by the following icons in the student book:

Worksheet (WS)

Practical activity (PA)

Mandatory practical (MP)

Topic review (TR)

Sample assessment task (SAT)

The **safety icon** highlights significant hazards, indicating caution is needed.

The **safety glasses icon** highlights that protective eyewear is to be worn during the practical activity.

Rate my learning

This innovative feature appears at the end of most worksheets, all practical activities and sample assessment tasks. It provides students with the opportunity for self-reflection and self-assessment. Students are encouraged to consider how they can continue to improve, and to identify areas of focus for further skill and subject matter development. This tool has been based on the Marzano and Kendall taxonomy of instructional verbs.

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

Teacher support

Fully worked solutions, suggested answers and responses to the worksheets, practical activities, mandatory practicals, topic reviews and sample assessment tasks are provided for teachers through the Teacher Support subscription. Risk assessments, expected results and handy hints for all practical activities are also provided.

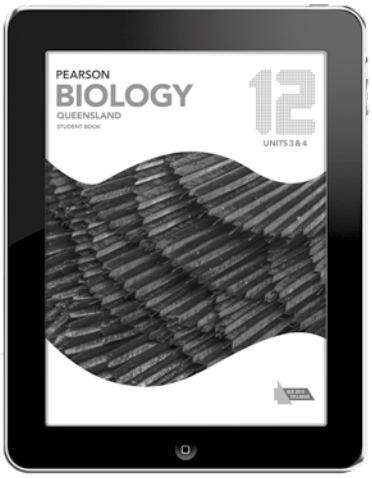
Series overview

Student book

Pearson Biology 12 Queensland Student Book has been developed by experienced Queensland teachers to address all the requirements of the new QCAA Biology 2019 General Senior Syllabus. The series features the latest developments and applications of biology, literacy and instructional design to ensure the content and concepts are fully accessible to all students.

Skills and assessment book

The *Pearson Biology 12 Skills and Assessment* book gives students the edge in preparing for all forms of assessment. Specifically prepared to provide opportunities to consolidate, develop and apply subject matter and science inquiry skills, this resource features a toolkit, key knowledge summaries, worksheets, practical activities and guidance, assessment practice and topic review sets.



Reader+ the next generation eBook

Reader+ is our next generation eBook. Students can read, take notes, save bookmarks and more in one seamless experience. Integrated multimedia (audio/video) and interactive activities enhance and extend the learning experience. In addition, Reader+ provides the digital-only Chapter 1 Biology skills and assessment toolkit.

Teacher support

Pearson Biology 12 Queensland Teacher Support provides:

- complete answers, fully worked solutions or suggested answers to all tasks in the student book, and the skills and assessment book
- expected results, common mistakes, suggested answers and full safety notes and risk assessments for all practical activities
- teaching, learning and assessment programs.

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