Biology 12

Unit 3 Syllabus grid and sample teaching, learning and assessment plan

Student book

Skills and assessment

Unit 3: Biodiversity and the interconnectedness of life

Unit description

In Unit 3, students explore the ways biology is used to describe and explain: the biodiversity within ecosystems; a range of biotic and abiotic components; species interactions; adaptations of organisms to their environment; principles of population dynamics; and how classification systems are used to identify organisms and aid scientific communication. An understanding of the structure of ecosystems, the processes involved in the movement of energy and matter in ecosystems and how environmental factors limit populations is essential to appreciate the dynamics, diversity and underlying unity of these systems. Students investigate the interactions within and between species, and the interactions between abiotic and biotic components of ecosystems. They also investigate how measurements of abiotic factors, population numbers, species diversity and descriptions of interactions between species can form the basis for spatial and temporal comparisons between ecosystems. They examine and analyse data collected from fieldwork to understand the interconnectedness of organisms, the physical environment and the impact of human activity.

Contexts that could be investigated in this unit include: the local ecosystem; fishing and mining industries; habitat destruction; and ecosystem management systems. Through investigating these contexts, student ts may explore the impact of human activity on biodiversity, and sustainability of practices.

Participation in a range of experiments and investigations will allow students to progressively develop their suite of science inquiry skills while gaining an enhanced appreciation of how scientific knowledge is used to offer valid explanations and reliable predictions, and the ways in which scientific knowledge interacts with social, economic, cultural and ethical factors. Collaborative experimental work also helps students to develop communication, interaction, character and management skills.

Throughout the unit, students develop skills in sampling ecological systems, organising and analysing data and developing ecological models to describe and explain the diversity and interconnectedness of life on Earth.

Unit objectives

By the end of this unit, students will:

1. **describe** and **explain** biodiversity and ecosystem dynamics
2. **apply understanding** of biodiversity and ecosystem dynamics
3. **analyse evidence** about biodiversity and ecosystem dynamics
4. **interpret evidence** about biodiversity and ecosystem dynamics
5. **investigate phenomena** associated with biodiversity and ecosystem dynamics
6. **evaluate processes**, **claims** and **conclusions** about biodiversity and ecosystem dynamics
7. **communicate understandings**, **findings**, **arguments** and conclusions about biodiversity and ecosystem dynamics.

Key

IA = Internal assessment
PA = Practical activity
KK = Key knowledge
TR = Topic review
MP = Mandatory practical
WS = Worksheet

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
Topic 1: Describing biodiversity				
• recognise that biological classification can be hierarchical and based on different levels of similarity of physical features, methods of reproduction and molecular sequences	**Classification processes**	2.1 Classification, page 5	KK WS 3.1.2 Classy classification—identifying individuals TR 3.1	
• describe the classification systems for - similarity of physical features (the Linnaean system) - methods of reproduction (asexual, sexual—K and r selection) - molecular sequences (molecular phylogeny—also called cladistics)	**Classification processes**	2.1 Classification, page 5	KK TR 3.1	Interactive: Scientific names
• define the term clade	**Classification processes**	2.2 Processes of classification, page 27	KK WS 3.1.7 Literacy review—concise communication TR 3.1	
• recall that common assumptions of cladistics include a common ancestry, bifurcation and physical change	**Classification processes**	2.2 Processes of classification, page 27	KK WS 3.1.3 Morphology and molecules—revealing relationships between species TR 3.1	Video: Phylogenetics
• interpret cladograms to infer the evolutionary relatedness between groups of organisms	**Classification processes**	2.2 Processes of classification, page 27	KK WS 3.1.3 Morphology and molecules—revealing relationships between species	
• analyse data from molecular sequences to infer species evolutionary relatedness	**Classification processes**	2.2 Processes of classification, page 27	KK WS 3.1.3 Morphology and molecules—revealing relationships between species TR 3.1	Interactive: Classification puzzle
• recognise the need for multiple definitions of species	**Classification processes**	2.1 Classification, page 5	KK WS 3.1.7 Literacy review—concise communication	

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• identify one example of an interspecific hybrid that does not produce fertile offspring (e.g. mule, Equus mulus)	**Classification processes**	2.1 Classification, p 5	KK WS 3.1.1 Knowledge preview—the language of biological diversity TR 3.1	
• explain the classification of organisms according to the following species interactions: predation, competition, symbiosis and disease	**Classification processes**	2.1 Classification, p 5	KK TR 3.1	
• understand that ecosystems are composed of varied habitats (microhabitat to ecoregion)	**Classification processes**	2.1 Classification, p 5	KK TR 3.1	
• interpret data to classify and name an ecosystem	**Classification processes**	2.1 Classification, p 5	KK WS 3.1.4 Ecosystem epithets—naming ecosystems	
• explain how the process of classifying ecosystems is an important step towards effective ecosystem management (consider old-growth forests, productive soils and coral reefs)	**Classification processes**	2.1 Classification, p 5	KK WS 3.1.6 Great Barrier Reef—examining a national treasure TR 3.1	
• describe the process of stratified sampling in terms of - purpose (estimating population, density, distribution, environmental gradients and profiles, zonation, stratification) - site selection - choice of ecological surveying technique (quadrats, transects) - minimising bias (size and number of samples, random-number generators, counting criteria, calibrating equipment and noting associated precision) - methods of data presentation and analysis.	**Classification processes**	2.3 Classification in practice, p 46	KK WS 3.1.5 Backyard biodiversity—simple sampling techniques and biodiversity assessments PA 3.1.1 Plants in their place—using line transects PA 3.1.2 The flatweed census—using quadrats to quantify a population MP 1 In the field—classifying an ecosystem TR 3.1	Video: Census consensus
• **Mandatory practical** Use the process of stratified sampling to collect and analyse primary biotic and abiotic field data to classify an ecosystem.	**Classification processes**	2.1 Classification, p 5 Mandatory practical 1, p 56 1.2 Orders of magnitude and estimation, p e17 1.3 Mathematical basics for biology, p e22 1.4 Units, p e25 1.5 Uncertainties in measurement and error, p e27 1.6 Tables and graphing, p e35 1.7 Statistics, p e42 1.8 Research and planning, p e57 1.9 Conducting an experiment, p e75	MP 1 In the field—classifying an ecosystem	Video: Being precisely accurate

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
		1.10 Results, p e80 1.11 Communicating and writing a scientific report, p e87		
• recognise that biodiversity includes the diversity of species and ecosystems	**Biodiversity**	3.1 Biodiversity and its measurement, p 70	KK WS 3.1.1 Knowledge preview—the language of biological diversity WS 3.1.5 Backyard biodiversity—simple sampling techniques and biodiversity assessments	Interactive: Ecosystem diversity
• determine diversity of species using measures such as species richness, evenness (relative species abundance), percentage cover, percentage frequency and Simpson's diversity index	**Biodiversity**	3.1 Biodiversity and its measurement, p 70	KK WS 3.1.5 Backyard biodiversity—simple sampling techniques and biodiversity assessments WS 3.1.6 Great Barrier Reef—examining a national treasure PA 3.1.1 Plants in their place—using line transects PA 3.1.2 The flatweed census—using quadrats to quantify a population MP 2 Examining ecosystems—determining biodiversity TR 3.1 IA1 Data test, dataset 1	Interactive: Species diversity and species richness
• use species diversity indices, species interactions (predation, competition, symbiosis, disease) and abiotic factors (climate, substrate, size/depth of area) to compare ecosystems across spatial and temporal scales	**Biodiversity**	3.2 Biodiversity and the abiotic environment, p 91	WS 3.1.4 Ecosystem epithets—naming ecosystems WS 3.1.6 Great Barrier Reef—examining a national treasure PA 3.1.2 Examining ecosystems—determining biodiversity MP 2 Examining ecosystems—determining biodiversity IA1 Data test, dataset 1 IA2 Student experiment	Interactive: Biotic and abiotic factors in the environment Video: Reviewing the scientific method Video: Being precisely accurate

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• explain how environmental factors limit the distribution and abundance of species in an ecosystem.	**Biodiversity**	3.2 Biodiversity and the abiotic environment, p 91	KK WS 3.1.4 Ecosystem epithets—naming ecosystems WS 3.1.6 Great Barrier Reef—examining a national treasure PA 3.1.2 The flatweed census—using quadrats to quantify a population IA2 Student experiment	
• **Mandatory practical** Determine species diversity of a group of organisms based on a given index.	**Biodiversity**	3.1 Biodiversity and its measurement, p 70 Mandatory practical 2, p 120 1.2 Orders of magnitude and estimation, p e17 1.3 Mathematical basics for biology, p e22 1.4 Units, p e25 1.5 Uncertainties in measurement and error, p e27 1.6 Tables and graphing, p e35 1.7 Statistics, p e42 1.8 Research and planning, p e57 1.9 Conducting an experiment, p e75 1.10 Results, p e80 1.11 Communicating and writing a scientific report, p e87	MP 2 Examining ecosystems—determining biodiversity	Video: Being precisely accurate
Topic 2: Ecosystem dynamics				
• sequence and explain the transfer and transformation of solar energy into biomass as it flows through biotic components of an ecosystem, including - converting light to chemical energy - producing biomass and interacting with components of the carbon cycle	**Functioning ecosystems**	4.1 Energy transfer, p 133	KK WS 3.2.1 Knowledge preview—essence of ecology WS 3.2.4 Energy and ecocycling—movement of energy and matter in ecosystems WS 3.2.7 Literacy review—concise communication TR 3.2	Video: The flow of chemical energy through the food chain
• analyse and calculate energy transfer (food chains, webs and pyramids) and transformations within ecosystems, including - loss of energy through radiation, reflection and absorption - efficiencies of energy transfer from one trophic level to another - biomass	**Functioning ecosystems**	4.1 Energy transfer, p 133	KK TR 3.2 IA1 Data test, dataset 2	Video: Nature's tangled web

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• construct and analyse simple energy-flow diagrams illustrating the movement of energy through ecosystems, including the productivity (gross and net) of the various trophic levels	**Functioning ecosystems**	4.1 Energy transfer, p 133	KK WS 3.2.3 Wild web—living in an ecosystem TR 3.2	
• describe the transfer and transformation of matter as it cycles through ecosystems (water, carbon and nitrogen)	**Functioning ecosystems**	4.1 Energy transfer, p 133	KK WS 3.2.4 Energy and ecocycling—movement of energy and matter in ecosystems WS 3.2.7 Literacy review—concise communication TR 3.2 IA1 Data test, dataset 2	
• define ecological niche in terms of habitat, feeding relationships and interactions with other species	**Functioning ecosystems**	4.2 Functioning ecosystems, p 157	KK WS 3.2.2 Intricate interactions—relationships in ecosystems WS 3.2.3 Wild web—living in an ecosystem WS 3.2.7 Literacy review—concise communication PA 3.2.1 The cane, the beetle, the toad and the quoll—a tale of population change for an Australian keystone species TR 3.2	Interactive: Interdependencies between organisms
• understand the competitive exclusion principle	**Functioning ecosystems**	4.2 Functioning ecosystems, p 157	KK WS 3.2.5 Fluctuating figures—population dynamics TR 3.2	

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• analyse data to identify species (including microorganisms) or populations occupying an ecological niche	**Functioning ecosystems**	4.2 Functioning ecosystems, p 157	WS 3.2.3 Wild web—living in an ecosystem	
• define keystone species and understand the critical role they play in maintaining the structure of a community	**Functioning ecosystems**	4.2 Functioning ecosystems, p 157	KK WS 3.2.1 Knowledge preview—essence of ecology WS 3.2.3 Wild web—living in an ecosystem WS 3.2.4 Energy and ecocycling—movement of energy and matter in ecosystems WS 3.2.7 Literacy review—concise communication PA 3.2.1 The cane, the beetle, the toad and the quoll—a tale of population change for an Australian keystone species	
• analyse data (from an Australian ecosystem) to identify a keystone species and predict the outcomes of removing the species from an ecosystem.	**Functioning ecosystems**	4.2 Functioning ecosystems, p 157	WS 3.2.4 Energy and ecocycling—movement of energy and matter in ecosystems PA 3.2.1 The cane, the beetle, the toad and the quoll—a tale of population change for an Australian keystone species	
• define the term *carrying capacity*	**Population ecology**	4.3 Population dynamics, p 176	KK WS 3.2.5 Fluctuating figures—population dynamics WS 3,2,7 Literacy review—concise communication PA 3.2.2 A numbers game—analysing population growth IA1 Data test, dataset 4	

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• explain why the carrying capacity of a population is determined by limiting factors (biotic and abiotic)	**Population ecology**	4.3 Population dynamics, p 176	KK WS 3.2.5 Fluctuating figures—population dynamics WS 3.2.7 Literacy review—concise communication PA 3.2.2 A numbers game—analysing population growth TR 3.2	
• calculate population growth rate and change (using birth, death, immigration and emigration data)	**Population ecology**	4.3 Population dynamics, p 176	WS 3.2.5 Fluctuating figures—population dynamics IA1 Data test, dataset 3	
• use the Lincoln Index to estimate population size from secondary or primary data	**Population ecology**	4.3 Population dynamics, p 176	KK PA 3.2.1 The cane, the beetle, the toad and the quoll—a tale of population change for an Australian keystone species IA1 Data test, dataset 3	
• analyse population growth data to determine the mode (exponential growth J-curve, logistic growth S-curve) of population growth	**Population ecology**	4.3 Population dynamics, p 176	KK WS 3.2.5 Fluctuating figures—population dynamics PA 3.2.2 A numbers game—analysing population growth IA1 Data test, dataset 4	

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• discuss the effect of changes within population-limiting factors on the carrying capacity of the ecosystem.	**Population ecology**	4.3 Population dynamics, p 176	KK WS 3.2.5 Fluctuating figures—population dynamics TR 3.2 IA1 Data test, dataset 4	
• explain the concept of ecological succession (refer to pioneer and climax communities and seres)	**Changing ecosystems**	4.4 Change in ecosystems, p 191	KK WS 3.2.6 Evolving ecosystems—change in ecosystems over time WS 3.2.7 Literacy review—concise communication PA 3.2.3 Cascading communities—examining an ecological chain reaction of change TR 3.2	
• differentiate between the two main modes of succession: primary and secondary	**Changing ecosystems**	4.4 Change in ecosystems, p 191	KK WS 3.2.7 Literacy review—concise communication TR 3.2	
• identify the features of pioneer species (ability to fixate nitrogen, tolerance to extreme conditions, rapid germination of seeds, ability to photosynthesise) that make them effective colonisers	**Changing ecosystems**	4.4 Change in ecosystems, p 191	KK WS 3.2.6 Evolving ecosystems—change in ecosystems over time WS 3.2.7 Literacy review—concise communication	

Subject matter	Sub topic	*Pearson Biology 12 Queensland Student Book* chapter modules	*Pearson Biology 12 Queensland Skills & Assessment* book	*Pearson Biology 12 Queensland Reader+*
• analyse data from the fossil record to observe past ecosystems and changes in biotic and abiotic components	**Changing ecosystems**	4.4 Change in ecosystems, p 191	KK WS 3.2.5 Fluctuating figures—population dynamics WS 3.2.6 Evolving ecosystems—change in ecosystems over time WS 3.2.7 Literacy review—concise communication TR 3.2	
• analyse ecological data to predict temporal and spatial successional changes	**Changing ecosystems**	4.4 Change in ecosystems, p 191	KK WS 3.2.5 Fluctuating figures—population dynamics TR 3.2	
• predict the impact of human activity on the reduction of biodiversity and on the magnitude, duration and speed of ecosystem change.	**Changing ecosystems**	4.4 Changing ecosystems, p 191	KK WS 3.2.5 Fluctuating figures—population dynamics PA 3.2.3 Cascading communities—examining an ecological chain reaction of change	
• **Mandatory practical** Select and appraise an ecological surveying technique to analyse species diversity between two spatially variant ecosystems of the same classification (e.g. a disturbed and undisturbed dry sclerophyll forest).	**Changing ecosystems**	4.4 Change in ecosystems, p 191 Mandatory practical 3, p 218 1.2 Orders of magnitude and estimation, p e17 1.3 Mathematical basics for biology, p e22 1.4 Units, p e25 1.5 Uncertainties in measurement and error, p e27 1.6 Tables and graphing, p e35 1.7 Statistics, p e42 1.8 Research and planning, p e57 1.9 Conducting an experiment, p e75 1.10 Results, p e80 1.11 Communicating and writing a scientific report, p e87	MP 3 Similar but different—evaluating ecological estimations	Video: Being precisely accurate