

# Life Sciences

LEVEL 2	15 TCE CREDIT POINTS
COURSE CODE	LSC215120
COURSE SPAN	2020 — 2022
READING AND WRITING STANDARD	NO
MATHEMATICS STANDARD	NO
COMPUTERS AND INTERNET STANDARD	NO

This course was delivered in 2022. Use [A-Z Courses](#) to find the current version (if available).

## Knowledge and understanding of science, scientific literacy and scientific methods are necessary for learners to develop the skills to resolve questions about their natural and constructed world

The purpose of science education is to develop scientific literacy, helping learners: to be interested in, and understand, the world around them; to engage in discourse about science; to understand the testable and contestable nature of science, and question the claims made by others about scientific matters; to be able to identify questions and draw evidence-based conclusions; and to make informed decisions about the environment, about their own health and well-being, and about the role and impact of science on society. Life Sciences is the study of the fascinating diversity of life: as it has evolved, as it functions and how it interacts with the environment. It focuses on investigations of living systems at the subcellular, cellular and organism level. This knowledge enables us to explore and explain everyday observations, find solutions to biological issues, and understand the processes of biological continuity and change over time.

### Course Description

Life Sciences Level 2 adopts a thematic approach, in which at least one (1) theme is chosen as the basis for study of, or to illustrate, relevant aspects of key life sciences areas in the Core. The purpose of this thematic approach is to allow for flexibility and teacher choice dependent on learner interest or particular geographical location, or to assist learners' progress on a particular academic or vocational pathway.

Core content in relation to the three (3) key areas of study is outlined in the Course Content section below. The Core is intrinsic to the study of biological or life sciences and is **compulsory**. The order of delivery and the method by which the Core is presented are not prescribed. Parts of the Core may be studied as an introduction to the course; parts or the whole Core may be integrated into the selected theme(s). To some extent this will be dependent on the theme(s), as different themes will cover the core content to varying degrees.

At least one selected theme **must** cover current biotechnology concepts and relevant applications.

This course has a design time of 150 hours. The Core and selected theme(s) will account for approximately 140 hours of design time, of which approximately 40 hours is to be spent engaged in practical activities and laboratory work. The remaining 10 hours of design time is to be spent on an Investigative Study.

## Rationale

Knowledge and understanding of science, scientific literacy and scientific methods are necessary for learners to develop the skills to resolve questions about their natural and constructed world.

The purpose of science education is to develop scientific literacy, helping learners: to be interested in, and understand, the world around them; to engage in discourse about science; to understand the testable and contestable nature of science, and question the claims made by others about scientific matters; to be able to identify questions and draw evidence-based conclusions; and to make informed decisions about the environment, about their own health and well-being, and about the role and impact of science on society.

Life Sciences is the study of the fascinating diversity of life: as it has evolved, as it functions and how it interacts with the environment. It focuses on investigations of living systems at the subcellular, cellular and organism level. This knowledge enables us to explore and explain everyday observations, find solutions to biological issues, and understand the processes of biological continuity and change over time.

## Aims

Life Sciences aims to develop learners' interest in the biological sciences as well as a respect for all living things and the environment. The course aims to develop understanding of biological concepts, theories and models and how biological systems interact, as well as how biological knowledge is applied to meet the needs of society. Learners will use basic investigative and interpretive skills, and learn how to communicate relevant information appropriately.

## Learning Outcomes

On successful completion of this course, learners will be able to:

1. undertake and complete scientific activities and tasks (including practical tasks) individually and as a group
2. inquire into biological systems, using practical skills and techniques, safely utilising equipment, collecting data and finding trends and patterns to draw valid conclusions
3. collect, process, organise and communicate biological data and information following accepted conventions
4. describe the application and impact of life sciences in society
5. describe and utilise basic biological concepts, theories and models for cells, systems and organisms
6. describe and utilise basic biological concepts, theories and models of biochemical and cellular processes that support life
7. describe ecosystem dynamics, how basic biological systems interact and are interrelated; the flow of matter and energy through and between these systems; and processes by which they persist and change
8. utilise appropriate biological concepts and knowledge to describe and interpret biotechnical contexts.

## Access

Learners are required to work as directed in practical situations as potentially dangerous materials and equipment may be used in this course.

## Pathways

This course is designed for learners who are interested in studying the science related to the living world. *Life Sciences* Level 2 may be studied as a stand-alone course and is also useful preparation for further study in Level 3 courses such as: *Biology* Level 3; *Environmental Science* Level 3; and *Physical Sciences* Level 3. It may provide background and support for vocational programs within training packages, traineeships and apprenticeships where some scientific knowledge and experience is useful.

## Resource Requirements

This course requires a suitably equipped laboratory and resources to conduct experiments.

Learners need to be able to access a wide range of reliable sources of information about the uses and applications of science within the wider community.

## Course Size And Complexity

This course has a complexity level of 2.

At Level 2, the learner is expected to carry out tasks and activities that involve a range of knowledge and skills, including some basic theoretical and/or technical knowledge and skills. Limited judgement is required, such as making an appropriate selection from a range of given rules, guidelines or procedures. VET competencies at this level are often those characteristic of an AQF Certificate II.

This course has a size value of 15.

## Investigative Study (Minimum 10 hours)

Each learner will complete an investigation that will represent at least 10 hours of design time. This study can be either an individual or a small group task.

The topic will be chosen in consultation with the teacher and will be based on any content or inquiry within the Core or the selected theme(s). There is no prescribed topic, method of investigation or format in which the study is presented. However, the investigation **must** contain some primary information or data and not be based solely on secondary knowledge and **must** adhere to a scientific inquiry approach as outlined in the Science Inquiry Skills section of the Course Content.

The Investigative Study may be assessed against criteria 1, 2, 3 and 8.

## Course Content

For the content areas of Life Sciences, the three interrelated strands - Science Inquiry Skills; Science as a Human Endeavour; and Science Understanding - build on learners' learning in F-10 *Australian Curriculum: Science*. In the practice of science, the three strands are closely integrated: the work of scientists reflects the nature and development of science; it is built around scientific inquiry; and it seeks to respond to and influence society.

In Life Sciences, these strands are to be integrated into three key areas of study:

- Cells, systems and organisms
- Chemical and cellular processes that support life
- Ecosystem diversity and dynamics.

### SCIENCE INQUIRY SKILLS

- Identify and construct questions for investigation.
- Plan and conduct investigations using inquiry-based methodology.
- Organise and use basic data to identify trends, patterns and relationships; use basic evidence to make conclusions.
- Communicate using appropriate language, nomenclature, genres and modes, including scientific reports.

### SCIENCE AS A HUMAN ENDEAVOUR

- Scientific knowledge is influenced by and influences social, economic, cultural and ethical considerations.
- The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences.
- Scientific knowledge can enable scientists to offer reliable explanations and make reliable predictions.

### SCIENCE UNDERSTANDING

#### **CORE**

Some or all of the Core content will be studied in relation to the selected theme(s).

#### **Demonstrate knowledge and understanding of cells, systems and organisms (Criterion 5)**

##### **Cells (Cells as the Basis of Life)**

- Cells as the basic organisational unit of life
- Identification and basic function of organelles
  - nucleus, nucleolus and nuclear membrane
  - mitochondrion
  - chloroplast
  - vacuole
  - cell membrane, cell wall
  - cilium, flagellum
- Differences between plant and animal cells
- Microscopy – use of light microscopes.

##### **Multicellular Organisms (Introductory level)**

- Multicellular organisms have cell specialisation and differentiation to sustain life  
(cells → tissues → organs → organ systems)
- Plants (dicotyledons only)
  - xylem transports water (process not required)
  - gas exchange (leaves and stomata)
- Animals
  - transport of materials (nutrients and wastes)
    - circulatory system

- digestive system
- gas exchange
  - respiratory system.

***Demonstrate knowledge and understanding of the cellular processes that support life (Criterion 6)***

**Materials Input/Output**

- Cells require suitable energy inputs and also need to exchange materials with their environment
  - nutrients
  - gases
  - wastes
- Movement of materials across membranes occurs via diffusion and osmosis (at a basic level)
- Factors that affect exchange of materials across membranes (at a basic level)
  - SA:V ratio
  - size and nature of molecules.

**Biochemical Processes in the Cell**

- Basic properties of biological compounds (carbohydrates, lipids, proteins)
- Enzymes
  - enzymes breakdown biological compounds
  - investigate factors affecting enzyme action
- Photosynthesis
  - word equation only
  - investigate factors affecting the rate of photosynthesis (such as availability of water, carbon dioxide and light)
- Cellular respiration
  - word equation only for aerobic respiration
  - products of anaerobic respiration
  - cellular respiration produces energy for cellular processes.

***Demonstrate knowledge and understanding of ecosystem diversity and dynamics (Criterion 7)***

**Classification of Life**

- Biological classification is hierarchical and based on different levels of similarity
- Classification systems (taxonomy) as a universal language (Kingdom, Phylum, Class, Order, Family, Genus, Species à binomial name)
  - use of keys (for example, dichotomous keys)
  - definition of a species.

**Ecosystem Dynamics**

- Terminology including
  - ecosystem
  - populations and communities
  - niches
- Distinguish between abiotic and biotic factors
- Energy flow through ecosystems
  - food webs
  - pyramids
- Cycling of matter (water and carbon)
- Feeding relationships
  - trophic levels (producers, consumers and decomposers)
  - predation, competition, symbiosis and disease
- Ecosystems change over time
  - population size and carrying capacity

- o influence of human activities.

### **THEMES**

The following themes are EXAMPLES only. They are expanded below to illustrate some relationships between themes and core topics, and possible areas of study related to biotechnology (Criterion 8):

- Human
- Agriculture
- Environment
- Biochemistry: The Chemical Basis of Life
- Marine Studies.

This list of themes and their suggested content are not exhaustive. Other themes might include: microbiology; Tasmanian flora and fauna; aquaculture; forestry, etc. At least one theme studied **must** cover current biotechnology concepts and relevant contexts (Criterion 8)

### **HUMAN SCIENCE THEME**

#### **Human Evolution**

- Humans and the evolutionary time-scale
- The Human evolutionary tree
  - o *Australopithecus* genus
  - o *Homo* genus
- Theories of human evolution
- How humans differ from other primates
- (bipedalism, big brains → tools, culture, consciousness)
- Human endeavour has impacted on human evolution (agriculture and modern medicine)
- Human population growth over time (graph).

#### **Human Systems**

- Digestive, circulatory and respiratory (expansion of the work covered in the core)
- Excretory
- Skeletal and muscular
- Skin
- Reproductive (include basics of mitosis and meiosis)
- Include some examples of common diseases.

#### **Human Genetics (Introduction)**

- Human karyotype
- Genetic definitions, real-life examples, and problem application
  - o homozygous and heterozygous
  - o dominant and recessive
  - o allele
  - o genotype and phenotype
  - o punnet squares (monohybrid only).

#### **Biotechnology**

- For example, a study of any or all of:
  - o reproductive technologies

- o DNA profiling (disease, forensics)
  - o Human Genome
  - o medical (stem cells, vaccines, etc)
- Ethical considerations of the use of biotechnology
  - o confidentiality
  - o cost (individual and society)
  - o use of information.

## AGRICULTURAL THEME

### **Factors influencing production such as:**

- Climate
  - o seasons
  - o extremes and cycles (El Niño, La Niña, global warming)
  - o water
- Topography
  - o aspect (light intensity)
  - o impact on soil profile (soil depth)
- Growth medium
  - o development of soil (rock cycle, soil composition).

### **Plant production:**

- Plant biology
- Plant requirements
- Plant reproduction (vegetative, sexual reproduction, life cycles – annuals, perennials, pollination – wind, insect)
- Production systems (pastures, crops, viticulture, fruit trees, flowers, timber)
- Diseases and pest control
- Harvesting.

### **Animal production:**

- Animal biology
- Digestive systems (foregut, hindgut fermenters)
- Reproduction systems (avian – egg production, bovine – milk production)
- Production systems (meat, fish, milk, fleece, egg, honey)
- Disease and pest control.

### **Impacts of production on natural ecosystems such as:**

- Eutrophication
- Pollution (insecticides, pesticides and herbicides)
- Biodiversity
- Tillage practices (fertilisers, erosion, salinity).

### **Biotechnology**

- How biotechnology has advanced production; examples include:
  - o genetic engineering
  - o yield increase
  - o nutrient modification (increasing protein content, edible vaccines)
  - o pest control
  - o disease resistance
  - o frost resistance.

## ENVIRONMENTAL THEME

### **Ecosystems**

- Terrestrial ecosystems
- Aquatic ecosystems.

### **Population dynamics**

- Factors affecting population growth
  - impact of introduced species on native populations
  - environmental resistance
  - density dependent and density independent factors
  - carrying capacity.

### **Human Activities (Australian context)**

- Reduction of biodiversity, examples can include:
  - habitat destruction, pollution, pest introduction, species removal, salinity, climate change, availability and quality of fresh water (siltation, drought and algae blooms)
- Conservation management
  - endangered species
  - challenges to conservation
  - strategies for conservation management including biological control (successful and unsuccessful).

### **Biotechnology**

- Development, use and regulation of biological systems (land, air, water)
- Green manufacturing technologies and sustainable development
- Breeding programs to maintain genetic diversity
- Rehabilitation of degraded areas using genetically modified organisms.

## BIOCHEMISTRY: THE CHEMICAL BASIS OF LIFE THEME

### **The Nature of Matter**

- Atoms, ions and molecules
- Types of chemical bonds
- Chemicals required for life can be organic or inorganic
  - Organic molecules are based on carbon
    - carbon is significant in that it can form 4 bonds and is able to bond with other carbon atoms to form long chains
    - structure and function of important organic molecules (carbohydrates, lipids, proteins, DNA)
  - Inorganic molecules are also necessary for life (e.g. water)
    - water is a key substance in a range of chemical systems because of its unique properties.

### **Cellular Processes**

- All cellular functions are derived from biochemical reactions
- Energy for life is stored in C-C bonds
  - photosynthesis: the basis for life as it is the principle mechanism for the transformation of light energy from the sun into useful forms
    - is a series of chemical reactions that convert energy from the sun to chemical energy in the form of glucose



- cellular respiration (glucose only) is required for all cells to produce energy
  - the breaking of the C-C bonds in glucose releases energy for ATP creation

Note: do not have to understand the reactions for photosynthesis and respiration in detail, but understand, that the net equations are the result of many smaller reactions.

### Chemical Reactions for Life

- Biological catalysts (enzymes) reduce activation energy required
- Life would not be sustained without enzymes (e.g. digestion)
- Investigate some of the various conditions present during chemical reactions that affect enzyme action, for example:
  - temperature (e.g. enzymes are temperature specific)
  - concentration
  - surface area
- Buffering systems, including
  - stomach acid
  - carbon dioxide in the blood.

### Biotechnology

- Biotechnology from a biochemistry perspective involves synthesis, processing and detection of compounds
- Medical
  - synthetic production of insulin
  - natural product pharmaceuticals
- Other areas of current study in biotechnology that may be of interest are:
  - plant genetic engineering
  - new enzymes and production methods for biofuels
  - bioactive milk proteins
  - rapid screening for illicit drugs.

### MARINE STUDIES THEME

#### Classification

- Biodiversity in a marine environment
- Unique nature of marine organisms and classification/identification of common Tasmanian species
- Use and construction of simple keys.

#### Materials Input/Output

- Factors changing nutrient levels (e.g. effects of currents, light)
- Importance of maintaining equilibrium
  - mechanism for regulating water/salt balance
  - ability of organisms to move between salt and fresh water
  - conservation of heat
- Survival mechanism at depth.

#### Multicellular Organisms

- Differences between phytoplankton and zooplankton
- Key characteristics of organs and organ systems in marine organisms
  - swim bladder
  - transport of gases
  - structure and function of simple asexual and sexual reproductive organs
- Adaptations

- investigate ways organisms adapt to a coastal marine environment (behavioural, functional, physiological, and structural)
- simple reproductive strategies
- specific Tasmanian examples.

### **Ecosystem Dynamics**

- Marine ecosystems (using a local example)
- Energy flow in a marine food chain
- Focus on pyramids of biomass and construction from field work
- Nutrient cycles
  - interaction between land and water
  - effect of sea surface temperature
  - impact of weather systems
  - impact of human activity
- Effects of change on a marine environment.

### **Biotechnology**

- Use of genetics as a management tool in aquaculture
- Examples of biotechnology in use in Tasmania (e.g. aquaculture breeding programs)
- Issues arising from genetic engineering
- Pharmaceuticals and sun screens from bacteria inhabiting saline lakes in Antarctica.

### **Assessment**

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate end-point of study. Although assessment – as part of the learning program – is continuous, much of it is formative, and is done to help learners identify what they need to do to attain the maximum benefit from their study of the course. Therefore, assessment for summative reporting to TASC will focus on what both teacher and learner understand to reflect end-point achievement.

The standard of achievement each learner attains on each criterion is recorded as a rating 'A', 'B', or 'C', according to the outcomes specified in the standards section of the course.

A 't' notation must be used where a learner demonstrates any achievement against a criterion less than the standard specified for the 'C' rating.

A 'z' notation is to be used where a learner provides no evidence of achievement at all.

Providers offering this course must participate in quality assurance processes specified by TASC to ensure provider validity and comparability of standards across all awards. To learn more, see TASC's [quality assurance](#) processes and [assessment](#) information.

Internal assessment of all criteria will be made by the provider. Providers will report the learner's rating for each criterion to TASC. The Investigative Study is a compulsory assessment activity against criterion 8 and other criteria as applicable.

## Quality Assurance Process

The following processes will be facilitated by TASC to ensure there is:

- a match between the standards of achievement specified in the course and the skills and knowledge demonstrated by learners
- community confidence in the integrity and meaning of the qualification.

**Process** – TASC will verify that the provider's course delivery and assessment standards meet the course requirements and community expectations for fairness, integrity and validity of qualifications TASC issues. This will involve checking:

- learner attendance records; and
- course delivery plans (the sequence of course delivery/tasks and when assessments take place):
  - assessment instruments and rubrics (the 'rules' or marking guide used to judge achievement)
  - class records of assessment
  - examples of learner work that demonstrate the use of the marking guide
  - samples of current learner's work, including that related to any work requirements articulated in the course document.

This process may also include interviews with past and present learners. It will be scheduled by TASC using a risk-based approach.

## Criteria

The assessment for Life Sciences Level 2 will be based on the degree to which the learner can:

1. apply skills to organise and complete activities
2. develop, undertake, interpret and review life sciences experiments
3. collect, process and communicate information
4. describe the application and impact of life sciences in society
5. describe and utilise concepts of cells, systems and organisms
6. describe and utilise concepts of the chemical and cellular processes that support life
7. describe and utilise ecosystem diversity and dynamics concepts
8. describe and interpret biotechnology concepts and contexts

## Criterion 1: apply skills to organise and complete activities

The learner:

Rating A	Rating B	Rating C
selects and uses techniques and equipment related to life sciences investigations safely, competently and methodically	uses familiar techniques and equipment related to life sciences safely and competently	uses familiar techniques and equipment related to life sciences safely
follows instructions accurately	follows instructions to complete a task	follows instructions. There may be some errors or omissions in doing so.
monitors and evaluates progress towards meeting goals and timelines, and plans future actions	monitors progress towards meeting goals and timelines, and plans future actions	monitors progress towards meeting goals and timelines
performs and monitors own tasks, and guides others in their contribution to the successful completion of group activities.	performs tasks and monitors their contribution to the successful completion of group activities.	performs tasks to contribute to the completion of group activities.

## Criterion 2: develop, undertake, interpret and review life sciences experiments

The learner:

Rating A	Rating B	Rating C
expresses a hypothesis to explain observations, as a precise and testable statement	expresses a hypothesis to explain observations, meeting most of the criteria of a testable hypothesis	states a prediction that could be tested by experiment
selects and uses appropriate equipment in life sciences experiments	from a limited range, selects and uses equipment in life sciences experiments	uses equipment in life sciences experiments as directed
designs a controlled, safe, ethical experiment, identifying the main variables and considering safety, to collect valid and reliable data	designs a controlled experiment, identifying the main variables and considering safety and ethics, to collect valid data	lists most of the elements of a controlled experiment
analyses and interprets experimental results to draw a valid conclusion that relates to the hypothesis	based on experimental results, draws a conclusion that relates to the hypothesis, and has some validity	based on experimental results, draws a conclusion that relates to the hypothesis
identifies some limitations in an experimental design, and suggests some improvements.	identifies a limitation in an experimental design, and suggests a valid improvement.	identifies a limitation in an experimental design.

## Criterion 3: collect, process and communicate information

The learner:

Rating A	Rating B	Rating C
uses a variety of practical resources or other sources to collect information, and evaluates their reliability	uses a variety of practical resources or other sources to collect information	uses a limited range of practical resources or other sources to collect information

uses appropriate referencing/citation methods	uses some appropriate referencing/citation methods	uses referencing/citation methods as directed
selects and uses an appropriate scientific format for communication of information.	from a range of formats, selects and uses an appropriate scientific format for communication of information.	as guided, uses an appropriate scientific format for communication of information.

## Criterion 4: describe the application and impact of life sciences in society

The learner:

Rating A	Rating B	Rating C
discusses how biological science has been used to meet needs in society	describes ways in which biological science has been used to meet needs in society	identifies ways in which biological science has been used to meet needs in society
explains an issue related to the application of biological science	describes an issue related to the application of biological science	identifies an issue related to the application of biological science
describes in detail components of an issue and presents a balanced discussion	identifies key components of an issue and presents a balanced discussion	identifies some components of an issue and lists points in favour, and against
argues a reasoned conclusion, articulating links to relevant evidence.	presents a reasoned conclusion, using some relevant evidence.	uses some evidence to reach a conclusion.

## Criterion 5: describe and utilise concepts of cells, systems and organisms

Related to the study of cells, systems and organisms, the learner:

Rating A	Rating B	Rating C
identifies cell organelles in cells and explains the function of each organelle	identifies the main cell organelles in cells and describes the function of some organelles	identifies cell organelles in familiar, basic cells and diagrams
identifies specific types of cells and explains this in terms of structural differences	describes the differences between different cell types	identifies basic differences between plant and animal cells
explains the components of systems of plants and animals, and explains how they function	describes the components of familiar systems of plants and animals and how they function	identifies the components of basic systems of plants and animals
uses information, including data, explains links to concepts, and makes plausible explanations/predictions.	uses given information, including basic data, describes links to concepts, and makes simple, plausible explanations/predictions.	uses given information, identifies links to basic concepts, and makes some simple, plausible explanations/predictions.

## Criterion 6: describe and utilise concepts of the chemical and cellular processes that support life

Related to the study of the cellular processes that support life, the learner:

Rating A	Rating B	Rating C
correctly uses basic terms to describe concepts and properties	correctly uses basic terms to describe concepts or properties	correctly uses some basic terms to identify properties
identifies the materials required by cells,	identifies the materials required by cells,	names the materials required by cells,

the wastes produced, and describes the cellular processes where these are used	the wastes produced, and identifies the cellular processes where these are used	the wastes produced, and basic cellular processes occurring in cells
explains how factors affect the rate of exchange of materials across membranes	describes familiar factors which affect the rate of exchange of materials across membranes	identifies a factor which affects the rate of exchange of materials across membranes
explains how factors affect the rate of biochemical processes occurring in cells	describes familiar factors which affect the rate of biochemical processes occurring in cells	identifies a factor which affects the rate of biochemical processes occurring in cells
uses information, including data, explains links to concepts, and makes plausible explanations/predictions.	uses given information, including basic data, describes links to concepts, and makes simple, plausible explanations/predictions.	uses given information, identifies links to basic concepts, and makes some simple, plausible explanations/predictions.

## Criterion 7: describe and utilise ecosystem diversity and dynamics concepts

Related to the study of ecosystem diversity and dynamics, the learner:

Rating A	Rating B	Rating C
correctly uses basic terms to explain concepts	correctly uses basic terms to describe concepts	correctly uses basic terms
explains biodiversity in relation to a classification system	describes characteristics of known organisms with reference to a classification system	identifies known organisms with reference to a classification system
explains in detail how components of ecosystems function	describes components of how ecosystems function	identifies components of how ecosystems function
uses information, including data, explains links to concepts, and makes plausible explanations/predictions.	uses given information, including basic data, describes links to concepts, and makes simple, plausible explanations/predictions.	uses given information, identifies links to basic concepts, and makes some simple, plausible explanations/predictions.

## Criterion 8: describe and interpret biotechnology concepts and contexts

Related to scientific concepts and knowledge in biotechnology contexts, the learner:

Rating A	Rating B	Rating C
correctly uses basic terms to explain concepts	correctly uses basic terms to describe concepts	correctly uses basic terms
describes ways in which biological knowledge has changed over time	identifies ways in which biological knowledge has changed over time	identifies that biological knowledge has changed over time
explains scientific principles and concepts of examples of biotechnology	describes familiar scientific processes of examples of biotechnology	identifies simple examples of biotechnology
applies scientific knowledge and concepts to explain data/information, interpret problems and make plausible predictions.	applies scientific knowledge and concepts to describe given basic data/information, interpret problems and make simple, plausible predictions.	identifies scientific knowledge that relates to given basic information to identify problems and make simple, plausible predictions.

## Qualifications Available

Life Sciences Level 2 (with the award of):

EXCEPTIONAL ACHIEVEMENT

HIGH ACHIEVEMENT

COMMENDABLE ACHIEVEMENT

SATISFACTORY ACHIEVEMENT

PRELIMINARY ACHIEVEMENT

## Award Requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 8 internal ratings.

The minimum requirements for an award in Life Sciences Level 2 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)

7 'A' ratings, 1 'B' rating

HIGH ACHIEVEMENT (HA)

3 'A' ratings, 4 'B' ratings, 1 'C' rating

COMMENDABLE ACHIEVEMENT (CA)

4 'B' ratings, 3 'C' ratings

SATISFACTORY ACHIEVEMENT (SA)

6 'C' ratings

PRELIMINARY ACHIEVEMENT (PA)

4 'C' ratings

A learner who otherwise achieves the ratings for a CA (Commendable Achievement) or SA (Satisfactory Achievement) award but who fails to show any evidence of achievement in one or more criteria ('z' notation) will be issued with a PA (Preliminary Achievement) award.

## Course Evaluation

The Department of Education's Curriculum Services will develop and regularly revise the curriculum. This evaluation will be informed by the experience of the course's implementation, delivery and assessment.

In addition, stakeholders may request Curriculum Services to review a particular aspect of an accredited course.

Requests for amendments to an accredited course will be forwarded by Curriculum Services to the Office of TASC for formal consideration.

Such requests for amendment will be considered in terms of the likely improvements to the outcomes for learners, possible consequences for delivery and assessment of the course, and alignment with Australian Curriculum materials.

A course is formally analysed prior to the expiry of its accreditation as part of the process to develop specifications to guide the development of any replacement course.

## Expectations Defined By National Standards In Content Statements Developed by ACARA

The statements in this section, taken from documents endorsed by Education Ministers as the agreed and common base for course development, are to be used to define expectations for the meaning (nature, scope and level of demand) of relevant aspects of the sections in this document setting out course requirements, learning outcomes, the course content and standards in the assessment.

### Science Understanding

#### Unit 1: Biodiversity and the Interconnectedness of Life

##### *Describing Biodiversity*

- Biodiversity includes the diversity of species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons across spatial and temporal scales (ACSBL015)
- Biological classification is hierarchical and based on different levels of similarity of physical features, methods of reproduction (.....) (ACSBL016)
- Biological classification systems reflect evolutionary relatedness between groups of organisms (ACSBL017)
- Most common definitions of species rely on morphological or genetic similarity or the ability to interbreed to produce fertile offspring in natural conditions – but, in all cases, exceptions are found (ACSBL018)
- Ecosystems are diverse, composed of varied habitats and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment. (ACSBL019)
- Relationships and interactions between species in ecosystems include predation, competition, symbiosis and disease (ACSBL020)
- In addition to biotic factors, abiotic factors including climate and substrate can be used to describe and classify environments (ACSBL021)

##### *Ecosystem Dynamics*

- The biotic components of an ecosystem transfer and transform energy originating primarily from the sun to produce biomass, and interact with abiotic components to facilitate biogeochemical cycling, including carbon and nitrogen cycling; these interactions can be represented using food webs, biomass pyramids, water and nutrient cycles (ACSBL022)
- Species or populations, including those of microorganisms, fill specific ecological niches; the competitive exclusion principle postulates that no two species can occupy the same niche in the same environment for an extended period of time (ACSBL023)
- Ecosystems have carrying capacities that limit the number of organisms (within populations) they support, and can be impacted by changes to abiotic and biotic factors, including climatic events (ACSBL025)
- Ecological succession involves changes in the populations of species present in a habitat; these changes impact the abiotic and biotic interactions in the community, which in turn influence further changes in the species present and their population size (ACSBL026)
- Human activities (for example, over-exploitation, habitat destruction, monocultures, pollution) can reduce biodiversity and can impact on the magnitude, duration and speed of ecosystem change (ACSBL028)

#### Unit 2: Cells and Multicellular Organisms

##### *Cells as the Basis of Life*

- Cells require inputs of suitable forms of energy, including light energy or chemical energy in complex molecules, and matter, including gases, simple nutrients, ions, and removal of wastes, to survive (ACSBL044)
- The cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment (ACSBL045)
- Movement of materials across membranes occurs via diffusion, osmosis (.....) (ACSBL046)
- Factors that affect exchange of materials across membranes include the surface-area-to-volume ratio of the cell, (.....) and the physical and (.....) nature of the materials being exchanged (ACSBL047)
- In (eukaryotic) cells, specialised organelles facilitate biochemical processes of photosynthesis, cellular respiration, the synthesis of complex molecules (including carbohydrates, proteins, lipids (.....)), and the removal of cellular products and wastes (ACSBL049)
- Biochemical processes in the cell are controlled by (.....), the presence of specific enzymes, and environmental factors (ACSBL050)
- Enzymes have specific functions, which can be affected by factors including temperature, pH, (.....) (ACSBL051)
- Photosynthesis is a biochemical process that in plant cells occurs in the chloroplast and that uses light energy to synthesise organic compounds; (.....) (ACSBL052)
- Cellular respiration is a biochemical process that (.....) metabolises organic compounds, aerobically and anaerobically, (.....) (ACSBL053)



### *Multicellular Organisms*

- Multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems (ACSBLO54)
- The specialised structure and function of tissues, organs and systems can be related to cell differentiation and cell specialisation (ACSBLO55)
- In animals, the exchange of gases between the internal and external environments of the organism is facilitated by the structure and function of the respiratory system at cell and tissue levels (ACSBLO56)
- In animals, the exchange of nutrients and wastes between the internal and external environments of the organism is facilitated by the structure and function of the cells and tissues of the digestive system (for example, villi structure and function), and the excretory system (.....) (ACSBLO57)
- In animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure and function of the circulatory system at cell and tissue levels (for example, the structure and function of capillaries) (ACSBLO58)
- In plants, gases are exchanged via stomata and the plant surface; their movement within the plant by diffusion does not involve the plant transport system (ACSBLO59)
- In plants, transport of water and mineral nutrients from the roots occurs via xylem (.....) (ACSBLO60)

### **Unit 3: Heredity and Continuity of Life (Relates to the Human Science Theme)**

#### *DNA, Genes and the Continuity of Life*

- Continuity of life requires the replication of genetic material and its transfer to the next generation through processes including binary fission, mitosis, meiosis and fertilisation (ACSBLO75)
- DNA is a helical double-stranded molecule that occurs bound to proteins in chromosomes in the nucleus, (.....) (ACSBLO76)
- Variations in the genotype of offspring arise as a result of the processes of meiosis and fertilisation, (.....) (ACSBLO84)
- Frequencies of genotypes and phenotypes of offspring can be predicted using probability models, including Punnett squares, and by taking into consideration patterns of inheritance, including the effects of dominant, autosomal (.....) alleles (.....) (ACSBLO85)

#### *Continuity of Life on Earth*

- Life has existed on Earth for approximately 3.5 billion years and has changed and diversified over time (ACSBLO88)

### **Science Inquiry Skills (Biology Units 1 and 2)**

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes (ACSBLO01 and ACSBLO30)
- Design investigations, including the procedure/s to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics (ACSBLO02 and ACSBLO31)
- Conduct investigations (...) safely, competently and methodically for the collection of valid and reliable data (ACSBLO03 and ACSBLO32)
- Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSBLO04 and ACSBLO33)
- Interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments (ACSBLO05 and ACSBLO34)
- Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions (ACSBLO06 and ACSBLO35)
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports (ACSBLO07 and ACSBLO36)

### **Science as a Human Endeavour (Units 1 and 2)**

- Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility (ACSBLO08 and ACSBLO37)
- Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSBLO09 and ACSBLO38)
- Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSBLO10 and ACSBLO39)

- The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSBL011 and ACSBL040)
- The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSBL012 and ACSBL041)
- Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSBL013 and ACSBL042)
- Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSBL014 and ACSBL043)

### **Accreditation**

The accreditation period for this course is from 1 January 2020 to 31 December 2022.

During the accreditation period required amendments can be considered via established processes.

Should outcomes of the Years 9-12 Review process find this course unsuitable for inclusion in the Tasmanian senior secondary curriculum, its accreditation may be cancelled. Any such cancellation would not occur during an academic year.

### **Version History**

Version 1 – Accredited on 29 October 2019 for use from 1 January 2020 to 31 December 2022. This course replaces Life Sciences (LSC215115) that expired on 31 December 2019.

## Appendix 1

### GLOSSARY

#### Apply

Use, utilise or employ in a particular situation.

#### Biotechnology

The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for human purposes.

#### Communicates

Conveys knowledge and/or understandings to others.

#### Data

The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.

#### Demonstrate

Give a practical exhibition as an explanation.

#### Describe

Give an account of characteristics or features.

#### Design

Plan and evaluate the construction of a product or process.

#### Develop

In history: to construct, elaborate or expand.

In English: begin to build an opinion or idea.

#### Evaluate

Provide a detailed examination and substantiated judgement concerning the merit, significance or value of something.

#### Evidence

In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.

#### Explain

Provide additional information that demonstrates understanding of reasoning and/or application.

#### Familiar

Previously encountered in prior learning activities.

#### Genre

The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).

#### Hypothesis

A tentative explanation for an observed phenomenon, expressed as a precise and unambiguous statement that can be supported or refuted by experiment.

#### Identify

Establish or indicate who or what someone or something is.

#### Investigation

A scientific process of answering a question, exploring an idea or solving a problem that requires activities such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.

#### Mode

The various processes of communication – listening, speaking, reading/viewing and writing/creating.

**Model**

A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.

**Reasoned**

Reasoned argument/conclusion: one that is sound, well-grounded, considered and thought out.

**Representation**

A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.

**Reproduce**

Copy or make close imitation.

**Select**

Choose in preference to another or others.

**Solve**

Work out a correct solution to a problem.

**Synthesise**

Combine elements (information/ideas/components) into a coherent whole.

**System**

A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.

**Understand**

Perceive what is meant, grasp an idea, and to be thoroughly familiar with.

**Unfamiliar**

Not previously encountered in prior learning activities.

**Validity**

The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.

## Line Of Sight

Learning Outcome	Criterion	Course Content	Criterion /Elements
undertake and complete scientific activities and tasks individually and as a group, including practical tasks	1. apply skills to organise and complete activities	All	C1 - All elements
inquire into biological systems, using practical skills and techniques, safely utilising equipment, collecting data and finding trends and patterns to draw valid conclusions	2. develop, undertake, interpret and review life sciences experiments	Science Inquiry Skills applied across all other content	C2 - All elements
collect, process, organise and communicate biological data and information following accepted conventions	3. collect, process and communicate information	All	C3 - All elements
describe the application and impact of life sciences in society	4. describe the application and impact of life sciences in society	Science as a Human Endeavour applied across all other content	C4 - All elements
describe and utilise basic biological concepts, theories and models for cells, systems and organisms	5. describe and utilise concepts of cells, systems and organisms	Demonstrate knowledge and understanding of cells, systems and organisms	C5 - All elements
describe and utilise basic biological concepts, theories and models of biochemical and cellular processes that support life	6. describe and utilise concepts of the chemical and cellular processes that support life	Demonstrate knowledge and understanding of the cellular processes that support life	C6 - All elements
describe ecosystem dynamics, how basic biological systems interact and are interrelated; the flow of matter and energy through and between these systems; and processes by which they persist and change	7. describe and utilise ecosystem diversity and dynamics concepts	Demonstrate knowledge and understanding of ecosystem diversity and dynamics	C7 - All elements
utilise appropriate biological concepts and knowledge to describe and interpret biotechnical contexts	8. describe and interpret biotechnology concepts and contexts	Themes	C8 - All elements