NCCA

An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

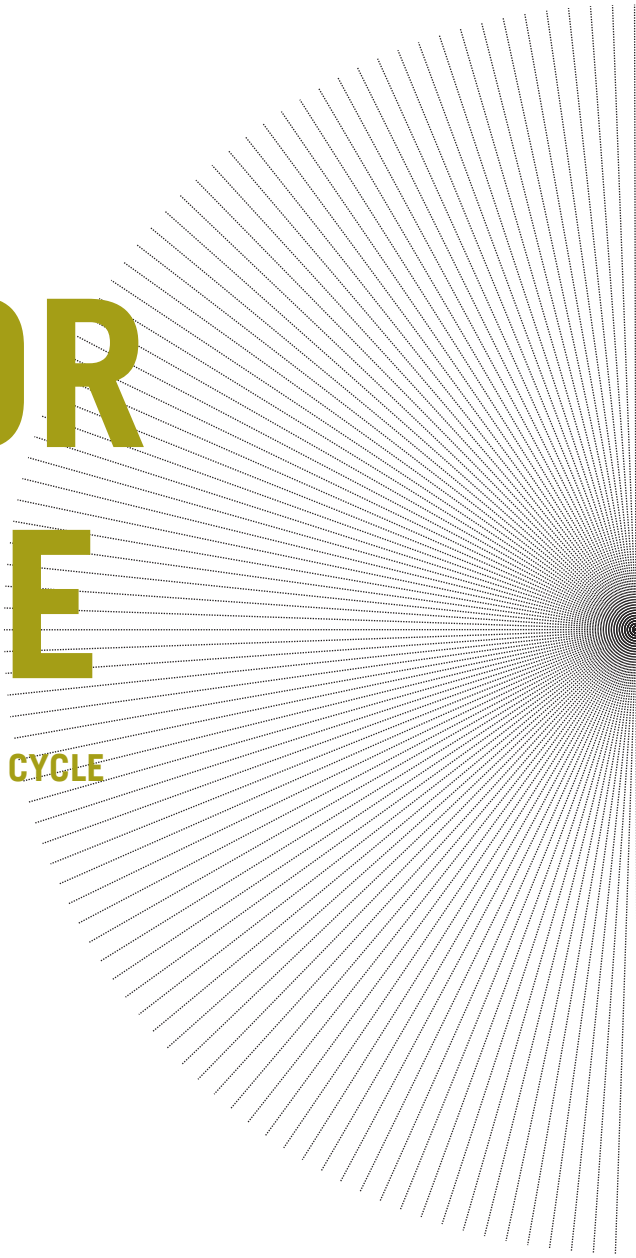
LEAVING CERTIFICATE

BIOLOGY

DRAFT SYLLABUS FOR CONSULTATION

SENIOR CYCLE

THE EXPERIENCE OF SENIOR CYCLE



Senior cycle

Introduction

Learners in senior cycle are approaching the end of their time in school and are focusing on the directions they would like to take in their future lives. Senior cycle plays a vital role in helping learners to address their current needs as young adults and in preparing them for life in a changing economic and social context.

Senior cycle is founded on a commitment to educational achievement of the highest standard for all learners, commensurate with their individual abilities. To support learners as they shape their own future there is an emphasis on the development of knowledge and deep understanding; on learners taking responsibility for their own learning; on the acquisition of key skills; and on the processes of learning. The broad curriculum, with some opportunities for specialisation, supports continuity from junior cycle and sets out to meet the needs of learners, some of whom have special educational needs, but who all share a wide range of learning interests, aptitudes and talents.

The range and scope of the curriculum components offered at senior cycle—subjects, short courses, transition units and curriculum frameworks—have been developed to allow for choice and flexibility, for a balance between knowledge and skills, and for the promotion of the kinds of learning strategies relevant to participation in and contribution to a changing world where the future is uncertain.

Assessment in senior cycle involves gathering, interpreting and using information about the processes and outcomes of learning. It takes different forms and can be used for a variety of purposes. It can be used to determine the appropriate route for learners through a differentiated curriculum, to identify specific areas of difficulty or strength for a given student and to test and certify achievement. Assessment can support and improve learning by helping learners and teachers to identify next steps in the teaching and learning process.

The experience of senior cycle

The vision of senior cycle education sees the learner at the centre of the educational experience. That experience will enable learners to be resourceful, to be confident, to participate actively in society, and to build an interest in and ability to learn throughout their future lives.

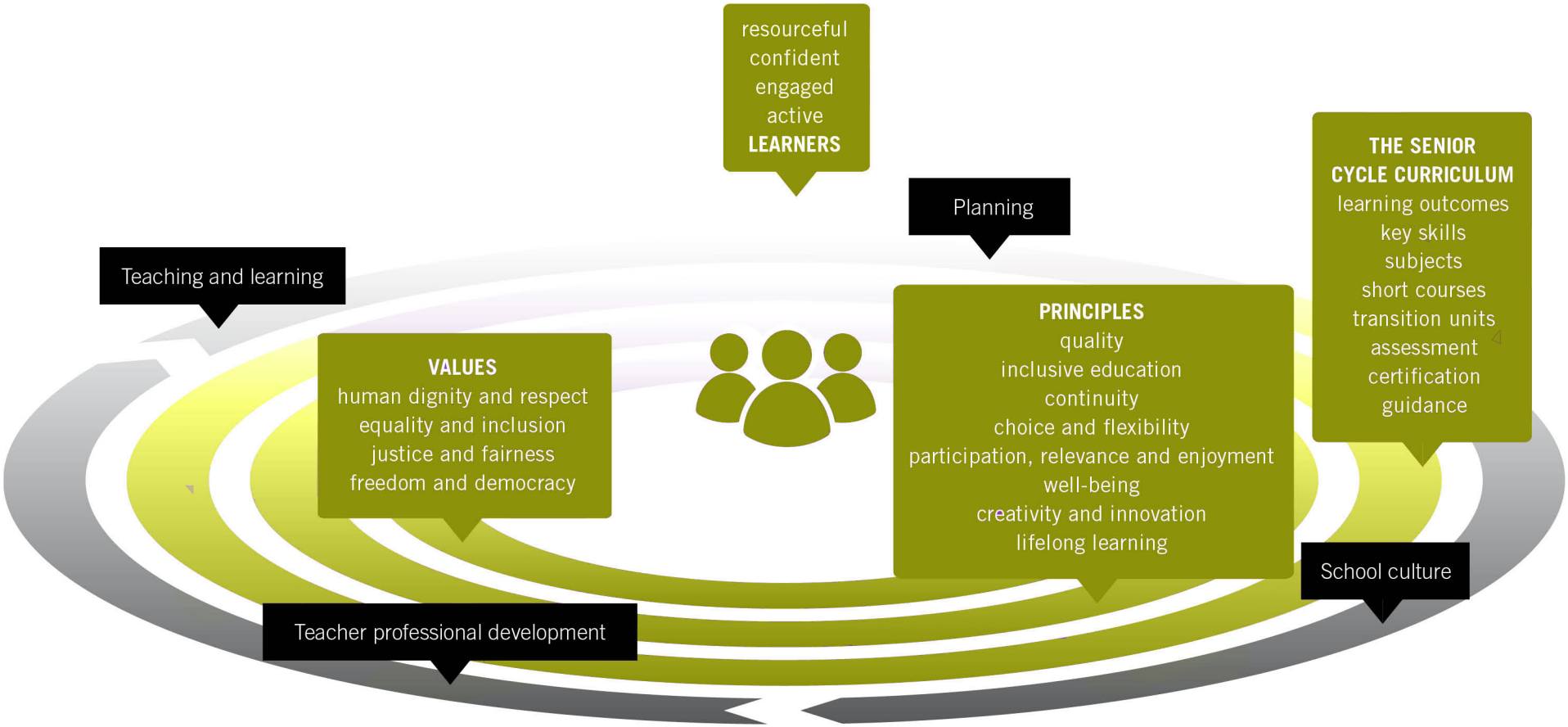
This vision of the learner is underpinned by the values on which senior cycle is based and it is realised through the principles that inform the curriculum as it is experienced by learners in schools. The curriculum, including subjects and courses, embedded key skills, clearly expressed learning outcomes, and diverse approaches to assessment is the vehicle through which the vision becomes a reality for the learner.

At a practical level, the provision of a high quality educational experience in senior cycle is supported by

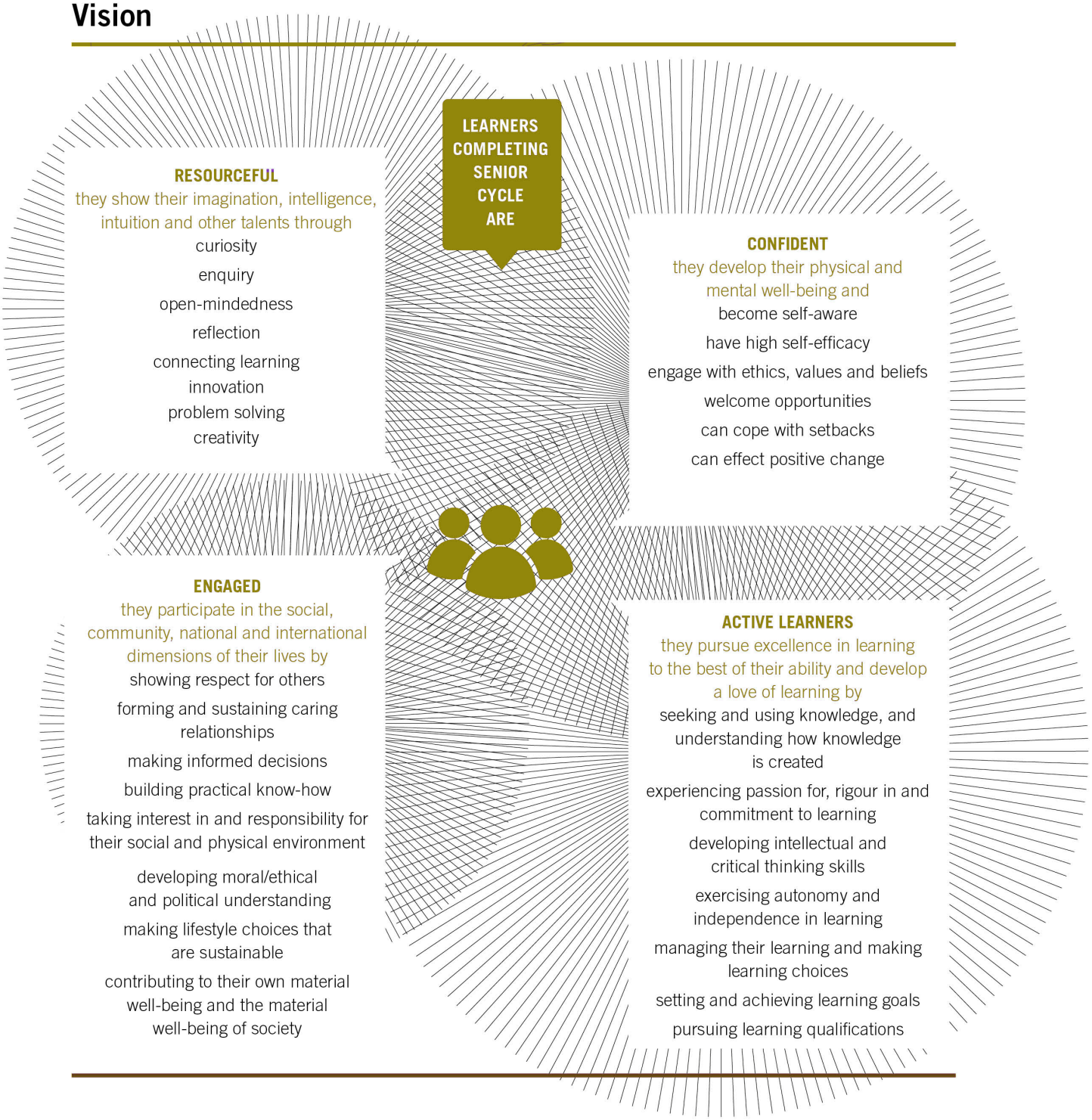
- effective curriculum planning, development and organisation
- teaching and learning approaches that motivate and interest learners, that enable them to progress, deepen and apply their learning, and that develop their capacity to reflect on their learning
- professional development for teachers and school management that enables them to lead curriculum development and change in their schools
- a school culture that respects learners, that encourages them to take responsibility for their own learning over time, and that promotes a love of learning.

Senior cycle education is situated in the context of a broader education policy that focuses on the contribution that education can make to the development of the learner as a person and as a citizen. It is an education policy that emphasises the promotion of social cohesion, the growth of society and the economy, and the principle of sustainability in all aspects of development.

Overview of senior cycle



Vision


LEARNERS COMPLETING SENIOR CYCLE ARE
RESOURCEFUL
they show their imagination, intelligence, intuition and other talents through
curiosity
enquiry
open-mindedness
reflection
connecting learning
innovation
problem solving
creativity
CONFIDENT
they develop their physical and mental well-being and
become self-aware
have high self-efficacy
engage with ethics, values and beliefs
welcome opportunities
can cope with setbacks
can effect positive change
ENGAGED
they participate in the social, community, national and international dimensions of their lives by
showing respect for others
forming and sustaining caring relationships
making informed decisions
building practical know-how
taking interest in and responsibility for their social and physical environment
developing moral/ethical and political understanding
making lifestyle choices that are sustainable
contributing to their own material well-being and the material well-being of society
ACTIVE LEARNERS
they pursue excellence in learning to the best of their ability and develop a love of learning by
seeking and using knowledge, and understanding how knowledge is created
experiencing passion for, rigour in and commitment to learning
developing intellectual and critical thinking skills
exercising autonomy and independence in learning
managing their learning and making learning choices
setting and achieving learning goals
pursuing learning qualifications

BIOLOGY

INTRODUCTION

AIM

OBJECTIVES

RELATED LEARNING

Biology

Introduction

Science education provides a means by which learners can interact with the world around them and understand how scientific concepts can be used to make sense of the physical world. As learners' scientific literacy grows they will be able to make sense of the various ways in which scientific knowledge is communicated. Science is a human construct; scientific knowledge is constructed by the sharing of ideas and by developing, refining, and rejecting or accepting these ideas. Through engagement with science, learners will acquire the knowledge skills, attitudes and values that will allow them to take informed positions on scientific issues. As well as constructing knowledge of science they will construct knowledge about science and the nature of science including its moral and ethical dimensions.

Biology is the science that investigates life, the relationships between living things and the relationships between living things and the environment. By studying biology learners develop an understanding of the cell as the unit of life. The structures and processes of the cell are shared by all living organisms, including human beings. The study of biology has an immediate relevance to our daily lives. Current areas of biological research include: sequencing the human genome, gene localisation and identity, gene therapy, genetically engineered organisms, bioengineered pharmaceuticals and the management of marine, freshwater and terrestrial environments. Learners will become aware of the possible consequences of the use of other living organisms for the benefit of humankind and the effects, both beneficial and harmful, on the environment.

The study of biology provides learners with the opportunity to gain insights into the scientific manner of investigating problems pertaining to the living world and experience the processes of science that lead to the discovery of new knowledge. Learners will learn that the value of the scientific method is limited by the extent of our own knowledge, by the basis of investigation, by our ability to interpret results, and by accidental discoveries.

The syllabus is designed for all learners; the skills developed will form part of their lifelong learning and prepare them both for the work place and for further studies in biology. Learners will develop the skills and knowledge needed to make ethically informed evaluations about contemporary biological issues which will affect their future lives as citizens. By studying biology, learners will develop an appreciation of the need for humankind to live in harmony with other organisms.

Aim

Senior cycle biology aims to give learners an appreciation of the complexity of the processes of the cell and of the organism, an appreciation of the diversity and interrelationships of all living things and their environment, whilst also developing the ability to investigate and to critically and ethically evaluate the Global and local application of scientific knowledge.

Objectives

The objectives of Leaving Certificate Biology are to

- enable learners to build on their existing knowledge and understanding of biology terminology, facts, principles and methods and to develop the skills needed to apply this knowledge and understanding to familiar and unfamiliar situations
- develop skills in scientific inquiry including the ability to interpret and analyse qualitative and quantitative data from different sources and to consider the validity and reliability of data in presenting and justifying conclusions
- develop skills in laboratory procedures and techniques, including the use of ICT, carried out with due regard for safety, together with the ability to assess the uses and limitations of these procedures through engagement in a wide variety of practical activities
- encourage learners to develop a deeper understanding of the ethical, environmental and technological aspects of biology, and how biology contributes to the social and economic development of society
- develop the ability to explain, evaluate and communicate the results of their experimental and investigative activities in verbal, graphical and mathematical form, using ICT where appropriate
- develop in learners qualities that enable them to make informed conclusions about contemporary biological and environmental issues, including those that raise ethical questions.

Related learning

Children learn, often through play, the skills of successful interaction, and to apply in rudimentary form, concepts like fairness and rights. In coming to decisions they learn to quantify and to use information

Early Childhood

Aistear, the early childhood curriculum framework, celebrates early childhood as a time of well-being and enjoyment where children learn from experiences as they unfold.
The theme of Exploring and Thinking is about children making sense of the things, places and people in their world by interacting with others, playing, investigating, questioning, and forming, testing and refining ideas.

Children use their senses, their minds and their bodies to find out about and make sense of what they see, feel and experience in the world around them. They gather information and develop new skills, including thinking skills. They form ideas and theories and test these out. They refine their ideas through exploring their environment actively and through interacting and communicating with adults and with other children. Much of this happens through play and other experiences that allow children to be creative, to take risks, and to make discoveries. As they learn, they retest their theories adjusting them to take on board new discoveries and new experiences.

Primary School

Social, environmental and scientific education (SESE) provides opportunities for the child to explore and investigate the world around them from a human, social and cultural perspective. Objects and events in science are experienced in reality before being the subject of mental manipulation.

Junior Cycle

Junior cycle science places student learning in the context of science activities, emphasising hands-on engagement through which learners develop their understanding of the scientific concepts and principles involved together with appropriate science process skills. This approach provides coherence with science in the Primary School Curriculum. There is an emphasis on an investigative approach, through which learners develop an understanding and appreciation of activities and processes that are fundamental to all science together with the ability to apply science principles to their everyday lives. Many junior cycle subjects have close links with science, particularly: geography, CSPE, PE, SPHE, home economics and religious education.

Senior Cycle Biology

Learners build on their science process skills and use them to develop deeper understanding of scientific concepts. Biology is not learned in isolation. It has significant, though varied, connections with other curriculum subjects. For example, concepts such as sustainable development are core to many subjects at senior cycle, and the knowledge and understanding gained in biology can be used in conjunction with that learned in other subjects to enrich overall learning. The biology syllabus has links with other subjects in senior cycles amongst these are agricultural science, physics, chemistry, LCVP, geography (in particular those parts of the course that deal with the environment) and home economics. Learners studying biology do not need a specific mastery of mathematics but they are expected to be able to work with data and produce graphs and interpret patterns and trends. Some simple statistics are required for ecology in particular and a simple understanding of probability is required for the understanding of genetics.

Further Study

A biology qualification can lead to many exciting and rewarding careers. Apart from pure biology, there is a diverse range of opportunities in related areas. Biology based courses include amongst others, biomedical, environmental, agricultural, food, health, sports and forensic science. Biotechnology is at the forefront of some of the most controversial advances in human knowledge.

Community and Society

Learners will develop an appreciation of the social and cultural perspectives of biology and of the impact of science and technology on people and on the environment. Biology has an immediate relevance to our daily lives. Sequencing the human genome, gene localization and identity, gene therapy, the creation and release of genetically engineered organisms, bioengineered pharmaceuticals, and ecosystem management of marine, freshwater and terrestrial environments, are all current areas of biological research. Biology also lies at the heart of major social problems that face the human race in the coming decade, such as sensible management of the environment and the effective control of human populations.

SYLLABUS OVERVIEW

STRUCTURE

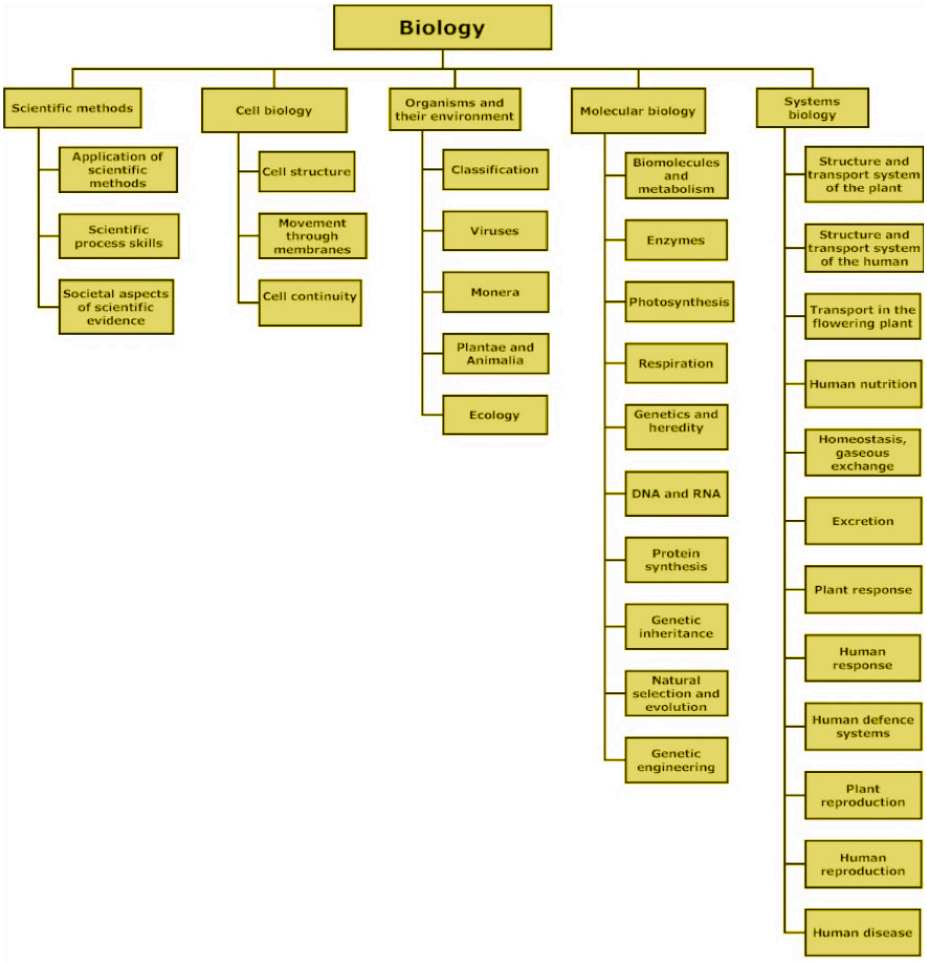
TIME ALLOCATION

KEY SKILLS

TEACHING AND LEARNING

DIFFERENTIATION

Structure

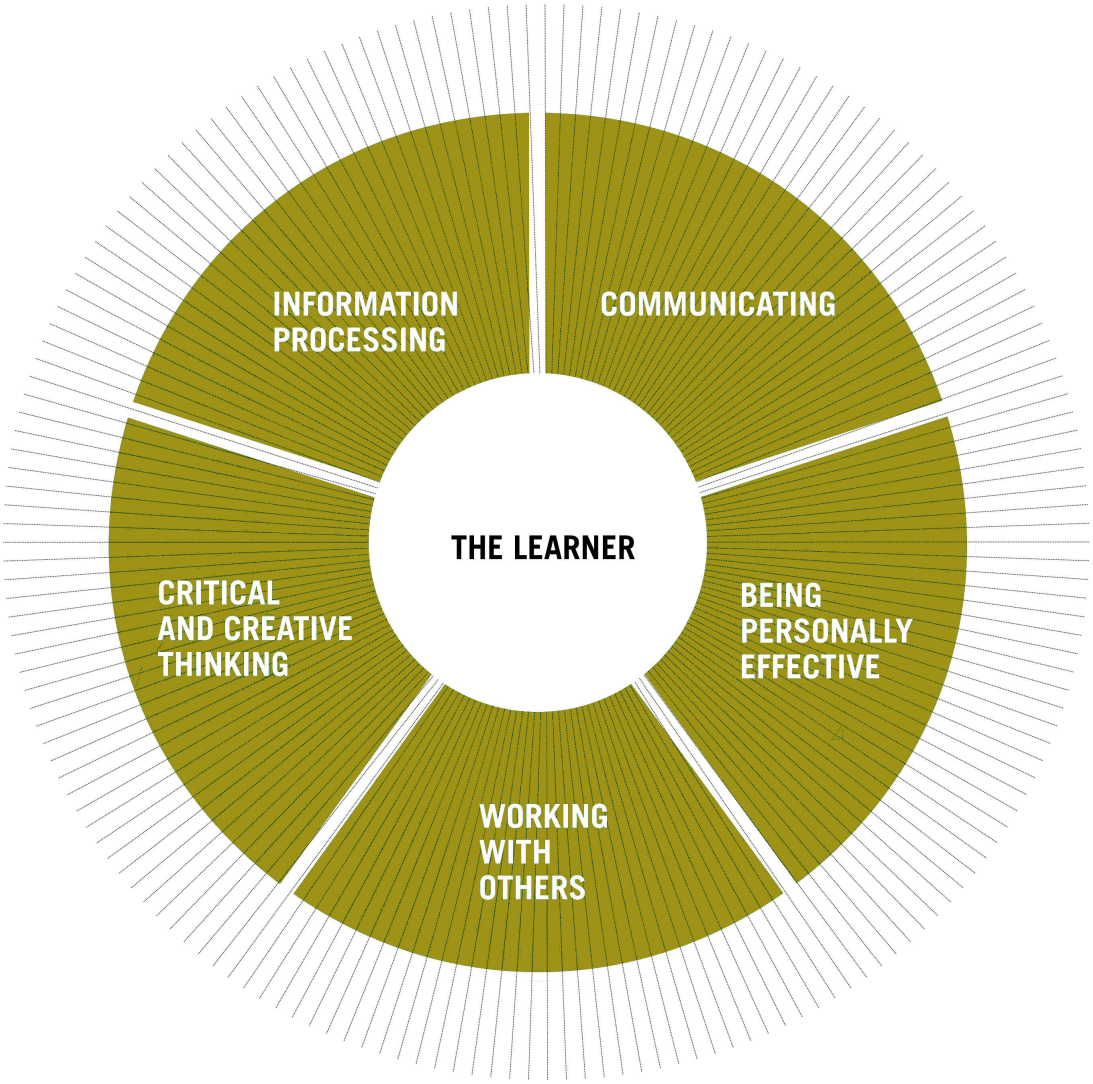


The biology syllabus focuses on the processes that occur in biological systems. Students will learn concepts and theories and conduct investigations in cell biology, environmental science, molecular biology and systems biology. Emphasis is placed on the practical application of concepts, and key skills are developed in contexts that arise naturally from the subject matter.

Time Allocation

The biology syllabus is designed for 180 hours of class contact time. It is recommended that at least one double period is allocated per week to undertake the practical activities.

Key skills



There are five skills identified as central to teaching and learning across the curriculum at senior cycle. These are information processing, being personally effective, communicating, critical and creative thinking and working with others. These key skills are important for all learners to achieve their full potential, both during their time in school and into the future and to participate fully in society, including family life, the world of work and lifelong learning. Learners develop key skills which enhance their abilities to learn, broaden the scope of their learning and increase their capacity for learning. The syllabus is designed to help learners develop skills as they build on their knowledge and understanding of biology form positive attitudes to learning and acquire good values through their learning experiences. The key skills are embedded within the learning outcomes of the syllabus and will be assessed in the context of the assessment of the learning outcomes.

Learners will engage with the fundamental principles and concepts of biology through participation in a wide range of skills-based activities. They will build on their knowledge of biology constructed initially through their exploration in science in the Primary School Curriculum and through their investigations in Junior Certificate Science. They will develop information processing and critical and creative thinking skills by examining patterns and relationships, analysing hypotheses, exploring options, solving problems and applying those solutions to new contexts. The Leaving Certificate Biology syllabus provides an opportunity for learners to work together to research, design, plan and conduct investigations and to present and communicate their findings.

In solving biological problems learners will use careful observation, thoughtful analysis and clarity of expression

to evaluate evidence, give their own interpretation of that evidence and make a clear presentation of their proposed solution. Students will learn how to research up-to-date and balanced information to develop a critical approach to accepted biological theories and in doing so come to understand the limitations of science.

A wide range of activities is appropriate for biology including, among others, experimental and investigative activities, field trips, poster presentations, research activities and debates. Participation in these activities will mirror the work of scientists and enable learners to connect their experiences with the theoretical concepts of biology.

In working with others to achieve shared goals, learners develop skills of communication as they share their ideas and present their work using a variety of media. The syllabus learning outcomes encourage learners make reasoned arguments and to express and justify their position.

Practical Activities

Included in the syllabus learning outcomes are a number of practical activities which are categorised under three headings

- **prescribed activities** develop skills in science process, laboratory techniques and safety procedures. These skills include: following experimental procedure, identifying controls and variables, collecting and recording data, observing and measuring, analysing data for patterns and meaning, and communicating conclusions
- **open-ended, investigative activities** develop skills in application of the strategies of scientific inquiry. These skills include identifying and refining good inquiry questions, developing testable hypotheses, initiating and planning, performing and recording, analysing and interpreting, problem solving and assessing results
- **research activities** develop skills in accessing information that has been gathered previously, selecting the relevant details, analysing that information for patterns and meaning, identifying bias and communicating findings or conclusions.

All forms of practical activities throughout the course develop communication skills. Although the traditional written report is one form of communication, learners will describe what they do and what they learn in other formats as well – such as poster presentations, computer presentations or video. Through various formats of co-operative learning, they will discuss, debate, and reflect on their own thinking and learning. As well as reinforcing the understanding of concepts, principles, laws, and theories the practical activities will support the development of key skills in a variety of contexts. The scientific approach, interpretation of data and use of evidence and argument in evaluating biological information are central to both the practical activities and the theoretical concepts.

Teaching and learning

Senior cycle learners are encouraged to develop the knowledge, skills, attitudes and values that will enable them to become independent learners and to develop a lifelong commitment to improving their learning.

Leaving Certificate Biology supports the use of a wide range of teaching and learning approaches. As learners progress they will develop learning strategies that are transferable across different tasks and different subjects enabling them to make connections between biology, other subjects and everyday experiences. By engaging in self-directed activities and reflection learners will assume much of the responsibility for planning, monitoring and evaluating their own learning and in so doing will develop a positive sense of their own capacity to learn. By engaging in group work learners will develop skills in reasoned argument, listen to each other, inform one another of what they are doing, and reflect on their own and the work of others.

Learners will integrate their knowledge and understanding of biology with the ethical, social, economic and environmental implications and applications of biology. Increasingly, arguments between scientists are the subject of public and media comment. By critically evaluating scientific texts and debating public statements about science, learners will engage with contemporary issues in biology that affect their everyday lives. They will learn to interrogate and interpret data—a skill that has a value far beyond biology wherever data are used as evidence to support argument. By providing an opportunity to examine and debate reports about contemporary issues in science, Leaving Certificate Biology will enable learners to develop an appreciation of the social context of science.

Information and communication technology (ICT)
Computer applications can be included in activities whenever they enhance student learning by enabling them to complete work more efficiently or to complete

work that otherwise could not be done. A wide variety of software tools should be used to collect, record, analyse and display information. Examples include reports, spread sheets, graphics, flow charts, concept maps, databases, and electronic presentations. Sensors and other appropriate hardware should be used to collect data where appropriate. The portability of sensor laboratory systems makes them useful for work outside as well as inside the classroom. Software simulations offer access to science experiments that may be difficult to illustrate in other ways. Such simulations are easy to relate to and immediately useful. Whilst simulations may substitute for experiences they should not be used to replace direct experiences that are safe, ethical, and available.

Differentiation

Differentiation occurs in three distinct areas: the learning outcomes of the syllabus, the process of teaching and learning, and assessment.

Learning outcomes

Ordinary level	Higher level
Only the learning outcomes that are presented in regular type Learners engage with a broad range of knowledge, mainly concrete in nature, but with some elements of abstraction or theory. They will be expected to demonstrate and use a moderate range of practical and cognitive skills and tools, select from a range of procedures and apply known solutions to a variety of problems in both familiar and unfamiliar contexts.	All learning outcomes including those in bold type Learners engage with a broad range of knowledge including theoretical concepts and abstract thinking with significant depth in some areas. They will be expected to demonstrate and use a broad range of specialised skills and tools to evaluate and use information, to plan and develop investigative strategies and to determine solutions to varied, unfamiliar problems. They will be expected to identify and apply skill and knowledge to a wide variety of both familiar and unfamiliar contexts.

Teaching and Learning

Learners vary in the amount and type of support they need to be successful. Levels of demand in any activity will differ as learners bring different ideas and levels of understanding to the learning activity. The use of strategies for differentiated learning such as adjusting the level of skills required, varying the amount and the nature of teacher intervention and varying the pace and sequence of learning will allow learners to interact at their own level.

Assessment

In common with other syllabuses for national certification, biology will be assessed at both Higher and Ordinary Levels. Those sections of the syllabus designated for Higher Level students only appear in **bold type**. Differentiation at the point of assessment will be reflected in the structure of the examination paper and in the style of questioning. Consideration will be given to the language level in the examination questions, the stimulus material provided, the structure of the questions and the amount of scaffolding provided for examination candidates, especially at Ordinary Level.

UNITS OF STUDY

UNIT 1: SCIENTIFIC METHODS

UNIT 2: CELL BIOLOGY

UNIT 3: ORGANISMS AND THEIR ECOLOGY

UNIT 4: MOECULAR BIOLOGY

UNIT 5: SYSTEMS BIOLOGY

Units of Study

Unit 1: Scientific methods

In addition to the ability to understand and apply the concepts, laws and theories of science, as specified throughout the syllabus, learners should also be able to understand and apply scientific methods in a variety of contexts. They should be competent in understanding the body of knowledge relating to the pursuit of suitable evidence that underpins scientific practice. Understanding methods of collection, analysis and interpretation of data and being able evaluate scientific evidence will enable learners to question and engage in debate on the evidence used to defend a scientific claim. This section contains learning outcomes that learners need to achieve so that the syllabus objectives are fully met.

Students learn about	Students should be able to
1.1 Application of scienific method	• apply their knowledge and understanding of science to develop arguments or draw conclusions related to both familiar and unfamiliar situations • use secondary data sources; locate and comprehend relevant information from books, scientific publications, internet, databases and other resources • make judgements and draw informed conclusions pertaining to the reliability and validity of data
1.2 Scientific process skills	• design, manage and carry out experimental and non-experimental investigations; select appropriate measuring devices; use scales and units accurately, being aware of limitations and errors • describe relationships (qualitatively and/or quantitatively) between sets of data; recognising the difference between causation and correlation • consider the validity and reliability of data in presenting and justifying conclusions
1.3 Societal aspects of scientific evidence	• make judgments and draw informed conclusions pertaining to the reliability and validity of data • critically examine the scientific process that was used to present a scientific claim • appreciate the limitations of scientific evidence

Unit 2: Cell biology

In this unit students will learn about the basic structure of all living things, cells and how these cells ensure their continuation from one generation to the next.

Students learn about	Students should be able to
2.1 Cell structure The Cell	• list the functions of the following organelles and structures and identify them from electron micrographs; cell wall, cytoplasm, cell membrane, mitochondrion, chloroplast, nucleus, nuclear pore, ribosome, and chromosome • **differentiate between the ultra-structures of prokaryotic and eukaryotic cells** • describe the complexity of multicellular organisms • use a light microscope to view cells in the preparation of a labelled diagram of cell structure; use appropriate stains
2.2 Movement through cell membranes	• describe the role of osmosis in food preservation • perform a quantitative investigation relating to osmosis
2.3 Cell continuity	• describe simply the process and functions of mitosis with the aid of labelled diagrams • compare the functions of mitosis and meiosis • explain the role of DNA replication and mitosis in the cell cycle • explain the term cancer • outline some of the factors considered important in the development of cancer

Unit 3: Organisms and their ecology

In this unit students learn about the way in which biologists classify all living things. Learners will examine the relationships between all organisms and the environment in which they exist. They will identify these relationships in a field study of a chosen ecosystem and apply their understanding of this ecosystem to other diverse ecosystems.

Students learn about	Students should be able to
3.1 Classification	• state the five-kingdom system of classification and give an example of each
3.2 Viruses	• discuss the difficulty of defining viruses • describe the structure of viruses • describe viral replication • evaluate the economic and medical importance of viruses
3.3 Monera	• describe bacterial cell structure, reproduction and nutrition • outline how temperature, pH, nutrient availability, water and oxygen availability affect bacterial growth • describe the industrial and medical importance of bacteria using two examples from each
3.4 Plantae and Animalia (refer to the sub-units in unit 4)	

3.5 Ecology	• explain the relationship between the biosphere, ecosystems and habitats • conduct a habitat study using appropriate resources (equipment, sensors, keys) to: identify five species of flora and fauna, investigate any three abiotic factors and conduct a quantitative study of any one species, identifying any sources of error. present quantitative results of the chosen species graphically; use the evidence collected to discuss the relevance of the results and relate them to biotic and abiotic factors • discuss how edaphic factors affect the distribution of organisms • construct a grazing food chain, a food web and a pyramid of numbers • describe how the adaptations of an organism enables it to exploit a niche in the ecosystem • describe the role of organisms in nutrient recycling • **interpret pyramids of biomass** • describe how the carbon cycle impacts on atmospheric levels of carbon dioxide • discuss the strategies that can be used to reduce atmospheric levels of carbon dioxide (including the use of biofuels and reforestation) • **discuss the main factors that affect population size** • **explain the feeding and symbiotic relationships that occur between organisms** • **evaluate the factors that affect human population** • describe how bioremediation can be used to repair a contaminated environment • use ICT to gather, process and analyse information on the ways in which humans impact on the environment and suggest how this can be minimised • give a general overview of the diversity of life forms and number of habitats from a selected ecosystem • distinguish between qualitative and quantitative studies of a selected ecosystem • describe two trophic interactions found between two organisms in the ecosystem studied • investigate the relationship between any two parameters for a species, quantify, graphically analyse and present the results to determine if a correlation exists. e.g. age / weight or length / weight relationships etc

Unit 4: Molecular biology

In this unit students will learn about the molecules and processes which are the basis of life. In particular learners will study the science of heredity and the theory of evolution.

Students learn about	Students should be able to
4.1 Cell structure The Cell	• outline the source and the structural and metabolic roles of lipid, protein and carbohydrate • describe the role and evaluate the effects of a deficiency in any one vitamin or mineral on health • illustrate some of the main functions of water in living organisms • distinguish between anabolic and catabolic cellular metabolism • **describe, in simple terms, the structure and role of ATP** • determine quantitatively the level of any one constituent in a range of food samples
4.2 Enzymes	• describe the nature, folded shape and function of enzymes • **explain the mechanism of action and specificity of enzymes** • discuss the use of immobilised enzymes in bioreactors • prepare one enzyme or cell immobilisation in order to demonstrate an application
4.3 Photosynthesis *(chemical equation and explanation)* ***(light energy is absorbed by chlorophyll to produce ATP, split water producing H+ and O2. ATP is used to add H+ to CO2 to produce glucose)***	• outline, in simple terms, the process of photosynthesis • **describe, in a simplified form, the light-dependent and the light independent stages of photosynthesis** • relate the leaf structure to its role in photosynthesis • illustrate the role manipulation of photosynthesis can play in horticulture
4.4 Respiration ***(1st stage: the breakdown of glucose to a 3C molecule (pyruvic acid) releasing ATP 2nd stage the 3C molecule is broken down to release ATP, CO2 and H2 3rd stage uses O2 and H to produce ATP and H2O)***	• outline, in simple terms, the processes of anaerobic and aerobic respiration • **describe the three stages in the process of aerobic respiration and describe their cellular location** • illustrate the role of micro-organisms in industrial fermentation • demonstrate fermentation • collect primary data using data logging sensors to investigate the effect of any one factor on plant metabolism

4.5 Genetics and heredity	• explain the terms species, heredity, gene expression, gene and chromosome • explain the structure of a chromosome and the role of the gene • describe the concept of DNA sequencing • explain the term bioinformatics • debate the principal outcomes and some of the applications of some genome projects and the legal, social, and ethical issues that arise from them
4.6 DNA and RNA structure *DNA is a double helix containing 4 bases with a complementary strand RNA is a single strand with 4 bases) replication (The 'unzipping' of DNA and the manufacture of 2 new complementary strands) , DNA profiles*	• relate the structure of RNA and DNA to their function • describe, in simple terms, the replication of DNA • describe in simple terms the production of DNA profiles and their possible use
4.7 Protein synthesis *protein synthesis,* ***(DNA is transcribed into mRNA which travels to the ribosome where mRNA attaches to particular amino acid in sequence these fold to produce proteins)***	• relate genes, proteins, enzymes and traits in organisms • outline, in simple terms protein synthesis • **describe, in simple terms, the role of DNA, RNA and ribosomes in protein synthesis**
4.8 Genetic inheritance	• explain how gametes are specialised for their functions, using the terms haploid and diploid • illustrate the inheritance to the first generation of a single unlinked trait in a cross involving homozygous parents of different phenotypes and heterozygous parents • **illustrate Mendel's first law** • **illustrate Mendel's Second Law using the Punnett square technique** • **explain how linkage affects Mendel's Second Law (knowledge of crossing over is not required)** • describe sex determination by X and Y chromosomes in humans • state two sex linked traits

4.9 Natural selection and evolution	• discuss the variations that come from sexual reproduction and mutations • illustrate how natural selection gives rise to evolution • explain how an 'evolutionary race' exists between pathogens and drug developers
4.10 Genetic engineering	• describe in simple terms what is meant by genetic engineering • outline the procedures used to produce recombinant DNA • describe some current applications of gene therapy for an identified disease • debate some of the ethical issues relating to stem cell technology and its therapeutic use • on the basis of information gathered from secondary sources, develop, present, and defend a position or course of action related to the use of genetically modified organisms • isolate DNA from plant tissue • use electrophoresis to produce a DNA profile • use a database to find organisms whose genomes contain an identified amino acid sequence and investigate the evolutionary relationship of two species using alignments of amino acid sequences

Unit 5: Systems biology

In this unit learners will study some of the different systems that are adapted to carry out the various functions necessary for life in flowering plants and in humans.

Students learn about	Students should be able to
5.1 Structure and transport system of the plant	• dissect and display the various parts of a flower • identify the location of the meristem, dermal, ground and vascular tissue in the root and shoot • relate structure to function in the root, stem, leaf and flower of the flowering plant • relate structure to function in the xylem and phloem
5.2 Structure and transport system of the human	• describe the composition and function of the blood • differentiate, between arteries, veins and capillaries based on their macrostructures and role in the circulatory system of humans • draw a labelled diagram of the internal structure of the heart in LS showing the associated blood vessels • dissect and display a heart • explain in simple terms: heartbeat and its control by the pacemaker, pulse, blood pressure and the cardiac blood supply • **relate the structure and operation of the human heart, including the cardiac cycle, to its function** • describe the use of a defibrillator in the restoration of normal heartbeat • explain what is meant by blood grouping; refer to the two main grouping systems, ABO and Rhesus factor • relate the structure to the function of the lymphatic system • describe the relationship between blood, tissue fluid lymph and plasma • discus the symptoms and risk factors of cardiovascular disease • collect data using sensors to relate exercise level to breathing rate or pulse rate in a human
5.3 Transport in the flowering plants	• describe the uptake and transport of water, minerals and carbon dioxide • **describe the transport of growth regulators and the products of photosynthesis through the plant**
5.4 Human Nutrition	• describe the macrostructure and function of the digestive system and its associated organs and glands • describe the processes that occur in the digestion of fats, carbohydrates and protein (bile and one enzyme) • describe the role of dietary fibre; outline its importance • outline the absorption transport and storage of the products of digestion

5.5 Homeostasis, gaseous exchange	• explain the necessity for homeostasis in living organisms • relate the structure of the leaf and lenticels to gaseous exchange • relate the anatomy and physiology of the lungs to their role in gaseous exchange • **outline the role of carbon dioxide concentration as a controlling factor to stomatal opening and to the human breathing system**
5.6 Excretion ***filtration of the blood, reabsorption of useful materials and the control of water and salt levels in the blood, role of ADH***	• describe the macrostructure of the urinary excretory system in humans • **give a brief description of the basic function and location of filtration, reabsorption and production of urine in the urinary system**
5.7 Plant response	• outline the role of tropisms in plant growth • give one example of the commercial use of growth regulators
5.8 Human response	• describe the structure and function of the parts of the CNS and the PNS • **describe the structure of a neuron and the mechanisms of message transfer in simple terms** • describe the role and mechanisms of a reflex action • describe the location and a role for each of the main endocrine glands • relate the use of a performance enhancing agent to their action in the body • compare nervous and hormonal coordination
5.9 Human defence systems	• illustrate how humans develop immunity • **distinguish between the roles of the B cells and T cells in the body's immune response** • relate the variability of antigens on pathogens to the limitations of vaccinations
5.10 Plant reproduction	• illustrate vegetative reproduction, both natural and artificial, in flowering plants • describe an example of how vegetative reproduction can be used commercially • outline the function of a pollen grain and of the embryosac • outline the methods of pollination • describe fertilisation as the fusion of the male and female gamete • relate the general structure and function of the parts of the flower • describe the structure and function of the parts of the seed • relate fruits to their role in the dispersal and survival of the plant • relate dormancy to agricultural and horticultural practices • compare reproduction by seed and by vegetative propagation

5.11 Human reproduction	• relate the general structure and functions of the male and female reproductive system • describe the role of hormones in the production of secondary sexual characteristics • outline the events of the menstrual cycle including the basic role of hormones • **describe in detail the menstrual cycle when fertilisation does not occur, including hormonal control** • evaluate four methods of birth control • evaluate the benefits and the problems that may arise from the use of hormones to control fertility • discuss a possible cause, prevention and treatment for male and female infertility • **describe in simple terms fertilization, implantation, placenta formation and placenta functions** • describe in simple terms the development of a fertilised egg to a blastocyst, to an embryo and to a foetus • describe in-vitro fertilisation and subsequent implantation • describe the stages of labour • discuss the biological benefits of breastfeeding
5.12 Human disease	• analyse quantitative data on illness and mortality rates to determine health risks and recognise that it is important to distinguish between correlation and causation • gather, process and analyse secondary information and produce a presentation showing one cause, symptom, prevention and treatment of a human disease/disorder

ASSESSMENT

ASSESSMENT IN LEAVING CERTIFICATE BIOLOGY

ASSESSMENT COMPONENTS

GENERAL ASSESSMENT CRITERIA

REASONABLE ACCOMODATIONS

Assessment in Leaving Certificate Biology

Assessment for certification in biology is based on the aim, objectives and learning outcomes outlined in the syllabus. Biology will be examined at two levels: Ordinary Level and Higher Level. There are two assessment components:

- Written examination 80%
- Second component assessment 20%

Both components of assessment will reflect the relationship between practical work and the theoretical content of the syllabus.

Assessment components

Written examination

The written examination will examine the following Assessment of the report will be based on the following:

- knowledge and understanding—application of biology principles and concepts
- problem solving based on integration, analysis and evaluation of qualitative and quantitative information and data
- capacity to form reasonable and logical argument based on evidence—clarity and coherence in argument, management of ideas.

–The percentage of total marks allocated to this component is 80%

General assessment criteria for the written examination

A high level of achievement in this component is characterised by a thorough knowledge and understanding of biology facts, principles, concepts and methods from the whole syllabus and with few significant omissions. Candidates consistently apply their knowledge and understanding of biology to problem solving in both familiar and new contexts. They accurately analyse and evaluate qualitative and quantitative data from different sources; manipulation of data will be almost flawless. Candidates present logical arguments and ideas which are clearly based on evidence.

A moderate level of achievement in this component is characterised by a good knowledge and understanding of biology facts, principles, concepts and methods from many parts of the syllabus. Candidates apply their knowledge and understanding of biology to problem solving in familiar contexts and in some new contexts using appropriate scientific terminology. They carry out adequate levels of analysis and evaluation on qualitative and quantitative data from different sources; much of their manipulation of data will be correct. Candidates present arguments and ideas which, in the main, are based on evidence.

A low level of achievement in this component is characterised by a limited knowledge and understanding of biology facts, principles, concepts and methods. Candidates select appropriate facts and principles to solve problems concerning familiar material using a limited range of scientific terminology. They carry out basic manipulation of data using straightforward mathematics. Candidates present some explanations based on evidence from familiar contexts, though they may include irrelevant material.

Second component assessment

The second component assessment will assess students' abilities to conduct first- hand investigations and communicate information and understandings based on these investigations. The second component of assessment is made up of two parts.

	Description	Marks
Laboratory notebook	reports on mandatory activities authenticated by teacher	5%
Practical examination	short tasks; learners record data, observations and analysis on a task sheet which is marked externally	15%

The percentage of total marks allocated to the second component assessment is 20%

Laboratory notebook

Students must complete the practical activities specified in the syllabus. Over the two years of the course each student is required to maintain a laboratory notebook, in which a record of these activities is kept. This record must be available for inspection. As part of the assessment, marks will be awarded on a pro rata basis for the satisfactory completion of the specified practical activities.

Practical examination

The practical examination is a laboratory based practical assessment focussing on the following experimental skills

- capacity to apply principles and skills of experimental investigation
- ability to critically analyse results making links to theoretical concepts
- management and control of data collection

- mechanical accuracy of scientific process skills—observation, measurement, graphical analysis.

Students will complete a series of 3 or 4 short set tasks over a period of 90 minutes. The knowledge and theory of experimental skills are drawn from within the syllabus; the contexts for the setting of tasks are not bound by the syllabus content. Within unfamiliar contexts, students are told exactly what to do and how to do it. Students are required to follow instructions to collect data and make observations. They then use these data and observations to analyse, evaluate and make deductions. Students record their data, observations and deductions on a task sheet which is marked externally.

General assessment criteria for the second component

A high level of achievement in this component is characterised by demonstration of a comprehensive range of manipulative techniques in experimental activities. Candidates make and record observations and measurements with a high level of accuracy and precision. In almost all cases candidates recognise and describe trends and patterns in data and use biology knowledge and understanding to account for inconsistencies and anomalies. Candidates accurately interpret and analyse experimentally derived data; manipulation of the data is almost flawless. In all cases, candidates link theoretical concepts to interpretation of experimental evidence. Candidates complete all of the prescribed practical activities carried out over the two years.

A moderate level of achievement in this component is characterised by demonstration of a good range of manipulative techniques in experimental activities. Candidates make and record observations and measurements with some accuracy and precision. In most cases candidates recognise and describe trends and patterns in data and in the main use biology knowledge and understanding to account for inconsistencies and anomalies. Candidates' interpretation and analysis of experimentally derived data is generally accurate; much of their manipulation of the data is correct. In some cases, candidates link theoretical concepts to interpretation of experimental evidence.
Candidates complete most of the prescribed practical activities carried out over the two years.

A low level of achievement in this component is characterised by demonstration of a limited range of manipulative techniques in experimental activities. There may be evidence of inaccuracy in measurement and recording of observations. Candidates fail to recognise and generally do not account for inconsistencies and anomalies. They show limited ability to interpret and analyse experimentally derived data; there may be significant levels of error in the manipulation of data Candidates do not link theoretical concepts to interpretation of experimental evidence. Candidates complete few or none of the prescribed practical activities carried out over the two years.

Reasonable accomodations

The scheme of Reasonable Accommodations is designed to assist candidates with special needs at the Certificate examinations. The term special needs applies to candidates who have physical/medical and/or specific learning difficulties.
Reasonable accommodations are designed to remove as far as possible the impact of a disability on a candidate's performance, so as he or she can demonstrate in an examination his or her level of achievement—they are not designed to compensate for a possible lack of achievement arising from a disability.

Applications for reasonable accommodations are considered within a published framework of principles (Expert Advisory Group Report, January 2000) and are submitted by the school which a candidate attends on prescribed application forms. Applications are normally invited one year in advance of the examination concerned.

NCCA

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