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| **EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME [EQAP]**C:\Users\geetanjalil\AppData\Local\Microsoft\Windows\INetCache\Content.Outlook\29KEG5D7\SPC-CPS-logo_colors-format-png (003).png**SOUTH PACIFIC FORM SEVEN** **CERTIFICATE [SPFSC]**  **BIOLOGY** **SYLLABUS**   |

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**SOUTH PACIFIC FORM SEVEN CERTIFICATE**

**BIOLOGY**

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**BIOLOGY**

# Preamble and Rationale

This syllabus defines the requirements for the South Pacific Form Seven Certificate Biology course.

Each Major Learning Outcome for the course is to be read in conjunction with the Indicator Notes given for each outcome and the learning outcomes that follow. Students also require knowledge and understanding of outcomes from the national Year 12 or Form 6 qualification or its equivalent, which are related to the specific outcomes of SPFSC Biology.

This syllabus derives from a revision of the Educational Quality and Assessment Programme (EQAP) 2019 syllabus and the New Zealand National Certificate of Educational Achievement (NCEA) Level 3 Biology Achievement Standards as published by the New Zealand Qualifications Authority (NZQA). The SPFSC Biology course is designed for students who wish to undertake university studies in Biology and other related fields.

# Aim

Students are expected to develop an understanding of:

* the interactions of organisms with their biotic and abiotic environment
* the process of evolution in producing the diversity of life forms
* the ways in which genes interact to determine the phenotype
* the impacts of climate change and global warming in our lives and ways to address them
* modern biotechnology and its role in our lives as well as issues that they pose
* practical biological investigations
* researching and processing information
* scientific thinking, investigating and reporting

Students are also expected to develop the attitude and values of problem solving, critical thinking, collaboration, tolerance, self-sufficiency and good judgement.

# Prerequisites

Students are expected to have completed the national Year 12 or Form 6 Biology course or its equivalent.

# General Objectives

Students will be expected to demonstrate an understanding of:

* aspects of animal behaviour
* process and patterns of evolution
* concepts and processes relating to gene expression
* applications in modern biotechnology
* aspects of environmental issues and ways to address them
* planning, carrying out and reporting on practical biological investigations
* researching and processing data to write a scientific report on a biological issue

# Content Components

The content of the SPFSC Biology course is organised under four strands and a number of sub-strands under each strand. These are outlined below:

|  |  |  |  |
| --- | --- | --- | --- |
| **Strand Number** | **Strand Title** | **Sub strand number** | **Sub-strand title** |
|  | Animal behaviour | 1.1 | Ecological Niche |
| 1.2 | Orientation and Navigation |
| 1.3 | Timing responses |
| 1.4 | Interspecific interactions |
| 1.5 | Intraspecific interactions |
|  | Gene Expression | 2.1 | DNA structure and replication |
| 2.2 | Protein structure, function, and synthesis |
| 2.3 | Mutations |
| 2.4 | Metabolic pathways, Genetic Linkages and Sex linkages |
| 2.5 | Gene-gene interactions and Mendelian inheritance |
|  | Biotechnology Applications | 3.1 | Gene cloning, Transgenesis and DNA profiling |
| 3.2 | Contemporary biotechnology issue |
|  | Processes and Patterns of Evolution | 4.1 | Variation |
| 4.2 | Natural selection |
| 4.3 | Gene pool and allele frequency |
| 4.4 | Speciation |
| 4.5 | Patterns of evolution |
|  | Environmental Issues | 5.1 | Climate Change |
| 5.2 | Conservation |

# Unpacking of Learning Outcomes

In this syllabus, Learning Outcomes are stated at three levels of generality: Major Learning Outcomes (MLOs) are stated at the strand level, Key Learning Outcomes (KLOs) are stated at the sub-strand level, and Specific Learning Outcomes (SLOs) are unpacked from the Key Learning Outcomes. Each SLO is a combination of a cognitive skill and a specific content component. Each SLO is given a skill level, level 1– 4, and this skill level results from the categorisation of the cognitive skill that is embedded in the SLO using the SOLO taxonomy[[1]](#footnote-1).

The SOLO taxonomy provides a simple, reliable and robust model for three levels of understanding – surface, deep and conceptual (Biggs and Collis, 1982).



**L1**

**L0**

**L2**

**L4**

**L3**

At the **prestructural** level (L0) of understanding, the task is inappropriately attacked, and the student has missed the point or needs help to start. The next two levels, unistructural and multistructural are associated with bringing in information (surface understanding). At the **unistructural** level (L1), one aspect of the task is picked up, and student understanding is disconnected and limited. The jump to the multistructural level is quantitative.

At the **multistuctural** level (L2), several aspects of the task are known but their relationships to each other and the whole are missed. The progression to relational and extended abstract outcomes is qualitative. At the **relational** level (L3), the aspects are linked and integrated, and contribute to a deeper and more coherent understanding of the whole. At the **extended abstract** level (L4), the new understanding at the relational level is re-thought at another conceptual level, looked at in a new way, and used as the basis for prediction, generalisation, reflection, or creation of new understanding (adapted from Hook and Mills 2011). [http://pamhook.com/solo-taxonomy/.. ]

The progression from Level 1 to Level 4 is exemplified in the progression from *define* 🡪*describe 🡪* *explain* 🡪 *discuss* with each succeeding level indicating a *higher level of understanding,* as follows:

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|  | * **define** – to state a basic definition of a concept [Unistructural or L1]
* **describe** – to give the characteristics of, or give an account of, or provide annotated diagrams. [Multistructural or L2]
 |
|   | * **explain** – to provide a reason for a relationship – an event and its impact, a cause and an effect, as to *how* or *why* something occurs. [Relational or L3]
 |
|  | * **discuss** – this means *linking biological ideas* (descriptions, explanations) to make generalisations or predictions or evaluations. It may involve relating, comparing, analysing, and justifying. [Extended Abstract or L4]
 |

# Learning Outcomes

## **Strand 1: Animal Behaviour**

**Major Learning Outcome**

Students are able to demonstrate an understanding of **biological concepts and processes** relating animal behaviour to biotic and abiotic environmental factors and how the behaviour **contributes to the organism’s survival.**

### Sub-strand 1.1 Ecological Niche

**Key Learning Outcome:** Students are able to demonstrate an understanding of the ecological niche of an animal species and to investigate and report an aspect of the animal species’ ecological niche.

**Notes:**

* ecological niche is defined as the role of an organism in a community in terms of the habitat it occupies, its interactions with other organisms, and its effect on the environment.
* adaptive features refer to structural, behavioural, and physiological features that help a species adapt in its niche.
* environment refers to biotic and abiotic factors.
* an investigation is an activity which includes: a statement of the purpose (hypothesis); testable question or prediction; collecting, recording, and processing data relevant to the hypothesis; and interpreting and reporting the findings in a scientific report.

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| **SLO#** | **Specific Learning Outcomes:** Students are able to | **Skill Level** | **SLO code** |
| 1 | Define the term ‘ecological niche’ | 1 | Bio1.1.1.1 |
| 2 | State a title for an investigation into an ecological niche of a named animal species | 1 | Bio1.1.1.2 |
| 3 | State an aim for an investigation into an ecological niche of a named animal species | 1 | Bio1.1.1.3 |
| 4 | State a hypothesis for an investigation into an ecological niche of a named animal species | 1 | Bio1.1.1.4 |
| 5 | Provide an independent variable with a minimum of 3 values given (fair test) or repeat samples were taken (pattern-seeking)  | 1 | Bio1.1.1.5 |
| 6 | Structure (organise) the scientific report correctly (appropriate order) for the aspect being investigated  | 1 | Bio1.1.1.6 |
| 7 | Describe the physical habitat in relation to an animal species’ ecological niche  | 2 | Bio1.1.2.1 |
| 8 | Describe the environment in terms of abiotic and biotic factors for a niche | 2 | Bio1.1.2.2 |
| 9 | Describe the adaptive features of an animal species in relation to the animal species’ habitat and/or niche | 2 | Bio1.1.2.3 |
| 10 | Describe the ecological niche of a named animal accurately and relate it to the aspect being investigated | 2 | Bio1.1.2.4 |
| 11 | List step by step the procedure (method) of the investigation  | 2 | Bio1.1.2.5 |
| 12 | Collect and record raw data relating to the aspect being investigated in a logbook | 2 | Bio1.1.2.6 |
| 13 | Measure or calculate the average (mean) value of the dependent variable and give unit(s)  | 3 | Bio1.1.3.1 |
| 14 | Tabulate and graph results (processed data i.e. average only)  | 3 | Bio1.1.3.2 |
| 15 | Explain the findings of the investigation  | 3 | Bio1.1.3.3 |
| 16 | Discuss the results of the investigation in relation to the ecological niche and the biology of the species and how these can be used to make predictions for other communities | 4 | Bio1.1.4.1 |
| 17 | Explain how problems with the validity of the method were overcome and how the reliability of the data collected is maintained using an appropriate statistical procedure | 3 | Bio1.1.3.4 |
| 18 | Explains reliability or validity of the research data using an appropriate statistical procedure | 3 | Bio1.1.3.5 |
| 19 | Discuss the biological significance of results and how they relate to the ecological niche of the species under study | 4 | Bio1.1.4.2 |
| 20 | Draw valid conclusions supported by the processed data (results) | 2 | Bio1.1.2.7 |
| 21 | Make recommendations on ways to improve the research process | 3 | Bio1.1.3.6 |

### Sub-strand 1.2 Orientation and Navigation

**Key Learning Outcome:** Students are able to demonstrate an understanding of animal orientation and navigation processes and how these influence movement and survival.

* innate and learned behaviour
* taxes (hydro, geo, chemo, photo, thigmo)
* kineses (ortho, klino)
* navigation using solar/sun compass, stellar / star patterns, magnetic field lines, chemical trails/scent, landmarks
* homing (the regular return of an animal to a nest site)
* migration (long-distance return migration between breeding and feeding/overwintering grounds)

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to* | **Skill level** | **SLO code** |
| 1 | Define innate / learned behaviour | 1 | Bio1.2.1.1 |
| 2 | Identify innate or learned behaviour in a given context | 1 | Bio1.2.1.2 |
| 3 | Distinguish between innate and learned behaviour  | 3 | Bio1.2.3.1 |
| 4 | Discuss the consequences of innate and learned behaviour  | 4 | Bio1.2.4.1 |
| 5 | Describe a method used for navigation (solar/sun compass, stellar/star patterns, magnetic field lines, chemical trails/scent, landmarks, ocean currents, communication and signalling among individuals) | 2 | Bio1.2.2.1 |
| 6 | Explain how navigation using solar/sun compass, stellar/star patterns, magnetic field lines, chemical trails/scent, landmarks contribute to migration and survival of a named animal | 3 | Bio1.2.3.2 |
| 7 | Discuss the effectiveness of navigation using solar/sun compass, stellar/star patterns, magnetic field lines, chemical trails/scent, landmarks for named animals | 4 | Bio1.2.4.2 |
| 8 | Define homing | 1 | Bio1.2.1.3 |
| 9 | Identify a feature or example of homing in a given context | 1 | Bio1.2.1.4 |
| 10 | Define migration | 1 | Bio1.2.1.5 |
| 11 | Describe how animals navigate during migration and homing | 2 | Bio1.2.2.2 |
| 12 | Discuss the impacts of homing on the survival of a named animal  | 4 | Bio1.2.4.3 |
| 13 | Explain the adaptive value of migratory behaviour and homing. | 3 | Bio1.2.3.3 |
| 14 | Distinguish between migration and homing. | 3 | Bio1.2.3.4 |
| 15 | Discuss the impacts of migration (long-distance return migration between breeding and feeding/overwintering grounds) on the survival of a named animal  | 4 | Bio1.2.4.4 |
| 16 | Define taxes/kinesis | 1 | Bio1.2.1.6 |
| 17 | Identify a feature of taxes (hydro, geo, chemo, photo, thigmo) in a given context | 1 | Bio1.2.1.7 |
| 18 | Describe the adaptive value of taxes (hydro, geo, chemo, photo, thigmo) | 2 | Bio1.2.2.3 |
| 19 | Discuss the impacts of taxes (hydro/geo/chemo/photo/thigmo) on the movement and survival of a named animal. | 4 | Bio1.2.4.5 |
| 20 | Describe the adaptive value of kineses (ortho, klino) | 2 | Bio1.2.2.4 |
| 21 | Explain the impacts of kineses (ortho, klino) on the movement and survival of a named animal. | 3 | Bio1.2.3.5 |

### Sub-strand 1.3 Timing Responses

**Key Learning outcome**: Students are able to demonstrate an understanding of timing responses and ways of representing and interpreting timing responses.

* timing responses (daily, tidal, lunar, annual) as determined by the movement of earth, sun, moon; diurnal, nocturnal, crepuscular
* biological rhythms (circadian, circatidal, circalunar, circannual)
* biological clock (in the brain) providing endogenous control (via melatonin) of rhythms and which is set by environmental cues (zeitgebers).

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| **SLO #** | **Specific Learning Outcomes: *Students are able to*** | **Skill level** | **SLO code** |
| 1 | Define biological timing (responses)/biological clocks | 1 | Bio1.3.1.1 |
| 2 | Describe the function of a biological clock. | 2 | Bio1.3.2.1 |
| 3 | Define diurnal/nocturnal/crepuscular | 1 | Bio1.3.1.2 |
| 4 | Identify diurnal/nocturnal/crepuscular activity in a given context | 1 | Bio1.3.1.3 |
| 5 | Define endogenous/exogenous biological rhythms  | 1 | Bio1.3.1.4 |
| 6 | Define actograms/free running period/phase shift/zeitgeber | 1 | Bio1.3.1.5 |
| 7 | Identify zeitgeber/endogenous/exogenous rhythmic activity in a given context | 1 | Bio1.3.1.6 |
| 8 | Explain the activity diagrams (actograms) of an organism using the following terms: free-running period, phase shift, zeitgeber | 3 | Bio1.3.3.1 |
| 9 | Discuss the implications of environmental destruction on biological clocks and survival of named organisms | 4 | Bio1.3.4.1 |
| 10 | Describe a rhythmic cycle (daily, tidal, lunar, annual) | 2 | Bio1.3.2.2 |
| 11 | Explain the adaptive value of a biological timing response (daily, tidal, lunar, annual) on the life cycle of an organism | 3 | Bio1.3.3.2 |
| 12 | Define circadian/circa tidal/circalunar/circannual biological rhythms | 1 | Bio1.3.1.7 |
| 13 | Identify circadian/circatidal/circalunar/circannual biological rhythms in a given context | 1 | Bio1.3.1.8 |
| 14 | Contrast the different biological rhythms (circadian, circatidal, circalunar, circannual) using examples | 3 | Bio1.3.3.3 |
| 15 | Discuss the importances of different biological rhythms (circadian/circatidal/circalunar/circannual) for a named organism | 4 | Bio1.3.4.2 |

### Sub-strand 1.4 Interspecific Interactions

**Key Learning outcome**: Students are able to demonstrate understanding of interspecific interactions and ways in which these interactions influence survival in the niches

* competition for resources (named e.g. food, living space, etc.) acting to limit numbers and distribution (fundamental niche versus realised / actual niche; zonation) of competing species; out-competition leading to niche differentiation
* predator-prey relationships and cycles acting to control numbers and distribution (fundamental niche versus realised / actual niche; zonation) of both predator and prey species

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to:* | **Skill level** | **SLO code** |
| 1 | Define niche differentiation/out-competition/interspecific competition | 1 | Bio1.4.1.1 |
| 2 | State the competitive exclusion principle | 1 | Bio1.4.1.2 |
| 3 | Identify niche differentiation in a given context | 1 | Bio1.4.1.3 |
| 4 | Identify interspecific competition in a given context | 1 | Bio1.4.1.4 |
| 5 | Identify out-competition in a given context | 1 | Bio1.4.1.5 |
| 6 | Describe the features of competitions | 2 | Bio1.4.2.1 |
| 7 | Explain how interspecific competition limit the numbers of a population | 3 | Bio1.4.3.1 |
| 8 | Explain how interspecific competition leads to niche differentiation | 3 | Bio1.4.3.2 |
| 9 | Explain how interspecific competition leads to species distribution | 3 | Bio1.4.3.3 |
| 10 | Discuss how interspecific competition contributes to species redistribution, population numbers and niche differentiation using named examples | 4 | Bio1.4.4.1 |
| 11 | Describe the features of predator-prey relationships  | 2 | Bio1.4.2.2 |
| 12 | Explain how predator-prey relationships contribute to cycles acting to control numbers and distribution of both predator and prey species | 3 | Bio1.4.3.4 |
| 13 | Discuss the impacts of a number of predators – prey relationships working together within a population on population numbers, food availability, and species distribution.  | 4 | Bio1.4.4.2 |

### Sub-strand 1.5 Intraspecific interactions

**Key Learning outcome**: Students are able to demonstrate an understanding of intraspecific interactions and ways in which these interactions influence survival in the niches.

* advantages (eg co-operative behaviour such as hunting/defence / detecting predators; finding food; parental care; mate availability) and disadvantages (eg increased intraspecific competition / aggressive encounters) of group living
* social organisation; hierarchies (linear and complex); advantages (reduction of serious aggression; controlled access to resources) and disadvantages (uneven access to resources); dominance and submissive behaviours in maintaining hierarchies
* territory and home range
* reproductive behaviour: r and k strategies; monogamous and polygamous mating; courtship, mating, and parental care

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to* | **Skill level** | **SLO code** |
| 1 | Define *r* and *k* strategies/monogamous and polygamous mating/social organisations | 1 | Bio1.5.1.1 |
| 2 | Identify *r* or *k* strategies in a given context | 1 | Bio1.5.1.2 |
| 3 | Identify monogamous or polygamous mating in a given context | 1 | Bio1.5.1.3 |
| 4 | Identify/state a feature or an example of social organisation in a given context | 1 | Bio1.5.1.4 |
| 5 | List the advantages and disadvantages of group living | 2 | Bio1.5.2.1 |
| 6 | Explain how group living influence survival of members group | 3 | Bio1.5.3.1 |
| 7 | Describe the features of *r* and *k* strategies | 2 | Bio1.5.2.2 |
| 8 | Explain how reproductive behaviour influence survival | 3 | Bio1.5.3.2 |
| 9 | Discuss how the different reproductive behaviours (*r* and *k* strategies; monogamous and polygamous mating; courtship and parental care) work together to influence the survival of a named species, using examples | 4 | Bio1.5.4.1 |
| 10 | List the advantages and disadvantages of different types of parental care | 2 | Bio1.5.2.3 |
| 11 | Describe the features of different types of social organisations | 2 | Bio1.5.2.4 |
| 12 | Outline the reasons for different types of social organisations | 2 | Bio1.5.2.5 |
| 13 | Discuss the evolution of group living and evaluate whether group living continues to be an advantage under changing social and environmental conditions | 4 | Bio1.5.4.2 |
| 14 | Describe the features of social organisation in terms of hierarchies and dominance and submissive behaviours  | 2 | Bio1.5.2.6 |
| 15 | Outline the advantages and disadvantages of different types of social organisations | 2 | Bio1.5.2.7 |
| 16 | Explain how dominance and submissive behaviours maintain hierarchies social organisation | 3 | Bio1.5.3.3 |
| 17 | Analyse / sequence the hierarchal order of social organisations.  | 3 | Bio1.5.3.4 |
| 18 | Define territory and home range | 1 | Bio1.5.1.5 |
| 19 | Explain how the establishment of territory and home range increases survival of a species | 3 | Bio1.5.3.5 |
| 20 | Discuss the social organisations of a number of species living together within an area and how these organisation support survival or threaten extinction, and how members of these species cope  | 4 | Bio1.5.4.3 |

## **Strand 2: Gene Expression**

 **Major Learning Outcome 2:**

Students are able to describe, explain and discuss **biological concepts and processes** relating to gene expression.

### Sub-strand 2.1 DNA structure and replication

**Key Learning outcome**: Students are able to demonstrate an understanding of the DNA structure and replication and ways in which these influence DNA functioning

* genome
* structure of the gene
* replication of DNA – revision and extension of form 6 to include: semi-conservative replication, enzyme control (helicase, DNA polymerase, ligase), strands, leading and lagging strands, Okazaki fragments and synthesis occurring in the 5 to 3’ direction.

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to*  | **Skill level** | **SLO code** |
| 1 | Define genome  | 1 | Bio2.1.1.1 |
| 2 | Identify / State a feature or example of a genome in a given context | 1 | Bio2.1.1.2 |
| 3 | Describe the structure of a gene or DNA | 2 | Bio2.1.2.1 |
| 4 | Explain how the genome determines full characteristics of an organism  | 3 | Bio2.1.3.1 |
| 5 | Define semi-conservative replication | 1 | Bio2.1.1.3 |
| 6 | Identify semi-conservative replication, in a DNA replication representation | 1 | Bio2.1.1.4 |
| 7 | Identify the leading and lagging strand in a DNA replication representation. | 1 | Bio2.1.1.5 |
| 8 | Describe the direction of the synthesis of the new strand [in the 5’ to 3’ direction] | 2 | Bio2.1.2.2 |
| 9 | Describe the structure and replication of DNA in terms of semi-conservative replication, enzyme control, antiparallel 3’ – 5’ strands | 2 | Bio2.1.2.3 |
| 10 | Explain the roles of respective enzymes in DNA Replication [Helicase/DNA Polymerase/Ligase]. | 3 | Bio2.1.3.2 |
| 11 | Explain the process of DNA Replication in terms of the leading and lagging strands and the Okazaki fragments | 3 | Bio2.1.3.3 |
| 12 | Discuss the process of DNA Replication of the lagging and leading strand and Okazaki fragments, with the help of enzymes(helicase/polymerase/ligase) | 4 | Bio2.1.4.1 |
| 13 | Describe ways in which DNA Replication problems may arise. | 2 | Bio2.1.2.4 |

### Sub-strand 2.2 Protein structure, function, and synthesis

**Key Learning outcome**: Students are able to demonstrate an understanding of protein structure, functions and synthesis and how these contribute to forms and functions

* protein structure (primary, secondary, tertiary) and function (structural e.g. collagen, keratin, and regulatory e.g. enzymes, hormones)
* protein synthesis; transcription and translation – revision and extension of form 6 to include the role of DNA (triplets), mRNA (codons), tRNA (anticodons), ribosomes; use of codon dictionary to identify amino acids; redundant nature of the genetic code
* protein structure (primary, secondary, tertiary) and function (structural e.g. collagen, keratin, and regulatory eg enzymes, hormones)
* protein synthesis; transcription and translation – revision and extension of form 6 to include the role of DNA (triplets), mRNA (codons), tRNA (anticodons), ribosomes; use of codon dictionary to identify amino acids; redundant nature of the genetic code

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to* | **Skill level** | **SLO code** |
| 1 | Define transcription/translation | 1 | Bio2.2.1.1 |
| 2 | Define codons/anticodons | 1 | Bio2.2.1.2 |
| 3 | State the function of mRNA/tRNA/rRNA | 1 | Bio2.2.1.3 |
| 4 | Identify transcription in a given representation of protein synthesis | 1 | Bio2.2.1.4 |
| 5 | Identify translation in a given representation of protein synthesis | 1 | Bio2.2.1.5 |
| 6 | Identify codons/anticodons in a given representation of protein synthesis | 1 | Bio2.2.1.6 |
| 7 | Identify mRNA/tRNA in a given representation of protein synthesis | 1 | Bio2.2.1.7 |
| 8 | Define protein synthesis | 1 | Bio2.2.1.8 |
| 9 | Identify/State a feature of protein synthesis, within a given context | 1 | Bio2.2.1.9 |
| 10 | Describe the process of protein synthesis [Transcription /Translation] | 2 | Bio2.2.2.2 |
| 11 | Describe the use of the Genetic Code to identify amino acids | 2 | Bio2.2.2.3 |
| 12 | Describe the redundant nature of the genetic code | 2 | Bio2.2.2.4 |
| 13 | Explain the relationships within transcription and translation including the role of DNA (triplets), mRNA (codons), tRNA (anticodons), ribosomes; use of codon dictionary to identify amino acids; redundant nature of the genetic code | 3 | Bio2.2.3.2 |
| 14 | Discuss the interdependency of the different parts of the process of protein synthesis (transcription and translation including the role of DNA (triplets), mRNA (codons), tRNA (anticodons), ribosomes; use of codon dictionary to identify amino acids; redundant nature of the genetic code | 4 | Bio2.2.4.2 |
| 15 | Describe the features of structural protein/ functional protein | 2 | Bio2.2.2.1 |
| 16 | Relate protein structure to its function (structural eg collagen, keratin, and functional e.g. enzymes, hormones) | 3 | Bio2.2.3.1 |
| 17 | Discuss the importance of protein structure to different forms and functions in plants and/or animals | 4 | Bio2.2.4.1 |

### Sub-strand 2.3 Mutations

**Key Learning Outcome**: Students are able to demonstrate an understanding of mutations andways in which these influence DNA functioning.

* mutations
* gene (point) mutations - the substitution of bases producing missense (different amino acid) or nonsense codons (termination); addition or deletion of bases producing a frameshift (as all following amino acids changed leading to early termination).
* chromosome (block) mutations – deletion, inversion, duplication, translocation of genes in and between chromosomes
* aneuploidy – change in number of chromosomes within a set resulting from nondisjunction during meiosis eg Downs (trisomy 21), Turners, Kleinfelters syndromes
* polyploidy – change in numbers of (whole) sets of chromosomes resulting from complete non-disjunction during meiosis eg triploid (3n), tetraploid (4n); autopolyploidy, allopolyploidy

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| **SLO#** | **Specific Learning Outcomes: *Students are able to*** | **Skill level** | **SLO code** |
|  | Define mutation | 1 | Bio2.3.1.1 |
|  | Describe the features of mutations and give examples | 2 | Bio2.3.2.1 |
|  | Describe gene (point) mutations (substitution of bases producing missense or nonsense codons; addition or deletion of bases producing a frameshift).  | 2 | Bio2.3.2.2 |
|  | Describe chromosome (block) mutations (deletion, inversion, duplication, translocation of genes in and between chromosomes) | 2 | Bio2.3.2.3 |
|  | Explain the causes of gene (point) mutations  | 3 | Bio2.3.3.1 |
|  | Differentiate between chromosome mutation and gene mutation | 3 | Bio2.3.3.2 |
|  | Explain the causes and effects of chromosome (block) mutations | 3 | Bio2.3.3.3 |
|  | Discuss the impact of gene (point) mutations on the functioning of an affected person using named examples | 4 | Bio2.3.4.1 |
|  | Discuss the impact of chromosome (block) mutations on an affected person using named examples | 4 | Bio2.3.4.2 |
|  | Define polyploidy | 1 | Bio2.3.1.2 |
|  | Define auto polyploidy, allopolyploidy | 1 | Bio2.3.1.3 |
|  | Describe the characteristics of polyploidy (change in numbers of (whole) sets of chromosomes resulting from complete non-disjunction during meiosis eg triploid (3n), tetraploid (4n); autopolyploidy, allopolyploidy)  | 2 | Bio2.3.2.4 |
|  | Compare and contrast autopolyploidy with allopolyploidy | 3 | Bio2.3.3.4 |
|  | Explain the effects of polyploidy on the genome | 3 | Bio2.3.3.5 |
|  | Discuss the impact of polyploidy on an affected individual using examples  | 4 | Bio2.3.4.3 |
|  | Define triploid (3n) | 1 | Bio2.3.1.4 |
|  | Compare and contrast the features of triploid with tetraploid | 3 | Bio2.3.3.6 |
|  | Define Non-Disjunction | 1 | Bio2.3.1.5 |
|  | Define tetraploid (4n) | 1 | Bio2.3.1.6 |
|  | Define Aneuploidy | 1 | Bio2.3.1.7 |
|  | Explain the effects of aneuploidy on the genome | 3 | Bio2.3.3.7 |
|  | Discuss the impact of aneuploidy on an affected individual using examples  | 4 | Bio2.3.4.4 |
|  | Identify from a given representation or a karyotype if a person is suffering from Down’s Syndrome/Turner’s Syndrome/Klinefelters Syndrome. | 1 | Bio2.3.1.8 |
|  | Describe the chromosomal characteristics of a person suffering from Down’s Syndrome/Turner’s Syndrome/Klinefelter’s Syndrome | 2 | Bio2.3.2.5 |
|  | Describe the common physical characteristics of a person suffering from Down’s syndrome/Turner’s syndrome/Kleinfelter’s syndrome | 2 | Bio2.3.2.6 |
|  | Compare the features of Down’s syndrome, Turner’s syndrome and Kleinfelter’s syndrome | 3 | Bio2.3.3.8 |
|  | Define deletion, inversion, duplication, translocation of genes  | 1 | Bio2.3.1.9 |
|  | Differentiate between the terms missense codons and nonsense codons | 3 | Bio2.3.3.9 |

### Sub-strand 2.4 Metabolic Pathways, Genetic Linkages and Sex Linkages

**Key Learning Outcome**: Students are able to demonstrate an understanding of metabolic pathways, linkages and sex linkages and ways in which these influence DNA functioning

* metabolic pathways eg. PKU
* effects of mutation on enzyme control of metabolic pathways
* linkage and sex linkage
* inheritance of: red-green colour blindness in humans; haemophilia in humans;

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| **SLO#** | **Specific Learning Outcomes: *Students are able to*** | **Skill level** | **SLO code** |
| 1 | Define metabolic pathway | 1 | Bio2.4.1.1 |
| 2 | Describe the characteristics of phenylketonuria (PKU) | 2 | Bio2.4.2.1 |
| 3 | Explain the relation between metabolic pathways disorder and PKU | 3 | Bio2.4.3.1 |
| 4 | Represent diagrammatically the metabolic pathway for PKU | 3 | Bio2.4.3.2 |
| 5 | Explain the effects of untreated PKU | 3 | Bio2.4.3.3 |
| 6 | Explain the effects of mutation on enzyme control of metabolic pathways | 3 | Bio2.4.3.4 |
| 7 | Interpret the effects of mutation on enzyme control of metabolic pathways based on given information | 3 | Bio2.4.3.5 |
| 8 | Define the term genetic linkage /sex linkage  | 1 | Bio2.4.1.2 |
| 9 | Identify/State a feature or example of sex-linked cnditions, in a given context | 1 | Bio2.4.1.3 |
| 10 | Describe the difference between Sex Linkage and Genetic Linkage | 2 | Bio2.4.2.2 |
| 11 | Describe the process of genetic likage and sex linkage | 2 | Bio2.4.2.3 |
| 12 | Describe the process of inheritance of red-green colour blindness/haemophilia in humans as an example of sex linkage | 2 | Bio2.4.2.4 |
| 13 | Describe an example of genetic linkage in humans | 2 | Bio2.4.2.5 |
| 14 | Compare linked genes to sex linked genes/sex linkage to genetic linkage | 3 | Bio2.4.3.6 |
| 15 | Discuss linkage and sex linkage as the biological basis of heredity | 4 | Bio2.4.4.1 |
| 16 | Explain using a punnet square the process of inheritance of sex linkage [haemophilia and colour blindness] | 3 | Bio2.4.3.8 |
| 17 | Discuss using examples of the complications associated with the inheritance of colour blindness/haemophilia | 4 | Bio2.4.4.2 |

### Sub-strand 2.5 Gene – Gene Interactions and Mendelian Inheritance

**Key Learning Outcome**: Students are able to demonstrate an understanding of gene-gene interactions and Mendelian inheritance and ways in which these influence DNA functioning

* gene-genene interactions: collaboration, epistasis (complementary; supplementary genes); polygenes (eg height and skin colour in humans); pleiotrophy (eg sickle cell disease)
* monohybrid and dihybrid crosses with: complete dominance, incomplete dominance, codominance, multiple alleles, test cross (genes, alleles, genotype, phenotype, homozygous, heterozygous) – revision of form 6

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| **SLO#** | **Specific Learning Outcomes: *students are able to*** | **Skill level** | **SLO code** |
| 1 | Define monohybrid cross / dihybrid crosses  | 1 | Bio2.5.1.1 |
| 2 | Define complete dominance/incomplete dominance/co-dominance,  | 1 | Bio2.5.1.2 |
| 3 | Define multiple alleles / / homozygous / heterozygous | 1 | Bio2.5.1.3 |
| 4 | Identify/State a feature or example of monohybrid cross/dihybrid crosses, in a given context | 1 | Bio2.5.1.4 |
| 5 | Identify/State a feature or example of complete dominance/incomplete dominance/co-dominance, in a given context | 1 | Bio2.5.1.5 |
| 6 | Identify/State a feature or example of multiple alleles / homozygous /heterozygous gene pairs, in a given context. | 1 | Bio2.5.1.6 |
| 7 | Identify or state a feature of a heterozygous gene pair in a given context. | 1 | Bio2.5.1.7 |
| 8 | Describe genotypes for monohybrid crosses with complete dominance, incomplete dominance, co-dominance, multiple alleles, test cross (genes, alleles, homozygous, heterozygous) | 2 | Bio2.5.2.1 |
| 9 | Explain the expression of characteristics from monohybrid crosses involving complete dominance, incomplete dominance, codominance, (genes, alleles, genotype, phenotype, homozygous, heterozygous) | 3 | Bio2.5.3.1 |
| 10 | Discuss the full picture of the inheritance of named characteristics through monohybrid and dihybrid crosses using named plants and or animals | 4 | Bio2.5.4.1 |
| 11 | Define the term epistasis. | 1 | Bio2.5.1.8 |
| 12 | Define the term complementary gene | 1 | Bio2.5.1.9 |
| 13 | Define the term supplementary gene. | 1 | Bio2.5.1.10 |
| 14 | Define the terms pleiotropy/polygene | 1 | Bio2.5.1.11 |
| 15 | Identify/State a feature or example of gene interactions / collaboration / epistasis (complementary; supplementary genes) / polygenes (e.g. height and skin colour in humans); pleiotropy, in a given context | 1 | Bio2.5.1.12 |
| 16 | Describe the process of gene – gene interactions with complementary genes | 2 | Bio2.5.2.2 |
| 17 | Describe the process of gene – gene interactions with supplementary genes | 2 | Bio2.5.2.3 |
| 18 | Describe the process of gene – gene interactions involving polygenes genes | 2 | Bio2.5.2.4 |
| 19 | Describe the process of gene – gene interactions involving pleiotropy | 2 | Bio2.5.2.5 |
| 20 | Explain height and skin colour in humans in terms of gene – gene interactions (e.g. sickle cell disease) | 3 | Bio2.5.3.2 |
| 21 | Explain sickle cell disease in humans in terms of gene – gene interactions  | 3 | Bio2.5.3.3 |
| 22 | Explain the difference between complementary gene and supplementary gene using appropriate examples | 3 | Bio2.5.3.4 |
| 23 | Discuss the type of epistasis shown using the phenotypic ratio from a dihybrid cross | 4 | Bio2.5.4.2 |
| 24 | Discuss the interrelationship between gene – gene interactions in determining various characteristics in humans and the impact of these characteristics on survival. | 4 | Bio2.5.4.3 |

## **Strand 3: Biotechnology Applications**

**Major Learning Outcome 3:**

Students are able to describe, explain and discuss **biotechnology applications** and the **human needs and demands** for the applications.

### Sub-strand 3.1 Gene cloning, Transgenesis and DNA Profiling

 **Key Learning Outcome:** Students are able to demonstrate an understanding of gene cloning, transgenesis and DNA profiling and ways in which these influence gene functioning

* the formation of recombinant DNA using techniques of restriction enzymes and ligation • the use of bacterial plasmids to produce multiple copies of the desired gene
* transgenesis using techniques of Agrobacterium tumefaciens; ballistic (‘gene gun’) method; pronuclear (‘micro’) injection; viral vectors
* formation of DNA profiles using the techniques of PCR and gel electrophoresis

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| **SLO#** | **Specific Learning Outcomes: *Students are able to*** | **Skill level** | **SLO code** |
| 1 | Define gene cloning/trans genesis/ bacterial plasmids | 1 | Bio3.1.1.1 |
| 2 | Identify gene cloning/trans genesis/ bacterial plasmids, in a given context | 1 | Bio3.1.1.2 |
| 3 | Describe the steps of using bacterial plasmids to produce multiple copies of the desired gene | 2 | Bio3.1.2.1 |
| 4 | Define *Agrobacterium* *tumefaciens* | 1 | Bio3.1.1.3 |
| 5 | Describe transgenesis using the technique of  *Agrobacterium* *tumefaciens* | 2 | Bio3.1.2.2 |
| 6 | Explain the positive and negative impacts of the use of trans genesis on the gene pool for a population | 3 | Bio3.1.3.1 |
| 7 | Discuss the positive and negative impacts of the use of transgenesis on the human gene pool | 4 | Bio3.1.4.1 |
| 8 | Discuss how recombinant DNA is formed using restriction enzymes and ligation and its impacts (benefits and dangers) on the transgenic organism. | 4 | Bio3.1.4.2 |
| 9 | Define short tandem repeat (STR) in DNA | 1 | Bio3.1.1.4 |
| 10 | Describe why every person’s DNA is unique in terms of STRs | 2 | Bio3.1.2.3 |
| 11 | Define DNA profiling | 1 | Bio3.1.1.5 |
| 12 | Identify DNA profiling in a given context | 1 | Bio3.1.1.6 |
| 13 | Define PCR / gel electrophoresis | 1 | Bio3.1.1.7 |
| 14 | Identify PCR / gel electrophoresis in a given context | 1 | Bio3.1.1.8 |
| 15 | Describe the formation of DNA profiles using the techniques of PCR | 2 | Bio3.1.2.4 |
| 16 | Describe the formation of DNA profiles using the techniques of gel electrophoresis | 2 | Bio3.1.2.5 |
| 17 | Explain the interrelationships of processes in the formation of DNA profiles using the techniques of PCR and gel electrophoresis | 3 | Bio3.1.3.2 |
| 18 | Explain the positive and negative impacts of DNA profiling on medical health sciences  | 3 | Bio3.1.3.3 |
| 19 | Discuss how DNA profiling has made the work of criminal justice easier. | 4 | Bio3.1.4.3 |
| 20 | Discuss the impact of the formation of DNA profiles using the techniques of PCR and gel electrophoresis on criminal justice, medicine and other areas | 4 | Bio3.1.4.4 |

### Sub-strand 3.2 Contemporary biotechnology issue

**Major Learning Outcome 5:**

Students are able to research and process information to write a report on a chosen contemporary issue regarding biotechnology.

**Key Learning Outcome:** Students are able to demonstrate an understanding of contemporary biotechnology issues

* human needs or demands that have lead to the development of a biotechnological application which is an issue
* techniques needed to carry out the application
* any potential biological, social, ethical, economic impacts of the application
* the differing opinions of named people or groups, including their own justified opinion, on the issue

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| **SLO#** | **Specific Learning Outcomes:** *Students are able to research into contemporary biotechnological issues and process information to write a report that demonstrates the ability to* | **Skill level** | **SLO code** |
| 1 | Name/Identify a biotechnology issue | 1 | Bio3.2.1.1 |
| 2 | Locate the area in which selected biotechnology issue is commonly encountered | 1 | Bio3.2.1.2 |
| 3 | List contemporary biotechnology issues as established through research | 2 | Bio3.2.2.1 |
| 4 | Describe the human needs or demands that are giving rise to the use of the selected biotechnology application and the related issues | 2 | Bio3.2.2.2 |
| 5 | Describe the procedures used in the selected biotechnology application | 2 | Bio3.2.2.3 |
| 6 | Provide elaboration on at least two critical steps in the selected biotechnology application. | 3 | Bio3.2.3.1 |
| 7 | Compare two differing opinions on the selected biotechnology application | 3 | Bio3.2.3.2 |
| 8 | State a personal opinion on the use of the selected biotechnology application using supporting evidence | 2 | Bio3.2.2.4 |
| 9 | Organise ideas in a logical and coherent manner | 2 | Bio3.2.2.5 |
| 10 | Discuss biological, social, ethical, economic impacts related to the selected biotechnology application | 4 | Bio3.2.4.1 |
| 11 | Produce a structured report with a logical flow of ideas  | 4 | Bio3.2.4.2 |
| 12 | Organise primary sources of information with correct referencing | 2 | Bio3.2.2.6 |

## **Strand 4: Processes and Patterns of Evolution**

**Major Learning Outcome 4:** Students are able to describe, explain and discuss **processes and patterns** of evolution

### Sub-strand 4.1 Variation

**Key Learning Outcome:** Students are able to demonstrate an understanding of the different types of variations,the causes of these variations and the circumstances that give rise to variation.

* role of mutation as a source of new alleles
* role of meiosis in producing variation and recombinant genotypes/gametes (independent assortment, segregation, crossing over) – revision and extension of form 6
* role of fertilisation in sexual reproduction in producing variation
* importance of variation in evolution

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| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define the terms independent assortment / segregation / crossing over / recombinant genotypes | 1 | Bio4.1.1.1 |
| 2 | Identify/State a feature or example of independent assortment / segregation / crossing over / recombinant genotypes, in a given context | 1 | Bio4.1.1.2 |
| 3 | Describe the process of independent assortment/segregation/crossing over during meiosis. | 2 | Bio4.1.2.1 |
| 4 | Explain how independent assortment/segregation/crossing over during meiosis contributes to variation. | 3 | Bio4.1.3.1 |
| 5 | Describe the process of mutation that leads to the formation of new alleles | 2 | Bio4.1.2.2 |
| 6 | Explain the contribution of mutation to the gene pool of the population | 3 | Bio4.1.3.2 |
| 7 | Discuss the positive and negative impacts of mutation on a population | 4 | Bio4.1.4.1 |
| 8 |  Identify the processes of meiosis and mitosis from a given context. | 1 | Bio4.1.1.3 |
| 9 | Identify/State a feature or example of meiosis / gametes / fertilisation / mitosis, in a given context | 1 | Bio4.1.1.4 |
| 10 | Describe the process of fertilisation in terms of the combination of chromosomes from gametes | 2 | Bio4.1.2.3 |
| 11 | Explain how fertilization in sexual reproduction produces variation | 3 | Bio4.1.3.3 |
| 12 | Discuss the role of fertilization in sexual reproduction in producing variation and enhancing biological success, using named examples. | 4 | Bio4.1.4.2 |
| 13 | Define evolution | 1 | Bio4.1.1.5 |
| 14 | Identify/State a feature or example of evolution, in a given context | 1 | Bio4.1.1.6 |
| 15 | List the key features of the process of evolution  | 2 | Bio4.1.2.4 |
| 16 | Explain the importance of variation in evolution | 3 | Bio4.1.3.4 |
| 17 | Discuss the impact of evolution on the survival of species and the critical role of variation in promoting evolution | 4 | Bio4.1.4.3 |

### Sub-strand 4.2 Natural Selection

**Key Learning Outcome:** Students are able to demonstrate an understanding of natural selection and factors that influence this, and things that are impacted by natural selection

* theory of natural selection as proposed by Darwin; selecting agents/selection pressures (eg predators)
* sexual selection as a special case of natural selection – females act as the selecting agent for which males (strongest / biggest / most showy / healthiest ) will breed
* artificial selection (selective breeding) – humans act as the selecting agent for which plants and animals (those with the desirable traits) will breed
* ‘fitness’ in terms of the organisms which breed successfully to produce the most offspring, so their alleles increase in frequency in the gene pool

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| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define natural selection, selection pressure, sexual selection | 1 | Bio4.2.1.1 |
| 2 | Identify/natural selection / selection pressure / sexual selection, in a given context | 1 | Bio4.2.1.2 |
| 3 | Outline the main points of the theory of natural selection as proposed by Darwin;  | 2 | Bio4.2.2.1 |
| 4 | List the selecting agents for selection pressures[biotic and abiotic factors] that contribute to natural selection | 2 | Bio4.2.2.2 |
| 5 | Explain with examples of how biotic and abiotic factors act as forces of Natural Selection | 3 | Bio4.2.3.1 |
| 6 | Explain the related ideas in the theory of natural selection as proposed by Darwin | 3 | Bio4.2.3.2 |
| 7 | Evaluate the theory of natural selection as proposed by Darwin; presenting your own opinion on the relative truth of the theory  | 4 | Bio4.2.4.1 |
| 8 | Outline the main features of sexual selection as a special case of natural selection (females act as the selecting agent for which males (strongest /biggest/ most showy/healthiest) will breed) | 2 | Bio4.2.2.3 |
| 9 | Explain the interrelationships within the sexual selection as a special case of natural selection  | 3 | Bio4.2.3.3 |
| 10 | Discuss the impact of sexual selection on populations using specific examples[limit your example to Peacocks/Wolves] | 4 | Bio4.2.4.2 |
| 11 | Define selective breeding | 1 | Bio4.2.1.3 |
| 12 | Identify/State a feature or example of selective breeding, in a given context | 1 | Bio4.2.1.4 |
| 13 | Describe the features of artificial selection or selective breeding  | 2 | Bio4.2.2.4 |
| 14 | Explain the role of humans in artificial selection (selective breeding)  | 3 | Bio4.2.3.4 |
| 15 | Discuss the impact of artificial selection (selective breeding) on variations in populations | 3 | Bio4.2.3.5 |
| 16 | Compare the ‘effectiveness’ of methods of sexual selection and selective breeding in terms of their contribution to variations in populations | 3 | Bio4.2.3.6 |
| 17 | Define ‘fitness’ | 1 | Bio4.2.1.5 |
| 18 | Identify/State a feature or example of fitness, in a given context | 1 | Bio4.2.1.6 |
| 19 | Explain how ‘fitness’ contributes to frequency of alleles in the gene pool | 3 | Bio4.2.3.7 |
| 20 | Evaluate the contribution of natural selection, sexual selection and selective breeding on a population, providing an opinion on the preferred method | 4 | Bio4.2.4.3 |

### Sub-strand 4.3 Gene pool and allele frequency

**Key Learning Outcome:** Students are able to demonstrate an understanding of gene pools and allele frequencies within gene pools of a population and factors that affect allele frequency.

* gene pool as the sum total of genes within a population
* allele frequency as to how often an allele occurs in a gene pool; factors affecting allele frequency - the size of the population; natural selection, sexual selection, migration (gene flow)
* genetic drift – the changes in allele frequency in a population by chance, related to population size
* founder effect and bottleneck effect as special cases of genetic drift

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| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define gene pool / allele frequency  | 1 | Bio4.3.1.1 |
| 2 | Define founder effect / bottleneck effect  | 1 | Bio4.3.1.2 |
| 3 | List the factors that affect allele frequency within a population | 2 | Bio4.3.2.1 |
| 4 | Describe how certain factors such a population size, natural selection and gene flow affects the allele frequency. | 2 | Bio4.3.2.2 |
| 5 | Explain how the size of a population affects allele frequency | 3 | Bio4.3.3.1 |
| 6 | Explain how natural selection affects allele frequency | 3 | Bio4.3.3.2 |
| 7 | Explain how migration (gene flow) affect allele frequency | 3 | Bio4.3.3.3 |
| 8 | Define genetic drift | 1 | Bio4.3.1.3 |
| 9 | Identify/State a feature or example of genetic drift, in a given context | 1 | Bio4.3.1.4 |
| 10 | Explain how genetic drifteffect changes in allele frequency in a population by chance | 3 | Bio4.3.3.4 |
| 11 | Explain how genetic drift is related to or affected by population size | 3 | Bio4.3.3.5 |
| 12 | Discuss the impact of genetic drift on populations and population size | 4 | Bio4.3.4.1  |
| 13 | Describe the features of the founder effect as special cases of genetic drift | 2 | Bio4.3.2.3 |
| 14 | Describe the features of the bottleneck effect as special cases of genetic drift | 2 | Bio4.3.2.4 |
| 15 | Explain the relation between the founder effect and bottleneck effect as special cases of genetic drift | 3 | Bio4.3.3.6 |
| 16 | Discuss the impacts of the founder effect and bottleneck effect as special cases of genetic drift | 4 | Bio4.3.4.2 |

### Sub-strand 4.4 Speciation

**Key Learning Outcome:** Students are able to demonstrate an understanding of the different types of speciation, the different reproductive isolating mechanisms and the impact of speciation on diversity

* allopatric, sympatric, instant (polyploidy) speciation
* reproductive isolating mechanisms :
	+ pre-mating (pre-zygotic) – geographical, ecological, behavioural, structural, temporal
	+ post-mating (post-zygotic) – hybrid inviable, hybrid sterile, hybrid breakdown.

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| **SLO#** | **Specific Learning Outcomes: *Students are able to*** | **Skill level** | **SLO code** |
| 1 | Define allopatric / sympatric / speciation | 1 | Bio4.4.1.1 |
| 2 | Identify an example of allopatric/sympatric / speciation, in a given context | 1 | Bio4.4.1.2 |
| 3 | Describe the features of allopatric and sympatric speciation | 2 | Bio4.4.2.1 |
| 4 | Describe the difference between allopatric and sympatric speciation | 2 | Bio4.4.2.2 |
| 5 | List the pre-mating and the pre-zygotic reproductive isolating mechanisms | 2 | Bio4.4.2.3 |
| 6 | Describe the features of each reproductive isolating mechanism  | 2 | Bio4.4.2.4 |
| 7 | Explain why geographical isolation leads to reproductive isolation  | 3 | Bio4.4.3.1 |
| 8 | Explain why ecological isolation leads to reproductive isolation | 3 | Bio4.4.3.2 |
| 9 | Explain why behavioural isolation leads to reproductive isolation  | 3 | Bio4.4.3.3 |
| 10 | Explain why structural isolation leads to reproductive isolation  | 3 | Bio4.4.3.4 |
| 11 | Explain why temporal isolation leads to reproductive isolation  | 3 | Bio4.4.3.5 |
| 12 | Define hybrid inviable/hybrid sterile/hybrid breakdown | 1 | Bio4.4.1.3 |
| 13 | Identify/State a feature or example of hybrid inviable / hybrid sterile/hybrid breakdown, in a given context | 1 | Bio4.4.1.4 |
| 14 | List the post-mating (pre-zygotic) reproductive isolating mechanisms | 2 | Bio4.4.2.5 |
| 15 | Explain why hybrid inviable mechanism leads to reproductive isolation  | 3 | Bio4.4.3.6 |
| 16 | Explain why hybrid sterile mechanism leads to reproductive isolation  | 3 | Bio4.4.3.7 |
| 17 | Explain why hybrid breakdown leads to reproductive isolation  | 3 | Bio4.4.3.8 |
| 18 | Discuss the combined impact of reproductive isolating mechanisms (pre-zygotic and post-zygotic) on speciation in populations using specific examples | 4 | Bio4.4.4.1 |

### Sub-strand 4.5 Patterns of Evolution

**Key Learning Outcome:** Students are able to demonstrate an understanding of the different patterns of evolution

* divergent evolution from a common ancestor; homologous structures
* convergent evolution; analogous structures
* co-evolution

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| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define divergent evolution / convergent evolution / co-evolution | 1 | Bio4.5.1.1 |
| 2 | Identify/State a feature or example of divergent evolution / co-evolution / convergent evolution, in a given context | 1 | Bio4.5.1.2 |
| 3 | Define homologous structures / analogous structures | 1 | Bio4.5.1.3 |
| 4 | Identify/State a feature or example of homologous structures / analogous structures, in a given context | 1 | Bio4.5.1.4 |
| 5 | Outline the features of divergent evolution from a common ancestor; homologous structures | 2 | Bio4.5.2.1 |
| 6 | Explain how divergent evolution from a common ancestor relates to homologous structures | 3 | Bio4.5.3.1 |
| 7 | Discuss the impact of divergent evolution from a common ancestor to the formation of new species using examples | 4 | Bio4.5.4.1 |
| 8 | Describe the features of convergent evolution; analogous structures | 2 | Bio4.5.2.2 |
| 9 | Explain how convergent evolution relates to analogous structures | 3 | Bio4.5.3.2 |
| 10 | Compare and contrast divergent and convergent evolution | 3 | Bio4.5.3.3 |
| 11 | Discuss the impact of convergent evolution from a common ancestor to formation of new species using examples | 4 | Bio4.5.4.2 |
| 12 | Describe the features of co-evolution | 2 | Bio4.5.2.3 |
| 13 | Discuss the interplay of divergent, convergent and co-evolution in the establishment of new organisms and new species | 4 | Bio4.5.4.3 |

## **Strand 5: Environmental Issues**

**Major Learning Outcome 5:** Students are able to demonstrate an understanding of biological concepts and processes relating to contemporary environmental issues.

### Sub-strand 5.1 Climate Change

**Key Learning Outcome:** Students are able to demonstrate an understanding of the different challenges of contemporary environmental issues.

* Climate change and Global warming
* Human activities contributing to climate change through increased emission of greenhouse gases
* Impacts of climate change

|  |  |  |  |
| --- | --- | --- | --- |
| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define climate change | 1 | Bio5.1.1.1 |
| 2 | Define global warming | 1 | Bio5.1.1.2 |
| 3 | Identify climate change in a given context | 1 | Bio5.1.1.3 |
| 4 | State an example of greenhouse gas (carbon dioxide/methane/nitrous oxide) | 1 | Bio5.1.1.4 |
| 5 | Describe human activities which contribute to global warming (use of fossil fuels/deforestation) | 2 | Bio5.1.2.1 |
| 6 | List the features of climate change (melting of polar ice caps, rising sea levels, heavy rains, death of coral reefs, migration of fishes and insects, stronger cyclones, drought, flooding, extreme temperatures) | 2 | Bio5.1.2.2 |
| 7 | Describe the effects of climate change in terms of rising sea levels | 2 | Bio5.1.2.3 |
| 8 | Describe the effects of climate change on weather patterns (stronger cyclones/flooding/drought) | 2 | Bio5.1.2.4 |
| 9 | Describe the effects of climate change on coral reefs (coral bleaching/migration of fishes) | 2 | Bio5.1.2.5 |
| 10 | Explain how human activity (fossil fuels/deforestation) contributes to climate change | 3 | Bio5.1.3.1 |
| 11 | Explain how changes in temperature impact the lives of animals and plants in a local example (extinction of native species, mass migration of animals) | 3 | Bio5.1.3.2 |
| 12 | Discuss the consequences of climate change on the livelihoods (water/food/medicine/shelter/clothing) of people living in the Pacific Island countries due to more extreme weather conditions (drought/flooding/stronger cyclones/extreme temperatures) using local examples. | 4 | Bio5.1.4.1 |
| 13 | Discuss the consequences of climate change on biodiversity (species composition) using coral reef ecosystem (coral bleaching/death of corals) as an example. | 4 | Bio5.1.4.2 |
| 14 | Demonstrate originality and creativity in constructing a poster/model on climate change issues. | 3 | Bio5.1.3.3 |

### Sub-strand 5.2 Conservation

**Key Learning Outcome:** Students are able to demonstrate an understanding of adaptation and mitigation action for climate change situations.

* Adaptations
* Mitigation actions (conservation practices)

|  |  |  |  |
| --- | --- | --- | --- |
| **SLO#** | **Specific Learning Outcomes:***Students are able to* | **Skill level** | **SLO code** |
| 1 | Define adaptation in the context of global warming/climate change | 1 | Bio5.2.1.1 |
| 2 | Define mitigation in the context of global warming/climate change | 1 | Bio5.2.1.2 |
| 3 | Identify a conservation practice in a given context | 1 | Bio5.2.1.3 |
| 4 | List a conservation practice (afforestation/reforestation/use of renewable sources of energy)  | 1 | Bio5.2.1.4 |
| 5 | Identify a renewable source of energy (hydro / wind / thermal / solar / biofuel) | 1 | Bio5.2.1.5 |
| 6 | Describe a renewable source of energy (hydro / wind / thermal / solar / biofuel) | 2 | Bio5.2.2.1 |
| 7 | List ways (building seawalls / relocation / planting on higher grounds / proper drainage / building wells) of adapting to climate change / global warming | 2 | Bio5.2.2.2 |
| 8 | Describe the steps needed to generate a renewable source of energy | 2 | Bio5.2.2.3 |
| 9 | List simple (local) materials needed to generate a renewable source of energy | 2 | Bio5.2.2.4 |
| 10 | Explain ways (building seawalls/relocation/planting on higher grounds/proper drainage/building wells) of adapting to climate change/global warming | 3 | Bio5.2.3.1 |
| 11 | Construct a model/poster of a renewable source of energy | 3 | Bio5.2.3.2 |
| 12 | Explain how a model of a renewable source of energy can be used to generate energy | 3 | Bio5.2.3.3 |
| 13 | Discuss how a renewable source of energy can be used to address the issue of climate change | 4 | Bio5.2.4.1 |

# Assessment

Assessment in this Biology course is in two parts - external assessment and internal assessment. The respective weightings are

1. **External Assessment (EA) : 60%**
2. **Internal Assessment (IA) : 40%**

The principal, or his/her nominee, will certify that the syllabus requirements have been fulfilled.

##  External Assessment

This will be a three-hour written examination and will be out of 60%.

The external written examination will assess learning outcomes from all five strands in the following proportions:

|  |  |  |
| --- | --- | --- |
| **Strand** | **Strand Title** | **Weighting** |
| Strand 1: | Animal Behaviour  | 10% |
| Strand 2: | Gene Expression  | 20% |
| Strand 3: | Biotechnology Applications  | 5% |
| Strand 4: | Processes and Patterns of Evolution  | 20% |
| Strand 5: | Environmental Issues | 5% |

Questions will require students to demonstrate skills of different levels (Levels 1, 2, 3 and 4). The common skills being assessed include defining or stating or naming, describing, explaining, discussing and evaluating biological concepts and processes using sentences and paragraphs. They will be expected to interpret resource material supplied (including diagrams, table, and graphs) and to solve genetic problems. All questions in the written examination paper are COMPULSORY.

##  Internal Assessment

There are four internal assessment tasks, and these include:

**Task 1**: Investigation into an Ecological Niche(10%)

**Task 2**: Resource Interpretation on Linkages, and Sex Linkages based on a video (10%)

**Task 3**: Research and report on a contemporary biotechnology application and issues (10%)

**Task 4**: Designing a poster based on Climate Change and renewable source of energy (10%)

**Teacher guidelines, assessment activities, assessment criteria and sample recording templates for the two internal assessment tasks are provided in appendices 1 to 4.** These will be used by **all** schools and teachers are *to ensure consistency in practice.* All student reports plus research material and logbooks will be retained on file by the schools after marking. This will assist with ensuring the authenticity of work from year to year and the information contained in them may be referred to by teachers to assist both teachers and students in future assessment activities.

## Assessment Blueprint

The blueprint below is to guide the internal and external assessment allocations for Biology.

The allocation of 20%, 30%, 30% and 20% for levels 1, 2 3 and 4 respectively is common across all subjects at the SPFSC level.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Strand | IA / EA | Level 1 | Level 2 | Level 3 | Level 4 | Total (%) |
| Strand 1: Animal Behaviour and Ecological Niche | EA |  |  |  |  | **10** | **20** |
| IA |  | 2 | 2 |  | **10** |
| Strand 2: Gene Expression | EA |  |  |  |  | **20** | **30** |
| IA | 1 | 1 | 1 | 1 | **10** |
| Strand 3: Biotechnology Applications | EA |  |  |  |  | **5** | **15** |
| IA |  | 3 |  | 1 | **10** |
| Strand 4: Process and Patterns of Evolution | EA |  |  |  |  | **20** | **20** |
| Strand 5: Environmental Issues | EA |  |  |  |  | **5** | **15** |
| IA |  |  | 2 | 1 | **10** |
| **Number of items** |  | **20** | **15** | **10** | **5** | **50** |  |
| **TOTAL** |  | **20** | **30** | **30** | **20** | **100** |  |

1. Structure of Observed Learning Outcomes by Biggs and Collis (1982) [↑](#footnote-ref-1)