CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®
CSEC®

BIOLOGY
SYLLABUS

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Content

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Biology Syllabus

♦ RATIONALE

The application of scientific principles and the conduct of relevant research are of significant importance in identifying, assessing and realising the potential of the resources of Caribbean territories. A good foundation in the sciences will enhance the ability of our citizens to respond to the challenges of a rapidly changing world using the scientific approach.

Biology is the discipline in science which seeks to understand the organisation of the organic world through an exploration of the structure and function of life forms at the molecular, cellular, organismal and ecosystem levels, as well as the complex interactions and interdependencies which occur at each of these levels. This knowledge provides the foundation for understanding the opportunities for promoting the well-being of humans and other living organisms in the environment. It generates an awareness of the importance of our biodiversity and the unique role of humans in conserving, protecting and improving the quality of the biological environment for future generations.

The CSEC Biology Syllabus is redesigned with a greater emphasis on the application of scientific concepts and principles. It recognises the need for an understanding of some of the basic principles of Chemistry, Physics and Mathematics, and, therefore seeks to strengthen the inter-relationship with these subjects. It also recognises the inter-relatedness among the topics in Biology, and social and environmental issues. Such an approach is adopted to develop those long-term transferable skills of ethical conduct, team work, problem-solving, critical thinking, and innovation and communication. It encourages the use of various teaching and learning strategies to inculcate these skills that will prove useful in everyday life, while at the same time catering to multiple intelligences and different learning styles and needs. It will provide a sound foundation to pursue the study of Life Sciences and related professions at the post-secondary level.

This syllabus will contribute to the development of the Ideal Caribbean Person as articulated by the CARICOM Heads of Government in the following areas: respect for human life and awareness of the importance of living in harmony with the environment; demonstrates multiple literacies; independent and critical thinking and the innovative application of science and technology to problem solving. In keeping with the UNESCO Pillars of Learning, this course of study will also contribute to a person who will learn how to do, learn to live together and learn to transform themselves and society.

♦ AIMS

The syllabus aims to:

1. develop an understanding of fundamental biological principles and concepts (such as structure and function relationships; unity in diversity; energy transduction), based upon practical and theoretical knowledge of living organisms and the environment;

2. make accurate observations of biological material and phenomena, both in the field and in the laboratory;

3. develop the ability to record information accurately;

4. formulate hypotheses and plan, design and carry out experiments to test them;

5. develop the ability to appraise information critically, identify patterns, cause and effect, stability and change and evaluate ideas;

6. appreciate that although generalisations have predictive value, there are often exceptions to them;

7. develop problem-solving and critical thinking skills;

8. develop an awareness that principles of Chemistry, Physics, Mathematics and other disciplines are necessary for a proper understanding of Biology;

9. recognise the dynamic nature of the interrelationships between organisms and their environment;

10. develop a natural curiosity about living organisms and a respect for all living things and the environment;

11. develop the ability to work independently and collaboratively with others when necessary;

12. apply biological knowledge for further studies as well as in everyday life situations;

13. acknowledge the social and economic implications of Biology;

14. integrate Information Communication and Technology (ICT) tools and skills.

♦ CANDIDATE POPULATION

The syllabus is designed for students intending to pursue further studies in science at the tertiary level as well as for students whose formal study of the subject is unlikely to proceed further.

CANDIDATE REQUIREMENTS

1. Candidates should have been exposed to at least three years of science at the secondary level, which should provide an introduction to basic physical and biological principles.

2. *Candidates should be concurrently studying or have done:*

   (a) *CSEC Mathematics or its equivalent;*

   (b) *CSEC English A (English Language) or its equivalent.*

CLASS SIZE

It is recommended that practical classes accommodate a maximum of **twenty-five** students.

♦ SUGGESTED TIME-TABLE ALLOCATION

It is recommended that a minimum of five 40-minute periods per week, including one double period, be allocated to the subject over a two-year period.

♦ ORGANISATION OF THE SYLLABUS

The syllabus is arranged in three sections, namely:

SECTION A - Living Organisms in the Environment

SECTION B - Life Processes and Disease

SECTION C - Continuity and Variation

♦ SUGGESTIONS FOR TEACHING THE SYLLABUS

It is recommended that Section A be taught first, followed by Sections B and C.

The organisation of each section in the syllabus is designed to facilitate inquiry-based learning and to ensure that connections among biological concepts are established. Teachers should ensure that their lessons stimulate the use of all of the senses in learning as this will help students view science as a dynamic and exciting investigative process.

The general and specific objectives indicate the scope of the content including practical work that should be covered. However, unfamiliar situations may be presented as stimulus material in examination questions.

This syllabus caters to varying teaching and learning styles, with specific attention being drawn to the interrelatedness of concepts. The fourth column entitled, "Skills and Interrelationships" states which specific objectives are best suited for the assessment of Drawing (DR), Observation, Recording and Reporting (ORR), Manipulation and Measurement (MM), Analysis and Interpretation (AI), and Planning and Designing (PD) skills. Whenever possible, a practical approach should be employed, with special attention given to the identification of variables and to the use of controls in biological investigations. Students should be encouraged to use information gathering tools and social networking media to aid investigation and teamwork. The need for repeated investigation and observations to arrive at meaningful conclusions should be emphasised.

Column four also highlights connections between biological concepts and the fields of Chemistry, Physics, Mathematics and other related disciplines. In order to make the course as relevant as possible, students' awareness of the effect of science on society and on the environment should be encouraged. All aspects of the environment: social, biological and physical must be considered in totality.

Greater emphasis should be placed on the application of scientific concepts and principles and less on the factual materials, which encourage memorisation and short-term recall. Every opportunity should be made to relate biological studies to the environment, and to use an ecological approach whenever pertinent. Biological principles should be illustrated by specific local and regional examples. Common names of organisms are acceptable.

The relationship between structure and function, cause and effect, stability and change is to be continually highlighted. Where appropriate, this relationship should be illustrated by the use of annotated diagrams.

The role of the teacher is to facilitate students' learning of accurate and unbiased information that will contribute to a more scientifically literate society that is capable of making educated and ethical decisions regarding the world we live in.

♦ CERTIFICATION AND DEFINITION OF PROFILES

The syllabus will be examined for General Proficiency certification.

In addition to the overall grade, there will be a profile report on the candidate's performance under the following headings:

(a) Knowledge and Comprehension;

(b) Use of Knowledge;

(c) Experimental Skills.

Knowledge and Comprehension (KC)

Knowledge	The ability to: identify, remember, and grasp the meaning of basic facts, concepts and principles;
Comprehension	select appropriate ideas, match, compare and cite examples of facts, concepts and principles in familiar situations.

Use of Knowledge (UK)

	The ability to:
Application	use facts and apply concepts, principles and procedures in familiar and novel situations; transform data accurately and appropriately; use formulae accurately for computational purposes;

Analysis and Interpretation	identify and recognise the component parts of a whole and interpret the relationship among those parts; identify causal factors and show how they interact with each other; infer, predict and draw conclusions; make necessary and accurate calculations and recognise the limitations and assumptions inherent in the collection and interpretation of data;
Synthesis	combine component parts to form a new and meaningful whole; make predictions and solve problems;
Evaluation	make reasoned judgements and recommendations based on the value of ideas, information and their implications.

Experimental Skills – (XS)

Manipulation/Measurement	The ability to: follow a detailed set or sequence of instructions; use techniques, apparatus and materials safely and effectively; make observations and take measurements with due regard for precision and accuracy.
Observation/Recording/Reporting	The ability to: select observations relevant to the particular activity; make accurate observations and minimise experimental errors; report and recheck unexpected results; select and use appropriate models of recording data or observations, for example, graphs, tables, diagrams; record observations, measurements, methods and techniques with due regard for precision, accuracy, and units; present data in an appropriate manner, using the accepted convention of recording errors and uncertainties; organise and present information, ideas, descriptions and arguments clearly and logically in a complete report, using spelling, punctuation and grammar with an acceptable degree of accuracy; report accurately and concisely using scientific terminology and conventions as necessary.

Planning and Designing	The ability to: make predictions, develop hypotheses and devise means of carrying out investigations to test them; plan and execute experimental procedures and operations in an appropriate sequence; use experimental controls where appropriate; modify an original plan or sequence of operations as a result of difficulties encountered in carrying out experiments or obtaining unexpected results; take into account possible sources of errors and precaution in the design of an experiment; select and use appropriate equipment and techniques.

♦ FORMAT OF THE EXAMINATIONS

Paper 01 (1 hour 15 minutes)	An objective test consisting of 60 multiple choice items.
Paper 02 (2 hours 30 minutes)	One compulsory data analysis question, two structured questions and three extended response questions.
Paper 03/1 School-Based Assessment (SBA)	School-Based Assessment will evaluate the achievement of the candidate in the Experimental Skills and Analysis and Interpretation involved in the laboratory and fieldwork. Candidates will be required to keep a separate practical workbook. CXC will require a sample of these for external moderation.
Paper 03/2 Assessment for Private candidates only (2 hours 10 minutes)	Alternate to the School-Based Assessment for private candidates. This paper will examine the same skills as those tested in Paper 03/1. The focus, therefore, will be on Experimental Skills and Use of Knowledge (Analysis and Interpretation).

NOTES ON THE EXAMINATION

1. There will be a combined Question Paper and Answer Booklet for Paper 02.

2. The International System of Units (S. I. Units) will be used on all examinations papers.

WEIGHTING OF PAPERS AND PROFILES

The percentage weighting of each paper and profile is presented in Table 1.

Table 1
Percentage Weighting of Papers and Profiles

PROFILES	***PAPER 1*** *Multiple Choice*	***PAPER 2*** *Structured and Data Analysis*	***PAPER 3*** *SBA*	***TOTAL RAW***	***TOTAL*** *%*
Knowledge and Comprehension	*60*	*36*	*-*	*96*	*48*
Use of Knowledge	*-*	*55*	*10*	*65*	*32.5*
Experimental Skills	*–*	*9*	*30*	*39*	*19.5*
TOTAL %	***60***	***100***	***40***	***200***	***100***

♦ REGULATIONS FOR PRIVATE CANDIDATES

Private candidates must be entered for examination through the Local Registrar in their respective territories and will be required to sit Papers 01, 02 and 03/2.

Paper 03/2 is a practical examination designed for candidates whose work cannot be monitored by tutors in recognised educational institutions. The Paper will be of 2 hours and 10 minutes duration and will consist of three questions. Questions will test the Experimental Skills and Use of Knowledge (Analysis and Interpretation) profiles and will incorporate written exercises and practical activities.

♦ REGULATIONS FOR RESIT CANDIDATES

Resit candidates must complete Papers 01 and 02 and Paper 03 of the examination for the year for which they re-register. Resit candidates may elect not to repeat the School-Based Assessment component, provided they re-write the examination no later than two years following their first attempt.

Candidates may opt to complete the School-Based *Assessment (SBA) or may opt to re-use another SBA score which satisfies the condition below.*

A candidate who re-writes the examination within two years may re-use the moderated SBA score earned in the previous sitting within the preceding two years. Candidates re-using SBA scores in this way must register as "Resit candidates" and provide the previous candidate number.

All resit candidates may enter through schools, recognized educational institutions, or the Local Registrar's Office.

♦ *THE PRACTICAL APPROACH*

The syllabus is designed to foster the use of inquiry-based learning through the application of the practical approach. Students will be guided to answer scientific questions by a process of making observations, asking questions, doing experiments and analyzing and interpreting data. The CSEC Biology Syllabus focuses on the following skills.

1. *Planning and Designing (PD)*

(a) *Ask questions: how, what, which, why or where. (Students must be guided by their teachers to ask scientific questions).*
Observation: Growth of plants are affected by their environment.

Example: Will plants that are grown using organic fertilizers grow taller than those that are grown using inorganic fertilizers?

(b) *Construct a hypothesis; the hypothesis must be clear, concise and testable.*

Example: Plants grown using organic fertilizer will grow taller than those grown using inorganic fertilizer.

(c) *Design an experiment to test the hypothesis. Experimental reports must include the following:*

(i) problem statement;

(ii) an appropriate aim related to the hypothesis;

(iii) list of materials and apparatus to be used;

(iv) observations to be made or measurements to be taken;

(v) precautions to be taken;

(vi) method of controlling variables;

(vii) clear and concise step by step procedure;

(viii) display of expected results;

(ix) use of results;

(x) possible limitations.

2. *Measurement and Manipulation (MM)*

(a) *Student's ability to handle scientific equipment competently.*

The list of equipment is:

(i) Bunsen burner;

(ii) Tripod stand with wire gauze;

(iii) binocular and monocular light microscope;

(iv) measuring cylinders (25-100cm^3);

(v) beaker (50-500cm^3);

(vi) *thermometer;*

(vii) *ruler;*

(viii) *stop watch/clock;*

(ix) *balance;*

(x) *boiling tube;*

(xi) *test tubes and test tube holders;*

(xii) *hand lens;*

(xiii) *syringe.*

(b) *Student's ability to take accurate measurements.*

(c) *Student's ability to use appropriate units.*

3. *Observation, Reporting and Recording (ORR)*

(a) *Recording*

Student's ability to record observations and to collect, organise and present data. Observations and data may be recorded in the following format.

(i) *Prose*
Written description of observations in the correct tense.

(ii) *Table (Neatly enclosed)*
Numerical: physical quantities in heading, units stated in heading, symbols, decimal points.
Non-numerical: headings correct, details present.

(iii) *Graph*
Axes labelled, correct scales, correct plotting, smooth curves/best fit lines, key to explain symbols if more than one dependent variable is being plotted.

(b) *Reporting*

Student's ability to prepare a comprehensive written report on their assignments using the following format:

(i) ***Date*** *(date of experiment).*

(ii) ***Aim/Purpose*** *(what is the reason for doing the experiment).*

(iii) ***Apparatus and Materials*** *(all equipment, chemicals and materials used in the experiment must be listed).*

(iv) ***Method/Experimental Procedure*** *(logically sequenced, step-by-step procedure written in the past tense, passive voice).*

(v) ***Results and Observations*** *(see a above: Observation/ Recording/Recording).*

(vi) ***Discussion and Conclusion*** *(see 4 below: Analysis and Interpretation).*

4. *Analysis and Interpretation*

Student's ability to:

(a) *identify patterns and trends, cause and effect, stability and change ;*

(b) *make accurate calculations;*

(c) *identify limitations and sources of error,*
make a conclusion to either support or refute the hypothesis,
compare actual results with expected results based on background/theoretical knowledge if they are different;

(d) *suggest alternative methods or modification to existing methods;*

(e) *analysing and interpreting results and observations and making conclusions.*

5. *Drawing (Dr)*

The following guidelines should be used for drawing.

(a) *The drawing should be placed in a position on the page which will allow for neat and clear labelling.*

(b) *If the drawing/diagram is included in the written material, it should be placed just before this material and should be referred to in your answer.*

(c) *Drawings should be done in pencil. The use of coloured pencils is not recommended.*

(d) *The drawing should be large enough so that all structures can be clearly drawn.*

(e) *The drawing should be correctly proportioned and parts should be accurately positioned.*

(f) *In order to get a smooth, unbroken line when drawing, lift the pencil from the paper as infrequently as possible until the line is completely drawn. This method will help to eliminate haphazard and sketchy lines.*

(g) *When a large number of small structures are present in a specimen, draw only a few of them carefully, showing structural details.*

(h) *Write labels in pencil.*

(i) *Labels should be annotated (that is, accompanied by brief explanatory notes).*

(j) *Label lines should never cross each other and should be horizontal where possible.*

(k) *In drawings where only a few structures are being labelled, all labels should be written on the right of the drawing.*

(l) *Drawings must have a full title and magnification. This is usually written below the drawing and underlined. The title tells the name of the structure or organism and the view from which the drawing was made.*

♦ SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT

SECTION A is designed as an introduction to the rest of the syllabus. It is expected that in the teaching of this section, students will work in groups outside of the classroom in order to study the interrelationships between organisms and their environment and to better facilitate their appreciation of the diversity and complexity of these relationships.

GENERAL OBJECTIVES

On completion of this Section, students should:

1. be aware that there is both diversity and similarity of form in living organisms;
2. understand the importance of the abiotic environment to living organisms;
3. understand that there is interdependence between living organisms and their environment;
4. understand that there is a flow of energy through living organisms within the ecosystem;
5. appreciate the finite nature of the 'worlds' resources *and the significance of recycling materials in nature;*
6. *be aware of the effect of human activities on the environment*;
7. apply the knowledge of the interrelationship of organisms with the environment to identify problems affecting the growth and survival of populations.

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
1.1. *group* living organisms found in a named habitat based on observed similarities and differences;	*Visible characteristics, such as* hairiness, colour, shape, venation, number of legs and wings, and body segmentation of organs found in both plants and animals as appropriate. Common names of organisms and groups are acceptable.	*Nature walks. Organise students in groups to observe organisms (plants and/or animals) in their natural habitat.*	*Skills: ORR; Dr.*
1.2 *classify organisms into taxonomic groups based on physical similarities;*	*Simple classification of all living organisms into the five kingdoms: Plantae, Animalia; Fungi (mushroom), Prokaryotae (Bacteria) and Proctotista (amoeba). Further subdivision of the Animal Kingdom into Phyla, for example, Chordata which*	*Make drawings and construct tables to record observations.*	*Continuity and Variation Skill: Dr.*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
	includes Classes (fish, reptiles, insects, birds mammals). These are further classified to the level of species. Modern classification uses DNA sequences to determine ancestry. Refer to SO A 2.2; B 1.1 *Note: Flowcharts could be included with drawings under Practical activities.*		
2.1 carry out a simple ecological study using the most appropriate collecting and sampling methods;	*Habitats may include terrestrial and aquatic, for example, a tree, wall or small pond.* Features of each habitat. Relationship between organism and habitat – adaptations that enable the organism(s) to survive in that habitat. Relationship between equipment used and habitat and species being investigated.	*Use quadrats to investigate the distribution of species in a particular habitat; estimate the density of a particular species. Calculate average (mean). Density = Total No. of organisms per unit area.* Use of pooters, bottles, jars, nets, sieves, quadrats, line and belt transects, mark, release and recapture methods to collect data on organisms from a named habitat.	*Math - Simple statistical analysis.* *Data collection and presentation.* *Skills: ORR; MM; Dr; PD.*
2.2 distinguish between the following pairs of terms: (a) abiotic and biotic factors, (b) niche and habitat,	Ecology – the study of living organisms in their environment. Ecosystem- a community of living organisms sharing an environment. Environment – *the* abiotic (non-living chemical and		*Skill: ORR.*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
(c) population and community, (d) species and population;	physical) and biotic (living) factors. Habitat - the place where a particular organism lives. Niche – the role of an organism in an ecosystem. Species – a group of individuals of common ancestry that closely resemble each other and are normally capable of interbreeding to produce a fertile offspring. Population – members of a particular species living in a particular habitat. Community – all the populations of different species found living in a particular habitat.		
2.3 discuss the impact of the abiotic factors (soil, water, climate) on living organisms;	Importance of soil in providing water, mineral nutrients and oxygen; importance of air in providing various raw materials: oxygen, carbon dioxide, nitrogen. Importance of light and temperature. Refer to SO A 5.1.	*Components of soil – air (O_2) and, water-holding capacity, mineral nutrients, pH and salinity.*	*Chemistry - Elements, mixture and compounds; Oxidation; Decomposition Biodegradable; Recycling; Homeostasis.* *Skills: ORR; MM.*
3.1 identify the relative positions of producers and consumers in food chains;	Construct food chains and simple pyramids.	*Provide a number of organisms from which to construct a food chain and a food web.*	*Interdependence on living organisms.*
3.2 identify *from each habitat, a food chain containing at least four organisms;*	*Terrestrial (arboreal and edaphic) and aquatic (marine and freshwater) habitats.*	*Construct food chains using organisms in each habitat.*	*Energy relations.*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
3.3 identify from each habitat: herbivore, carnivore and omnivore;	Not to be confined to familiar domestic animals.		
3.4 identify from each habitat, predator/ prey relationships;	*Terrestrial arboreal and edaphic) and aquatic (marine and fresh water) habitats. Example of the application of predator relationship. The use of 'Biological Controls'.*		*Link: Predator/Prey Relationships, Natural Selection.*
3.5 construct a food web to include different trophic levels;	Use of examples from the habitat(s) investigated. Students may be required to interpret a food web containing unfamiliar examples.	*Identify different trophic levels in food webs.*	*Energy Flow in an Ecosystem.*
3.6 explain the role of decomposers;	*Role of fungi and bacteria in converting complex compounds to simple substances.*	*Action of mould on bread, production of biogas from domestic organic waste material.*	*Chemistry- Hydrolysis. Enzyme. Nutrient cycling.*
3.7 assess the special relationships among organisms;	*Simple treatment of symbiotic relationships: parasitism, commensalism, mutualism - using local examples, such as lice and ticks on mammals, epiphytes on trees, nitrogen fixing bacteria in root nodules of legumes. Give names of partners.*	*Observations from a large tree. Examine root nodules, on the peanut plant.*	*Evolution Interdependence of living organisms and their environment.* *Skill: ORR.*
4.1 explain energy flow within a food chain or web;	*Simple diagram of non-cyclic energy flow from the sun.*		*Different forms of energy.*
5.1 explain, with examples, the impact of the continual re-use of materials in nature;	*Note the role of decomposers in the Carbon Cycle. Refer to SO A3.6.*		*Nutrient cycling.*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
5.2 discuss the importance of and difficulties encountered in recycling manufactured materials;	Consider biodegradable and non-biodegradable materials, collection, transport and storage; note economic factors.	*Interpret data on waste management and pollution in the Caribbean (See Caribbean Environmental Outlook).*	*Chemistry and Social Sciences.*
6.1 describe the impact of human activities on natural resources;	*Energy, mineral, forest, marine, over population and over fishing.*		*Alternative sources of energy.*
6.2 explain the negative impact of human activity on the environment;	Consider pollution by agricultural practices such as use of chemical fertilizers; products of industrialization and improper garbage disposal. Impact on eco-tourism. *Loss of habitat, species; impact on human health.*	*Research projects. (For example, collect data on use of agricultural chemicals).*	
6.3 assess the implications of pollution of marine and wetland environments;	*Refer specifically to impact on the health of ecosystems, aesthetic and economic benefits to small island states.*	*Research and interpret data on pollution of marine environments in the Caribbean, for example, Coral reefs.*	
6.4 discuss current and future trends regarding climate change;	*Refer to increase in greenhouse gases, rising global temperatures, rising sea levels and ocean acidification. Particular attention should be paid to the vulnerability of small island states to climate change (See Barbados Action Plan).* *http://www.unep.ch/regionalseas/partners/sids.htm.*		*Chemistry- Natural versus synthetic Social Science – Impact of human activity.*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
6.5 suggest means by which the environment could be conserved and restored;	Consider effect of the change in practices; example use of natural materials in agriculture, conservation methods, education, monitoring strategies, organic agriculture.	*Research projects. (For example, describe a project involving conservation to include a listing the various strategies).*	
7.1 discuss the factors that affect the growth and survival of populations including human populations.	Include competition for food and space; effects of disease, pests, invasive species, natural disasters.	*Research projects. Analyse graphical data showing effect of different factors on natural populations, for example, giant snail.*	*Skill: AI.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.

1. *Construct a poster depicting either a terrestrial, marine or freshwater food web that you would find in your country. Showcase how competition, adaptation, and energy flow play key roles in the process.*

2. *Watch the videos on "Symbiotic Relationships" at PBS.org. http://www.pbs.org/wnet/nature/lessons/symbiotic-strategies/video-segments/1496/. Identify local examples of parasitism, commensalism, and mutualism in the Caribbean.*

3. *Create a PowerPoint presentation, movie or poster on the importance of Marine and Coastal areas in the Caribbean (Interpret data on pages 56-63 in the Caribbean Environmental Outlook). http://hqweb.unep.org/geo/GEO_Regions.asp Identify at least TWO threats to these fragile ecosystems.*

4. *Design a "Wanted" flyer for a criminal!! In this case, the criminal is an invasive species in the Caribbean, for example, the Small Indian Mongoose (*Herpestes auropunctatus*) and Lion fish. Invasive species are considered one of the greatest threats to island biodiversity and habitat loss. See examples of "Wanted Flyers" below: http://science.nature.nps.gov/im/units/pacn/outreach/Invasive_species_trading_cards/NPSA_trading_cards.pdf*

SECTION A - LIVING ORGANISMS IN THE ENVIRONMENT (cont'd)

5. *Discuss the main issues addressed by the 1994 Barbados Action Programme on the sustainable development of Small Island Developing States (SIDS).*

6. *Research the negative effects of climate change on your own community and write a short literary piece (short story, song, or poem) to present to the class.*

7. *Organise a debate regarding the positive and negative impacts of tourism development in your country and discuss the need for and importance of sustainable development in the Caribbean.*

8. *Arrange a debate on high population growth or high consumerism as principal causes of global environmental problems. See reports from the 1992 Rio Conference, the 1994, Barbados Programme of Action. (Note: Caribbean GEO).*

9. *Choose an environmental issue that concerns you (for example, the lack of recycling and the accumulation of plastics in the oceans which result in the death of marine mammals, invertebrates and sea turtles) or watch the video "Losing Paradise" http://www.youtube.com/watch?v=vCanbznET3Y . Write a convincing policy brief to be sent out to business owners, schools, and/or government officials in an effort to tackle this problem.*

10. *Interpret the data on forest cover in the Caribbean as presented in the Caribbean Environment Outlook by the United Nations Environmental Programme (UNEP) and CARICOM. http://hqweb.unep.org/geo/GEO_Regions.asp (Pages 34-38; http://hqweb.unep.org/geo/pdfs/Caribbean_EO_final.pdf).*

11. *Interpret the data on the state of "Waste Management" and "Pollution" in the Caribbean. (See pages 44-48 in the Caribbean Environmental Outlook); http://hqweb.unep.org/geo/pdfs/Caribbean_EO_final.pdf.*

♦ SECTION B - *LIFE PROCESSES AND DISEASE*

The life processes *will largely be illustrated* in humans and flowering plants because these are the two groups with which students are most familiar, and about which they should have some degree of understanding. **Comparisons with other organisms should be included where appropriate**. Details of anatomical structure are used to illustrate the relationships between structure and function.

There should be a focus on the interdependence of the *internal* processes *occurring at the organ and cellular levels* in maintaining the organism in a healthy state.

Diseases common in the Caribbean variously affect the quality of life of its people, the efficiency of its human resources and its economy. The purpose of this aspect of the syllabus is to make students sufficiently aware of the problems and their implications so that they can recognise and deal with them in their own environments.

GENERAL OBJECTIVES

On completion of this Section, students should:

1. know the structure of an unspecialised cell (plant and animal) and appreciate the functions of the main cell structures and of cell specialisation;

2. understand that nutrition is the means by which living organisms obtain their energy and material requirements, and this occurs in different ways;

3. understand that respiration is the means by which energy is made available for carrying out life processes;

4. *understand the role of transport, storage and defense in* living organisms;

5. understand the processes by which living organisms get rid of metabolic waste and regulate body fluid concentration;

6. understand the mechanisms of movement and appreciate its role(s) in living organisms;

7. understand that organisms detect and respond to changes in their external and internal environment;

8. understand that organisms increase in mass, size and complexity during their lives;

9. understand the processes by which life is perpetuated;

10. *appreciate the social and economic importance of disease control in plants and animals.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
1. Cells			
1.1 compare the structure of the generalised plant and animal cells, and selected microbes;	Cell wall, cell membrane, nucleus, cytoplasm, vacuoles, mitochondrion, chloroplast. *Microbes to include bacterium, Protista, for example, amoeba. Simple structure of a bacterium to include nucleoid, cell wall, capsule and flagellum.*	Draw and label cells *and cell structures from electron micrographs (mag.x2,000).*	*Structure and function relationships* *Skill: Dr.*
1.2 *distinguish between cell wall and cell membrane; mitochondrion and chloroplast;*		*Examine a variety of cells, for example, cells of Allium (purple onion),* Rhoeo discolor, *Elodea, prepared slides of blood cells, nerve cells and skin. Construct models using plasticine or other materials found around the home or laboratory.*	
1.3 r*elate the structure of organelles to their functions;*	*Simple treatment of chloroplast; mitochondrion; vacuole; nucleus. For example, nucleus: chromosomes carry genetic information in the form of DNA.* *Refer SO C1.1*		Chemistry - *DNA; proteins, chlorophyll; carbohydrates.*
1.4 differentiate between plant and animal cells;	Reference to plant cells as characterised by the presence of a cell wall, large vacuoles and chloroplasts. Relate structure to function.		

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
1.5 explain the importance of cell specialisation in multi-cellular organisms;	*Examples of tissues from both plants and animals. Consideration that a number of different tissues (for example, epidermis, xylem, phloem) come together to form organs (leaf, stem) and organ systems (transpiration; translocation).* *Refer to SO B.4.7, 4.11.*	*Examine and draw the cross section of a stem or root as seen under the light microscope*	*Hierarchy of cells, tissues, organs; organ systems; organism; population; community, ecosystem.* *Refer to SO A2.2.* *Skills: ORR; DR*
1.6 *explain the processes of diffusion and osmosis;*	*Importance of diffusion and osmosis in transporting substances in and out of cells and from one cell to another in all living organisms. Reference to the cell membrane as a differentially permeable membrane, contrast with cell wall which is freely permeable.*	*Carry out simple investigations to illustrate the movement of particles (molecules and ions).* *Identify every-day instances of these processes occurring.*	*Physics-Osmosis, diffusion.* *Chemistry-Particulate nature of matter; ions.* *Skills: ORR; MM; AI.*
1.7 discuss the importance of diffusion, osmosis and active transport in living systems.	*Cite examples of each process occurring in living organisms. For example, diffusion across membrane of Amoeba, gas exchange across respiratory surfaces, absorption in small intestine, active uptake of mineral ions by plant roots.*		*Physics and Chemistry-Osmosis, diffusion.*
2. Nutrition			
2.1 distinguish among heterotrophic, autotrophic and saprophytic nutrition;	Simple inorganic substances used by plants compared to complex organic substances consumed *by animals and fungi.* *Refer to SO A2.7.*	*Identify sources of food for a named organism for each type of nutrition.*	*Chemistry-Water, nitrogen, carbon dioxide, starch, sugars, protein. Photosynthesis; respiration; decomposers. Energy relations.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
2.2 describe the process of photosynthesis in green plants;	Simple treatment involving an equation to summarize the process; - *the evolution of oxygen as a result of the splitting of water by light energy;* - *the subsequent reduction of carbon dioxide to a carbohydrate;* - *the chloroplast as the site of the reaction;* - *role of chlorophyll;* - *the fate of products (metabolised to provide energy or stored).*	*Test for evolution of oxygen using water plant. Carry out controlled experiments to demonstrate that light and chlorophyll are necessary for photosynthesis; Tests for end products, starch or reducing sugar.*	*Chemistry - Oxidation and reduction.* *Skills: ORR; MM.*
2.3 relate the structure of the leaf of a flowering plant to its function in photosynthesis;	*The external features* and the internal structure of a dicotyledonous *leaf as seen in cross section under the light microscope. Emphasise adaptations for photosynthesis (stomata; intercellular spaces; chloroplasts in palisade layer close to epidermis).*	*Draw and label the external features and internal structure of a dicotyledonous leaf as seen in cross section.*	*Role of water for opening of stomata; diffusion of CO_2.* *Skills: ORR; Dr.*
2.4 explain how environmental factors affect the rate of photosynthesis;	Use green and variegated leaves of hibiscus.	*Investigations to include temperature, water and CO2.*	*Chemistry- Properties of some bio-molecules. Physics-Forms of energy, wavelengths of light; Fluorescent molecules. Skills: ORR; Dr; MM, PD.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
2.5 discuss the importance of minerals in plant nutrition using nitrogen and magnesium as examples;	*Emphasis on the importance of nitrogen in the formation of proteins and magnesium in the formation of chlorophyll.*	*Investigate the effect of the lack of nitrogen on seedlings.*	*Chemistry- Oxidation and reduction.* *Skills: PD; ORR; MM; AI.*
2.6 perform tests to distinguish among food substances;	*Starch, protein, lipids, reducing and non-reducing sugars; chemical and physical properties (solubility) of carbohydrates, proteins, lipids; hydrolysis and condensation (dehydration synthesis).*	*Test for proteins (Biuret), fats (grease spot, ethanol – emulsion tests), starch (iodine), reducing sugars (Benedict's solution). Note the necessity for hydrolysis and neutralisation in testing for non-reducing sugars.*	*Chemistry–Redox solubility, Organic Chemistry- condensation/hydrolysis.* *Skills: ORR; MM.*
2.7 relate the structures of the human alimentary canal to their functions;	*Simple diagrams of the alimentary canal and internal structure of a tooth required.* *Mastication and the role of teeth in the mechanical breakdown of food to be included.*		*Skill: Dr.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
2.8 explain the role and importance of enzymes;	*Inclusion of catalysis. Properties of enzymes, role of digestive enzymes in the mouth, stomach and pancreatic enzymes in the small intestine.*		*Chemistry - Rate of reaction, properties of proteins. Skills: ORR; MM; AI.*
2.9 investigate the effect of temperature and pH on the activity of the enzymes catalase or amylase;	*Candidates may be asked to deduce from tables and graphs the effects of temperature and pH on enzyme activity.*		*Chemistry-Acids and bases rate of reaction; Math - Simple graphs.* *Skills: ORR; MM; AI and PD.*
2.10 describe what happens to the products of digestion after their absorption;	*Simple diagram of villi and role in absorption of products of digestion. Transport to the liver and assimilation to be included, that is, how products are used and what happens to excess. Link to blood sugar control Refer to SO B5.2, 5.3*		*Homeostasis.*
2.11 discuss the importance of a balanced diet in human.	*Components of a balanced diet (including vitamins and minerals and their roles). The results of their deficiency or surplus (malnutrition). The effects of age, sex and occupation on dietary needs. Vegetarianism Dietary recommendations for treating and preventing named deficiency and physiological diseases – diabetes and hypertension.*		*Nutrition/Special diets.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
3. Respiration			
3.1 describe the process of aerobic respiration;	*Involvement of enzymes in releasing energy as ATP. Distinguish between respiration and breathing.* *Simple treatment. A chemical and word equation to show the starting materials and final products of aerobic respiration is required.*		*Chemistry- Endothermic and exothermic reactions. Physics - First and second law of thermodynamics.*
3.2 distinguish between aerobic and anaerobic respiration;	*Include the production of lactic acid in muscle, alcohol and carbon dioxide in plants, production of bio-gas from organic matter.*	*Simple investigations to show the products of anaerobic respiration in yeast.*	*Chemistry- Reactions involved in making bread and in vigorous exercise.* *Skills: MM; ORR; AI.*
3.3 *describe the mechanism of breathing in humans and gaseous exchange in flowering plants;*	*Simple diagrams to show the relationship between the trachea, the bronchi, alveoli and lungs and the diaphragm and ribcage required.* The necessity for a continuous supply of oxygen and the removal of waste products to be included. O*xygen debt.* *Refer to SO B1.7, 3.2.*	Use of model of the thorax. *Note limitations.*	*Physics-Pressure, Diffusion.* *Skills: Dr, AI.*
3.4 identify characteristics common to gaseous exchange surfaces;	*Emphasis on mechanisms for increasing surface area in humans, fish and plants. Refer to SO B1.7.*	*Examine lungs of a mammal, gills of fish and various types of leaves.*	*Skill: Dr.*

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
3.5 *discuss the effects of smoking.*	*For example, nicotine addiction, damage to the lining of the lungs, cancer-causing effects and reduction in the oxygen carrying capacity of the blood. Marijuana addiction, acute chest illness, obstruction of airways (no further details required).*	*Interpret smoking data worldwide and for the Caribbean (cigarette use, death rates, cancer incidence).*	*Drug abuse and health.*
4. Transport			
4.1 explain the need for transport systems in multi-cellular organisms;	*The limitations of simple diffusion. Comparison with single celled organism such as the amoeba. The relationship between surface area and volume.*	*Make models, such as, cubes of different sizes and compare their surface area/volume ratio.*	*Chemistry-Diffusion Mathematics – Calculating area and volume.*
4.2 identify the materials which need to be transported in animals and plants;	*Oxygen, carbon dioxide, hormones, mineral nutrients, glucose and amino acids.*		
4.3 describe *the structure and function of* the circulatory system in humans;	*Structure and function of the heart. Names of blood vessels supplying lungs, kidney, liver, brain, intestine only.*	*Draw diagrams to show differences in the structures of arteries, veins and capillaries. Examine external and internal features of fresh or preserved specimens of mammalian hearts.*	*Skills: ORR; Dr.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/ EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
4.4 relate the structure of the components of blood to their function;	Diagrams of red and white blood cells required.	*Use prepared slides only to show blood cells.* *Do not use fresh samples.*	*Skill: Dr.*
4.5 describe the role of blood in defending the body against disease;	*Include the clotting mechanism; the role of phagocytes and natural immunity.*		
4.6 explain how the principles of immunisation are used in the control of communicable diseases;	*As demonstrated by artificial immunity via vaccines.* *Refer to SO C5.4, 6.2.*		Antigen/antibody, *variation, natural selection .*
4.7 explain how the structure of xylem vessels is suited for their function;	Hollow tubes- non-living with lignified walls; no end walls- allow for a continuous flow of water.		*Physics-Cohesion, adhesion, tension.* *Skill: Dr.*
4.8 discuss the role of the process of transpiration in plants;	*Transpiration stream from roots to leaves to be included.* *Refer to SO B4.2.*	*Observe small herbaceous plant placed in coloured water.*	
4.9 describe the effect of external factors on transpiration;	*Light intensity, temperature, humidity, and air movements should be included.*	*Carry out controlled investigations.*	*Skill: ORR.*
4.10 discuss adaption in plants to conserve water;	*Simple treatment of root length, cuticle thickness, water storage.*	*Observe succulent, xerophytic plants.*	
4.11 explain how the structure of the phloem is suited to its function;	Source←------>→ Sink		*Translocation; storage organs; growing points. Formation of fruits/seeds; germination.*

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
4.12 identify the products stored in plants and animals and the sites of storage;	Roots, stems, leaves, fruits, seeds in plants; the liver, fat deposits in animals to be included. Detailed structure of storage organs not required.	*Carry out food tests for starch, sugars and oil in storage organs.*	*Chemistry-Sugar, starch, fats.* *Skills: MM, AI.*
4.13 discuss the importance of food storage in living organisms.	*Storage as a means of overcoming the need for continuous food intake or manufacture, providing for periods of scarcity, providing for special functions, such as, production of sexual or vegetative reproductive structures, development of embryos.*	*Draw and annotate stages in germinating seeds; Draw buds from plant storage organs (stems and tubers).*	*Physics-Energy. Chemistry-conversion of simple soluble substances to insoluble macromolecules.* *Skill: Dr.*
5. Excretion			
5.1 distinguish between egestion and excretion;	*Undigested material versus bilirubin in faeces, and urea in urine.*		*Metabolism.*
5.2 discuss the importance of excretion in living organisms;	*Implications of toxicity.* For example, carbon dioxide, *heat,* urea, water, oxygen, calcium oxalate and tannins.		*Chemistry-Oxygen, carbon dioxide, water.*
5.3 state how metabolic wastes are excreted from plants and animals;	*Leaf fall, loss of bark and storage in plants;* *lungs, skin, urinary systems in humans to be included.*		
5.4 relate the kidney to its osmoregulatory and excretory functions.	*Highlight structure of the urinary system and kidney tubule; The function of the parts. Mention kidney failure and dialysis.* *Role of ADH in homeostasis.*	*Annotated simple diagrams of the gross kidney structure and that of the nephron to illustrate the production of urine required.*	*Chemistry - Dialysis, Filtration contrast with Osmosis.* *Skill: Dr.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
6. Movement			
6.1 *distinguish between growth movements in plants and movement in animals;*	The distinction should be made between: (a) growth movement as shown by germinating seedlings, Refer to SO B7.2 and B8.1. (c) *Locomotion/whole* movement as illustrated by animals.	*Germinate peanuts or kidney beans or any appropriate seeds.*	*Skills: ORR; Dr; AI; MM.*
6.2 relate the structure of the skeleton to its function in humans;	Functions to include protection, support, locomotion, blood formation.	*Examine a human skeleton.*	*Physics-Centre of gravity.*
6.3 discuss the importance of locomotion in animals;	*Comparison with flowering plants; make reference to role in nutrition and reproduction.*		
6.4 describe the mechanism of movement in a human fore limb.	*The relationship between the bones and muscles of a limb. Behaviour of antagonistic muscles; types of joint, action at moveable joints.* *Draw, label and annotate a simple diagram of the long bone of a fore limb.*	*Simple line drawing to show the relationships. Note origin and insertion of muscles.*	*Physics- Moment of a force, efficiency levers.* *Skill: Dr.*

SECTION B - *LIFE PROCESSES AND DISEASE* (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
7. Irritability			
7.1 define 'stimulus' and 'response';			
7.2 describe the response of:			
(a) *green plants to stimuli;*	*The response of stems and roots of seedlings to light, touch and gravity. Relate observations to the behaviour of plants in natural situations. Refer to SO B6.1; 4.13.* *Role of auxins not required.*	*Carry out controlled investigations; make observations; record and report as appropriate.*	*Physics - Light and gravity.* *Skills: ORR; PD; MM.*
(b) invertebrates to variations in light intensity, temperature and moisture;	*The response of invertebrates* for example, millipedes, earthworms or woodlice.	*Construct simple choice chambers. Record observations.*	
7.3 define receptor and effector;	Sense organs, muscle and glands. Leaf, petiole, apical meristem.	*Reaction to hot objects, insect bites.*	
7.4 explain why the response to stimuli is important for the survival of organisms;	Reference to investigations with green plants and invertebrates in SO B7.2.		*Skill: AI.*
7.5 explain the relationship among the receptor, the central nervous system and the effector;	Emphasis on the coordinating function of the brain and spinal cord and the roles of sensory and motor neurones.		

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
7.6 explain a simple reflex action;	*Use of simple flow diagrams to show the pathway along which the impulse travels in the reflex. Diagrams showing a spinal cord and spinal nerves not required.*	*Investigate changes in pupil size in response to changes in light intensity, using mirrors, or the knee jerk reflex.*	
7.7 describe the functions of the main regions of the brain;	Cerebrum, cerebellum and medulla.	*Use models and charts.*	
7.8 *discuss the physiological, social and economic effects of drug abuse;*	*Include alcohol and one illegal drug. Mention the use and abuse of prescription drugs, for example, diet pills, tranquilisers, steroids, caffeine and analgesics (pain-killers). Refer to SO B7.6, 7.7.*	*Research project. Research and interpret data on drug abuse in your territory.*	*Chemistry-Reactions of alcohol.* *Skill: AI.*
7.9 relate the structure of the human eye to its functions as a sense organ;	Cross section or longitudinal section of the eye required. Role of rods and cones as specialized receptor cells. Refer to SO B1.5.	*Examine dissected eye of a mammal.*	*Physics-Lenses.*

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
7.10 explain accommodation; sight defects and *the* corrections *of each*;	Long and near sightedness; the use of corrective lenses; glaucoma.		*Physics –Light and image.*
7.11 *relate structure of the human skin to its function in temperature regulation and protection.*	Role of skin structures in temperature control as an example of homeostasis is required. *Refer to SO B 5.4.* *Mention skin care and the effect of chemicals. The importance of melanin and SPF (simple treatment only). Discuss the skin bleaching phenomenon.*		*Skills: ORR; Dr.*
8. Growth			
8.1 make deductions from simple investigations designed to demonstrate growth in living organisms;	Examples could involve measuring changes in length, mass or surface area using roots, leaves, or other suitable material or counting the number of leaves in a named plant from seedling to fruiting plant. Include cell division in meristem; Comparison of growth in plants and animals. Refer to Mitosis SO C4.2.	*Conduct simple exercise to investigate patterns of growth.* *Draw and interpret graphs (growth curves, histograms) from given data.*	*Skills: ORR; Dr; MM, AI, PD.*
8.2 describe the structure of a dicotyledonous seed;	*Functions of the seed. Refer. S.O. B. 4.12; 4.13.*	*Draw, label and annotate the external and internal structures of a seed.*	*Skill: Dr.*

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
8.3 describe the processes taking place within a seed during germination.	Include breakdown of food stores and translocation to growing points. Refer To SO B4.12, 8.1.	*Use food tests to compare the food substances found in cotyledons before and after germination.*	*Chemistry-hydrolysis.*
9. Reproduction			
9.1 compare sexual and asexual reproduction;	Explanation that sexual reproduction leads to variation in the off-spring while asexual reproduction is conservative -offspring identical to the parent. *Refer to SO C 4.2-4.6.*		*Genetic variation.*
9.2 describe the structure and function of the reproductive systems in humans;	Male and female reproductive systems. Functions of the various parts.	*Label and annotate given diagrams.*	*Genetic variation and meiosis.* *Skill: Dr.*
9.3 describe the menstrual cycle;	The roles of oestrogen and progesterone and the effect of pregnancy on the menstrual cycle to be included. Include pituitary/gonads.	*Use models, charts.*	
9.4 outline the mechanism for bringing gametes together, their fusion and the development of the embryo in humans;	Include implantation, functions of the amnion, placenta and umbilical cord.		
9.5 discuss the advantages and disadvantages of various methods of birth control;	For example, natural, barrier, hormonal and surgical methods. Consider social aspects.		

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
9.6 discuss the transmission and control of Acquired Immune Deficiency Syndrome (AIDS) and gonorrhoea;	Implications of sexually transmitted infections (STI's). Include causative agents. Mention prevention, treatment and control.	*Research and interpret Human Immunodeficiency Virus (HIV) incidence data in the Caribbean.*	*Genetic variation, mutations, natural selection, evolution.*
9.7 *relate the parts of a flower to their functions;*	Knowledge of: petals, sepals, anther, filament, stigma, style, ovary, ovules, embryo sac, micropyle and carpel required.	*Draw, label and annotate local specimens.*	*Skills: Dr; ORR.*
9.8 compare the structure of an insect pollinated flower and a wind pollinated flower;	Names of pollinating agents required.	*Examine and draw the various parts of an insect and wind pollinated flower.*	*Skills: ORR; Dr.*
9.9 distinguish between the processes of pollination and fertilisation;	Means by which male and female gametes are brought together and their fusion to form the zygote of a flowering plant. Include cross and self-pollination.		
9.10 explain how fruit and seed formation occur after fertilization;	Knowledge of the processes in dicotyledon plants only.		

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
Disease			
9.11 describe fruit structure including adaptations for fruit and seed dispersal.	At least one example of water, wind, mechanical and animal dispersal methods. Mention the importance of dispersal.	*Draw examples of fruits and seeds to show adaptations for dispersal.*	*Physics- Archimedes principle, density.*
10.1 distinguish among pathogenic, deficiency, hereditary and physiological diseases;	Include examples of each.		*Immunity; nutrition; genetics.*
10.2 identify the stages in the life *cycle* of a mosquito;	Include habitat and mode of life of each stage.	*Collect eggs and larvae of mosquitoes. Make observations and drawings of complete metamorphosis.*	*Skill: Dr.*
10.3 *discuss the role of the mosquito as a vector in the transmission of pathogenic diseases;*	Knowledge of malaria, dengue, yellow fever required.	*Collect and analyse data on the incidence of these diseases in the territory.*	
10.4 suggest appropriate methods of control of each stage of the life *cycle* of mosquito;	Refer to SO B10.2		
10.5 discuss the treatment and control of the four main groups of disease;	The role of diet and exercise in controlling physiological diseases: hypertension and diabetes to be included. Knowledge of insulin and glucagon required. Refer to SO B 2.11; 4.5; 9.6.		

SECTION B - LIFE PROCESSES AND DISEASE (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
10.6 discuss the social, environmental and economic implications of disease with reference to both plant and animal diseases.	Emphasize loss of productivity, loss of human life, livestock and agricultural crops. Refer to SO A7.1.	*Display and interpret statistical data from local examples.*	*Social Science.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.

1. *Create a 3D model of a plant/animal cell OR write a first person narrative from the perspective of a particular type of cell, for example, "I'm Woody, the plant cell..."*

2. *Carry out simple controlled investigations to monitor the growth of seedlings for a period of one month. Manipulate variables (for example, sunlight, water, nutrients, soil type), take measurements and report the findings.*

3. *Visit the Malaria website from the nobelprize.org and play both the "Mosquito" and the "Parasite" games on the site. Familiarise yourself with the relationship between Plasmodium (the human parasite), the mosquito (the vector) and humans (the host). http://nobelprize.org/educational/medicine/malaria/.*

4. *Work in groups to write short newspaper articles on the human body systems and the diseases that affect each (for example, the reproductive system – STIs, prostate cancer, cervical cancer).*

5. *Interpret health data by investigating the number of persons in your country who suffer from diabetes and cancer. What are the causes, incidence rates and treatments available in your area?*

6. *The Caribbean region is the most heavily affected by HIV/AIDs after Sub-Saharan Africa. Interpret HIV/AIDS data on the Caribbean as given by the United Nations. UNDP Report 2009. AIDS Epidemic Update.* http://data.unaids.org/pub/Report/2009/jc1700_epi_update_2009_en.pdf.

7. *Make educational flyers to post around your town to educate the public on facts and myths about HIV and other STIs.*

8. *Compare the anatomy of an animal of your choice to the anatomy of a human.*

9. *Create posters to highlight the structure and function of a body organ of your choice. The poster should be a creative in describing function associated, diseases and disorders, and whether a person can live without the organ.*

♦ SECTION C - CONTINUITY AND VARIATION

The teaching of Section C should highlight the implications of variation. The simple treatment of meiosis is deliberate; it is important that the consequences of the process be appreciated. Use of this knowledge for improved efficiency in agriculture should be considered.

Note to Teacher: Biological evolution refers to genetic changes in the heritable traits in a population over multiple generations and is distinct from the origins or creation of Life. Scientists agree that evolution is the central-most concept in biology and provides a well-supported explanation for the biodiversity of life and how species adapt to new challenges. In particular, the treatment of evolution in the syllabus is of great importance to Small Island Developing States (SIDS) such as those found in the Caribbean. Our territories are faced with drastic changes due to human activity, overpopulation, limited resources, susceptibility to natural disasters, overfishing, deforestation and other pressures all of which pose a risk to the survival of species. Basic treatment of Biological evolution combined with genetics can enhance awareness and enable students to make more educated decisions regarding the environment. It is noteworthy to mention that in science the word "theory" is generally defined as an explanation that is firmly supported by evidence and widely accepted within the scientific community. Finally, the importance and applications of genetic variation and biological evolution in agriculture, healthcare, technology, and conservation should be noted.

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *understand the "species" concept and the two major forms of speciation*;

2. *understand the importance of genetic variation in species;*

3. *understand the concept of the gene as it pertains to DNA, chromosomes and allele;.*

4. *understand the role of genes and heredity in determining how traits can be altered and inherited by asexual and sexual means;*

5. *understand natural selection, mutation, gene flow, and genetic drift as mechanisms for biological evolution;*

6. *understand the evidence for biological evolution and the importance and applications of biological evolution in terms of healthcare, food technology, forensic science, and conservation biology;*

7. *appreciate the social and ethical implications of genetic engineering.*

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
1.1 distinguish among DNA, chromosomes, genes and alleles;	*DNA (deoxyribonucleic acid) as nucleic acid that contain all genetic information. Gene as a portion/segment of DNA that carries information to produce a specific protein. Chromosome as DNA and protein (histones). Haploid as the 'n' number of chromosomes. Diploid as the '2n' number of chromosomes. Alleles as two or multiple forms of the same gene.*	*Construct models of the structure of DNA and chromosomes.*	*Relationships between gene; allele; DNA; chromosome protein.*
2.1 describe the process of mitosis;	*Emphasis on its importance for maintaining species chromosome number. Mention the replication of chromosomes. Names of stages are not required. Refer to SO B9.1.*	*Construct models.*	*Skill: Dr. Significance of mitosis in growth and asexual reproduction.*
2.2 explain the role of mitosis in asexual reproduction;	*Include at least two examples of asexual reproduction in plants such as sugarcane cuttings and Bryophyllum leaves.*		*Genetic variation - Genotype maintained.*
2.3 explain why asexual reproduction gives rise to genetically identical offspring;	*Cloning as the reproduction of populations of genetically identical individuals.*		*Tissue culture, Human cloning. Ethical issues.*

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
2.4 describe the process of meiosis;	*Simple treatment to include only homologous pairs, crossing over, separation of homologous chromosomes and subsequent separation of chromatids. Names of stages not required.*	*Construct models.*	*Formation of gametes (pollen; ovule; ovum; sperms).*
2.5 state the importance of halving of chromosome number in the formation of gametes;			
2.6 explain the role of meiosis in the transmission of inheritable genetic characteristics;	*Role of crossing over random assortment and recombination in genetic variation (benefits of sexual reproduction).*		
2.7 explain the meaning of the following terms: dominant trait, recessive trait, codominance, genotype, phenotype, homozygous and heterozygous;	*Codominance: blood group inheritance in humans.*		
2.8 explain the inheritance of traits (dominant and recessive genes);	*Examples to include Sickle cell anaemia, and albinism. Genetic diagrams required.*		

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
2.9 predict the results of crosses involving one pair of alleles in the heterozygous, homozygous dominant and recessive conditions;	*Include Punnet squares and pedigree charts to show dominant, recessive and co-dominant traits. Include genotypic and phenotypic ratios. Students should be able to identify the various phenotypic ratios obtained from crossing homozygous and heterozygous parental genotypes.*		
2.10 describe the mechanism of sex determination and inheritance of sex linked diseases in humans;	*Include example of sex linked disease such as haemophilia and colour blindness.*		
3.1 explain how genetic variation arises;	*Sexual reproduction; mutation.*		
3.2 explain why genetic variation is important;	*Variation makes it less likely that a change in environmental conditions will wipe out an entire species.*	*Observe and record plant and animal variations in your community, for example, hibiscus flowers, frogs, fishes, birds. Stress variations within a species, for example, humans and tomatoes.*	*Adaptation.*

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
3.3 distinguish between continuous and discontinuous variation in populations;	*Example: foot size, presence or absence of horns in cattle, pod size, tongue rolling, and leaf size. Mention genetic and environmental effects.*	*Carry out a survey on appropriate characteristics; for example, observe and record the range of variation in a particular feature of any kind of organism.*	*Skills: ORR; PD; AI.*
4.1 define a species;	*Include biological species concept (group of closely related organisms that are able to interbreed and produce fertile offspring). Give examples of species of birds, plants that can inter-breed. When two unrelated species mate, their offspring are not viable or if survive will be infertile, for example, the mule.* *Refer to SO A2.1, 2.2.*		
4.2 describe how new species are formed;	*Two types:* *-Speciation caused by physical geographic separation such as a river forming, colonizing a new island or rise of a mountain range (occurs with loss of habitat or the formation of new habitat);* *–Speciation caused by ecological and behavioral differences such as courtship behaviour/ differences in coloration. Note: Over time, species can also go extinct due to hunting/habitat loss/disease, for example, Caribbean Monk Seal.*	*Make drawings to depict both types of speciation mechanisms.*	

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	*SUGGESTED PRACTICAL ACTIVITIES*	*SKILLS AND INTER-RELATIONSHIPS*
Students should be able to:			
5.1 explain how natural selection plays a role in biological evolution;	*Natural selection as a process by which a population retains those genes which makes it adapted to its habitat. Natural selection normally preserves useful adaptations. Relate genetic variation to natural selection (variation provides the template for natural selection to act on).* *Mutation.* *The peppered moth, the Galapagos finches, bacterial resistance to antibiotics, pesticide resistance; the radiation of the Caribbean lizards. Use other local examples. For example, flower coloration: If a goat is attracted to red flowers and eats 75% of red flowers compared to the pink flowers in population, it acts as the selective force that leads to changes in the overall genetic diversity of the plant population.*	*Research how natural selection has played a role in the evolution of cassava plants, sea turtles, and Caribbean lizards.*	
5.2 distinguish between natural and artificial selection;	*Mention plant and animal breeding. Humans select traits to suit their needs. Cite local examples.*		*Agricultural Science*

SECTION C - CONTINUITY AND VARIATION (cont'd)

SPECIFIC OBJECTIVES	CONTENT/EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES	SKILLS AND INTER-RELATIONSHIPS
Students should be able to:			
6.1 describe how genetic engineering can be used to change the traits of an organism;	Changing the traits of one organism by inserting genetic material from a different organism. *Include food production and medical treatment. For example, insulin production and incorporation of beta carotene producing gene in rice for areas that are affected by night blindness.* Refer to SO B2.11; B7.3.		*Agriculture and medicine.*
6.2 discuss the possible advantages and disadvantages of genetic engineering.	*Social, ethical and ecological implications; Fingerprinting, DNA tests, gene therapy, captive breeding programmes.*		

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Section, teachers are advised to engage students in the teaching and learning activities below. These activities are designed to promote inquiry-based learning and cater to students with various learning styles.

1. *Create a comic book that gives life to the following terms: DNA, chromosome, gene, allele, haploid, diploid, dominant, recessive, co dominance, genotype, and phenotype.*

2. *Take a trip to your local zoo or aquarium to identify local examples of biodiversity in the Caribbean. Discuss why genetic variation is important.*

3. *Discover the truth about and importance of Natural Selection. Navigate through the University of California at Berkeley's site on natural selection, natural selection at work, misconceptions about natural selection, mutations, genetic variation, adaptation and artificial selection. http://evolution.berkeley.edu/evolibrary/article/evo_25.*

4. *The Caribbean is regarded as one of the world's biodiversity "hotspots" (Myers et al. 2000). Interpret data on Biodiversity in the Caribbean presented in pages 51-56 in the Caribbean Environmental Outlook; http://hqweb.unep.org/geo/pdfs/Caribbean_EO_final.pdf. Make a collage showcasing the biodiversity in your country.*

SECTION C - CONTINUITY AND VARIATION (cont'd)

5. *Diversity and adaptations of organisms. Write a research paper on the evolution of domestic dogs from wolves. Video Resources: http://www.pbs.org/wnet/nature/lessons/from-wolf-to-dog/video-segments-dogs-that-changed-the-world/4800/*

6. *Critical thinking problem: A few of months ago, the shed in Mr. Farmer's backyard suddenly became infested with flies. It was sprayed with a solution of insecticide, which killed nearly all the flies. However, sometime later, the numbers of flies increased again. The spraying process with the insecticide was repeated five (5) times, but it was clear that every time spraying was done, the insecticide became less and less effective in killing the flies. Write a short explanation for these observations.*

7. *Research some of the species in the Caribbean are gone extinct (for example, Caribbean Monk Seal, Giant tortoises (Geochelone spp), and some primates). What caused the extinction of these species?*

8. *Write a one-page plea from the viewpoint of an endangered species in your country. Why is this species important and why should it be protected?*

9. *Research the role of natural selection in the evolution of Cassava plants, Sea Turtles, Green Monkeys and Caribbean Lizards in the Caribbean. Summarise the findings on one page.*