CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Advanced Proficiency Examination
CAPE®

BIOLOGY SYLLABUS

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Introduction

The Caribbean Advanced Proficiency Examination (CAPE) is designed to provide certification of the academic, vocational and technical achievement of students in the Caribbean who, having completed a minimum of five years of secondary education, wish to further their studies. The examinations address the skills and knowledge acquired by students under a flexible and articulated system where subjects are organised in 1-Unit or 2-Unit courses with each Unit containing three Modules. Subjects examined under CAPE may be studied concurrently or singly.

The Caribbean Examinations Council offers three types of certification. The first is the award of a certificate showing each CAPE Unit completed. The second is the CAPE diploma, awarded to candidates who have satisfactorily completed at least six Units, including Caribbean Studies. The third is the CAPE Associate Degree, awarded for the satisfactory completion of a prescribed cluster of seven CAPE Units including Caribbean Studies and Communication Studies. For the CAPE diploma and the CAPE Associate Degree, candidates must complete the cluster of required Units within a maximum period of five years.

Recognised educational institutions presenting candidates for CAPE Associate Degree in one of the nine categories must, on registering these candidates at the start of the qualifying year, have them confirm in the required form, the Associate Degree they wish to be awarded. Candidates will not be awarded any possible alternatives for which they did not apply.

Biology Syllabus

RATIONALE

Science plays a major role in the evolution of knowledge. It empowers us to use creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever expanding challenges. It enhances our ability to inquire, seek answers, research and interpret data. These skills lead to the construction of theories and laws that help us to explain natural phenomena and exercise control over our environment. Science is, thus, an integral component of a balanced education.

The most important natural resource in the Caribbean is its people. If the Caribbean is to play an important role in the new global village and survive economically, a sustained development of the scientific and technological resources of its people is essential.

The diverse forms of life, investigated and recorded by human society, have led to the development of a discipline known as Biology. The study of this subject leads to an understanding and appreciation of the concept of life at all levels and, hence, to a greater respect and reverence for life. The interconnected web of life and the unique role of the human species is integral to the dynamic nature of the biosphere. Students of Biology should recognise the enormous responsibility they must undertake to ensure the continuity of life in all its forms. It is incumbent on them to use this knowledge to protect, sustain, conserve and improve the variety of life in the ecosphere. Additionally, the study of Biology prepares students for careers in biological, agricultural, environmental, medical, paramedical and applied science.

This CAPE syllabus is, therefore, designed to provide a coherent course of study which addresses, in addition to a specific knowledge base, the development of related skills and attitudes. The syllabus takes into account the requirements for tertiary education at regional and international institutions. The syllabus is structured in such a way as to ensure that students become aware of their moral, social, and ethical responsibilities, as well as, the benefits intrinsic to the practical application of scientific knowledge to careers in the scientific field.

AIMS

The syllabus aims to enable students to:

1. acquire a body of knowledge and develop an understanding of biological concepts and principles;
2. understand how new information results in reformulation or rejection of earlier models and concepts;
3. recognise the scope of Biology from the molecular level to that of entire ecosystems;
4. develop an ability to communicate biological information in a variety of acceptable ways;

5. acquire an understanding of the scientific method and be able to apply it to solving problems, both in academic and non-academic settings;

6. appreciate the impact of biological knowledge on society and its relevance to ethical, economic, environmental and technological issues;

7. acquire training in the practical skills and thought processes associated with the study of science;

8. develop the ability to apply biological knowledge and skills to relevant Caribbean situations and issues.

◆SKILLS AND ABILITIES TO BE ASSESSED

The skills students are expected to develop on completion of this syllabus, have been grouped under three main headings:

(i) Knowledge and Comprehension;

(ii) Use of Knowledge;

(iii) Experimental Skills.

Knowledge and Comprehension (KC)

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

Use of Knowledge (UK)

Application	The ability to: - use facts, concepts, principles and procedures in unfamiliar situations; - transform data accurately and appropriately; - use common characteristics as a basis for classification; - use formulae accurately for computations.

Use of Knowledge (UK) (cont'd)

Analysis and Interpretation	The ability to: - identify and recognise the component parts of a whole and interpret the relationships between 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 of data.
Synthesis	The ability to: - combine component parts to form a new meaningful whole; - make predictions and solve problems.
Evaluation	The ability to make reasoned judgements and recommendations based on the value of ideas and information and their implications.

Experimental Skills (XS)

Observation, Recording and Reporting	The ability to: - select observations relevant to the particular activity; - make accurate observations and minimise experimental errors; - recognise, identify and interpret biological materials both microscopically and macroscopically; - record observations, measurements, methods and techniques with due regard for precision, accuracy and units; - record and report unexpected results; - select and use appropriate models of recording data or observations, for example, graphs, tables, diagrams and drawings; - present data in an appropriate manner, using the accepted convention of recording errors and uncertainties;

Experimental Skills (XS) (cont'd

- 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.

Manipulation and Measurement

The ability to:

- follow a detailed set or sequence of instructions;

- make measurements with due regard for precision and accuracy;

- handle chemicals and living organisms with care;

- cut, stain and mount sections and make temporary mounts;

- set up light microscope for optimum use both under low power and high power;

- use the stage micrometer and eyepiece graticule for accurate measuring;

- assemble and use simple apparatus and measuring instruments.

Drawing

The ability to:

- make clear, accurate line representations of specimens, with no shading or unnecessary details;

- produce drawings with clean continuous lines of even thickness;

- label drawings accurately and use label lines which do not cross each other or carry arrowheads or dots;

- annotate drawings appropriately and accurately;

- make drawings which are large enough to display specific details;

- calculate the magnification of the drawings.

Experimental Skills (XS) (cont'd)

Planning and Designing	The ability to:

- identify problems, make predictions, develop hypotheses and devise means of carrying out investigations to test the hypotheses;
- 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 danger in the design of an experiment;
- select and use appropriate equipment and techniques.

Planning and Designing skills may be assessed by use of fieldwork.

◆PRE-REQUISITES OF THE SYLLABUS

Any person with a good grasp of the Caribbean Secondary Education Certificate (CSEC) Biology and Chemistry syllabuses, or the equivalent, should be able to pursue the course of study defined by this syllabus. However, successful participation in the course of study will also depend on the possession of good verbal and written communication skills.

◆STRUCTURE OF THE SYLLABUS

This syllabus is arranged into TWO Units, each made up of three Modules. Whilst each Module in each Unit is independent, together they form a coherent course of study which should prepare candidates for the world of work and studies at the tertiary level.

Unit 1: Biomolecules, Reproduction and Development

Unit 1 is expected to be covered in approximately 150 hours, and consists of three Modules. This Unit is structured as follows:

Module 1	-	*Cell and Molecular Biology*
Module 2	-	*Genetics, Variation and Natural Selection*
Module 3	-	*Reproductive Biology*

Unit 2: Bioenergetics, Biosystems and Applications

Unit 2 is expected to be covered in approximately 150 hours, and consists of three Modules. This Unit is structured as follows:

Module 1	-	*Bioenergetics*
Module 2	-	*Biosystems Maintenance*
Module 3	-	*Applications of Biology*

Each Unit forms a discrete package for certification.

The syllabus is arranged into two (2) Units, Unit 1 which will lay the foundation, and Unit 2 which expands on and applies the concepts formulated in Unit 1. It is, therefore, recommended that Unit 2 be taken after satisfactory completion of Unit 1 or a similar course. Each Unit will be certified separately.

For each Module there are general and specific objectives. The general and specific objectives indicate the scope of the content, including practical work, on which the examination will be based. However, unfamiliar situations may be presented as stimulus material in a question.

Explanatory notes are provided to the right of some specific objectives. These notes provide further guidance to teachers as to the level of detail required.

The single underlining of a specific objective and its explanatory notes, indicate those areas of the syllabus that are suitable for practical work. However, practical work should not necessarily be limited to these objectives.

It is recommended that of the approximately 50 hours suggested for each Module, a minimum of 20 hours be spent on laboratory-related activities, such as conducting experiments, making field trips and viewing audio-visual materials.

UNIT 1: BIOMOLECULES, REPRODUCTION AND DEVELOPMENT

MODULE 1: CELL AND MOLECULAR BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the chemical structure of water, carbohydrates, lipids and proteins and their roles in living organisms;

2. *understand* that cells are the basic units of living organisms, grouped into tissues and organs;

3. understand fluid mosaic model of membrane structure and the movement of substances into and out of cells;

4. *understand the mode of action of enzymes.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
1.	**Aspects of Biochemistry**	
Students should be able to:		
1.1	*discuss how* the structure and properties of water relate to the role that water plays as a medium of life;	*Water as a most suitable solvent in relation to its essential roles in transport: cellular and systemic levels.*
1.2	explain the relationship between the structure and function of glucose;	*Exact molecular ring structure in full.*
1.3	explain the relationship between the structure and function of sucrose;	*Exact molecular ring structure in full.*
1.4	*discuss how* the molecular structure of starch, glycogen and cellulose relate to their functions in living organisms;	*Molecular structure: types of bonds; chain and ring structure where appropriate; 3D nature; hydrolysis and condensation reactions; relate structure to properties.*
1.5	describe the molecular structure of a triglyceride and its role as a source of energy;	Without going into detail, the student should be made aware of the relationship between triglycerides and obesity.

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Aspects of Biochemistry (cont'd)		
1.6	describe the structure of phospholipids and their role in membrane structure and function;	*Relate structure to properties and hence to function.*
1.7	describe the generalised structure of an amino acid, and the formation and breakage of a peptide bond;	
1.8	*explain the meaning of the terms: primary, secondary, tertiary and quaternary structures of proteins;*	*Describe the types of bonding (hydrogen, ionic, disulphide) and hydrophobic interactions that hold the molecule in shape.*
1.9	*outline the molecular structure of haemoglobin, as an example of a globular protein, and of collagen, as an example of a fibrous protein;*	*Ensure that the relationships between their structures and functions are clearly established.*
1.10	*carry out tests for reducing and non-reducing sugars, starch, lipids and proteins;*	*Benedict's test, KI/I_2 test, emulsion test, Biuret test.*
1.11	*investigate and compare quantitatively reducing sugars and starch.*	
2.	**Cell Structure**	
Students should be able to:		
2.1	make drawings of typical animal and plant cells as seen under the light microscope;	*Clear drawings required (refer to page 4).* *Differences between electron and light microscope and between resolution and magnification.*
2.2	*describe and interpret drawings and electron micrographs of the structure of membrane systems and organelles of typical animal and plant cells;*	*Rough and smooth endoplasmic reticulum, Golgi body, mitochondria, ribosomes, lysosomes, chloroplasts, cell membrane, nuclear envelope, centrioles, nucleus and nucleolus.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
	Cell Structure (cont'd)	
2.3	*outline the functions of membrane systems and organelles;*	*As specified in the Explanatory Notes of Specific Objective 2.2.*
2.4	*compare the structure of typical animal and plant cells;*	*Stress similarities and differences.*
2.5	*describe the structure of a prokaryotic cell;*	
2.6	*compare the structure of prokaryotic cells with that of eukaryotic cells;*	*Outline the basis of the endosymbiotic development of eukaryotic cells.*
2.7	*explain the concepts of tissue and organ using as an example the dicotyledonous root;*	
2.8	*make plan drawings to show the distribution of tissues within an organ, such as the dicotyledonous root.*	*Use transverse section of a dicotyledonous root to illustrate tissues including parenchyma, xylem and phloem. The root is used as an organ.*
3.	**Membrane Structure and Function**	
Students should be able to:		
3.1	*explain the fluid mosaic model of membrane structure;*	*Outline the roles of phospholipids, cholesterol, glycolipids, protein and glycoproteins. Diagrams are required.*
3.2	*explain the processes of diffusion, facilitated diffusion, osmosis, active transport, endocytosis and exocytosis;*	*Emphasise the distinction between diffusion and osmosis; and active and passive processes.* *Diagrams are required.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Membrane Structure and Function (cont'd)		
3.3	investigate the effects on plant cells of immersion into solutions of different water potentials.	No calculations will be set on water potential.
4.	**Enzymes**	
Students should be able to:		
4.1	explain that enzymes are globular proteins that catalyse metabolic reactions;	*Definition of metabolism, anabolism, catabolism required.*
4.2	*explain the mode of action of enzymes in terms of an active site, enzyme and/or substrate complex, lowering of activation energy and enzyme specificity;*	*Properties of enzymes. Induced-fit hypothesis.*
4.3	*explain the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme action;*	*Construction and interpretation of graphs.*
4.4	explain the effects of competitive and non-competitive inhibitors on enzyme activity;	*Use succinic dehydrogenase, nicotine and insecticides (pyrethroids) as examples of enzyme inhibitors.*
4.5	*investigate the effects of temperature and substrate concentration on enzyme-catalysed reactions, and explain these effects.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Conduct laboratory exercises to reinforce subject matter rather than as a separate activity.*

2. *Read and use current information in this particular area, since it is constantly changing.*

3. Use multimedia and 3-dimensional models to assist in conceptualising cell and/or molecular structure.

Scientific Journals, such as:

New Scientist

Scientific American

Biological Sciences Review

News Magazines, such as:

Time

Newsweek

Discover

RESOURCES

Bradfield, P., Dodds, J. et al — *AS Level Biology*, Essex: Pearson Education Limited, 2001.

Clegg, C. with Mackean, D. — *Advanced Biology: Principles and Applications*, London: John Murray Publishers, 2006.

Jones, A., Reed, R. and Weyers, J. — *Practical Skills in Biology*, 3rd Edition, New Jersey: Pearson Prentice Hall, Pearson Education Limited, 2003.

UNIT 1
MODULE 2: GENETICS, VARIATION AND NATURAL SELECTION

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand the structure of nucleic acids and their roles in protein synthesis and nuclear division;*
2. *understand the behaviour of chromosomes, nucleus and cytoplasm in mitotic and meiotic cell division and their importance for stability and variation in a species;*
3. *understand the importance of mitosis and meiosis for stability and variation in a species;*
4. *understand the patterns of inheritance;*
5. *understand selected aspects of genetic engineering and its medical, agricultural, environmental, ethical and social implications;*
6. *understand the genetic basis of variation and its importance in natural selection.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. *Structure and Roles of Nucleic Acids*	
Students should be able to:	
1.1 *illustrate the structure of RNA and DNA using simple labelled diagrams;*	*Draw a nucleotide using shapes; recognise (not draw) the structural formulae of nucleotides, ribose, deoxyribose, pyrimidines, purines; nature of hydrogen bonds.*
1.2 *explain the importance of hydrogen bonds and base pairing in DNA replication;*	*Recognise (include) the significance of 5' and 3'; semiconservative replication; genetic code; initiation, transcription, translation, termination.*
1.3 *explain the relationship between the sequence of nucleotides and the amino acid sequence in a polypeptide;*	
1.4 *describe the roles of DNA and RNA in protein synthesis;*	*Different types of RNA and their respective roles.*
1.5 *explain the relationship between the structure of DNA, protein structure and the phenotype of an organism;*	
1.6 *describe the relationship between DNA chromatin and chromosomes.*	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
2.	**Mitotic and Meiotic Cell Division**	
Students should be able to:		
2.1	*describe with the aid of diagrams, the processes involved in mitotic cell division;*	*Include interphase.*
2.2	*make drawings from prepared slides, and/or a freshly prepared root tip squash to show the stages of mitosis;*	
2.3	*explain the importance of DNA replication for maintaining genetic stability;*	
2.4	*discuss the role and importance of mitosis in growth, repair and asexual reproduction;*	
2.5	*explain what is meant by homologous pairs of chromosomes, and the terms haploid and diploid;*	
2.6	*describe with the aid of diagrams, the processes involved in meiotic cell division;*	*Include crossing over, alignment of chromosomes at metaphase, random segregation at anaphase. Names of the intermediate stages of meiosis not required.*
2.7	*construct models to demonstrate chromosome behaviour in meiosis;*	*Pipe cleaners, plastic wire, embroidery thread. Bristol board may be used for modelling chromosome behaviour in meiosis – biodegradable materials not recommended.*
2.8	*describe how meiosis contributes to heritable variation.*	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
3.	*Patterns of Inheritance*	
Students should be able to:		
3.1	*explain the terms: gene, allele, dominant, recessive, codominant, homozygous and heterozygous;*	*Use examples.*
3.2	*use genetic diagrams to solve problems involving monohybrid and dihybrid crosses;*	*Include those involving sex linkages, codominance multiple alleles and dominant epistasis. Candidates should understand the ratios.*
3.3	*analyse the results of a genetic cross by applying the Chi-square test;*	*Formulae will be given. Set out data in tabular form.*
3.4	*determine whether the difference between the observed and expected ratio is significant using the results of the Chi-square test.*	*Include the concept of probability. Explain the use of 0.05 confidence limits and the null hypothesis.*
4.	*Aspects of Genetic Engineering*	
Students should be able to:		
4.1	*outline the principles of restriction enzyme use in removing sections of the genome;*	
4.2	*explain the steps involved in recombinant DNA technology;*	*Include isolation of genes; cloning of genes; vectors. Use examples including insulin production.*
4.3	*discuss the possible benefits and hazards of gene therapy;*	*Use examples including cystic fibrosis.*
4.4	*discuss the implications of the use of genetically modified organisms on humans and the environment.*	*Medical, agricultural, ethical and social implications.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
5. <u>Variation and Natural Selection</u>	
Students should be able to:	
5.1 Explain why sexually produced organisms vary in characteristics;	
5.2 describe gene and chromosome mutations;	
5.3 *discuss the implications of changes in DNA nucleotide sequence for cell structure and function in sickle cell anaemia;*	
5.4 explain how mutation brings about genetic variation;	*Consider sickle-cell anaemia, Down Syndrome.*
5.5 explain why heritable variation is important to selection;	
5.6 *explain how environmental factors act as forces of natural selection;*	*Include examples, such as resistance to antibiotics, Biston betularia (peppered moth).*
5.7 explain how natural selection may be an agent of constancy or an agent of change;	*Directional, disruptive and stabilising selection; knowledge of appropriate graphs is required.*
5.8 *discuss* how natural selection brings about evolution;	*Darwin's theory, its observations and conclusions.*
5.9 *discuss the biological species concept;*	*Discuss the limitations of this concept, for example, in breeding.*
5.10 explain the process of speciation.	*Include isolating mechanisms – reproductive, geographic, behavioural and temporal, allopatric and sympatric speciation with reference to two named examples.*

UNIT 1
MODULE 2: *GENETICS, VARIATION AND NATURAL SELECTION (CON'TD)*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Attempt several exercises in order to gain familiarity with the mathematical aspects of Biology and to appreciate levels of significance.

2. *Review literature on biodiversity and conservation.*

3. *Discuss how humans use artificial selection to create, for example, domesticated animals, different breeds of dogs, chickens that lay a lot of eggs, Barbados Blackbelly sheep, Jamaica Hope.*

RESOURCES

Gaston, K. and Spicer, J. — *Biodiversity – An Introduction*, 2nd Edition, United Kingdom: Blackwell Publishing, 2004.

National Geographic Magazine

Video and/or Television materials such as those found on the Discovery Channel

Darwin_ online.org.uk

Conservation International Website (http:// www.conservation.org)

PBS Evolution website http://www.pbs.org/wgbh/evolution works on Darwin

www.merlot.com

www.nap.edu/readingriom/books/evolution98 *teaching about evolution in the nature of science.*

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand asexual reproduction and vegetative propagation;*

2. *understand sexual reproduction in the flowering plant;*

3. *understand sexual reproduction in humans.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. *Asexual Reproduction and Vegetative Propagation*	
Students should be able to:	
1.1 *explain the term asexual reproduction;*	*Discuss binary fission, budding, asexual spore formation, fragmentation; one example of asexual reproduction in plants, for example, ginger, meristems, hormone stimulation, details of the processes involved in tissue culture and the production of cuttings.*
1.2 *discuss the advantages and disadvantages of asexual reproduction;*	
1.3 *explain the principles and the importance of vegetative propagation as exemplified by the use of cuttings and tissue culture;*	
1.4 *discuss the genetic consequences of asexual reproduction.*	
2. *Sexual* **Reproduction in the Flowering Plant**	
Students should be able to:	
2.1 describe the structure of the anther and the formation of pollen grains;	*Annotated* diagrams required.
2.2 describe the structure of the ovule and the formation of the embryo sac;	*Annotated* diagrams required.

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
<u>*Sexual*</u> **<u>Reproduction in the Flowering Plant (cont'd)</u>**		
2.3	*<u>make drawings of the anther and embryo sac from prepared slides;</u>*	
2.4	*explain how cross-fertilisation is promoted;*	Non-synchronous maturation of stamens (P*rotogyny)* and carpels *(protandry)*, separate sexes *(dioecy)*, insect pollination, self incompatibility *and sterility*.
2.5	*discuss the genetic consequences of sexual reproduction;*	*Include self fertilization and cross fertilization.*
2.6	*explain the sequence of events from pollination to fertilization;*	*Annotated diagrams required.*
2.7	*explain the significance of double fertilization in the embryo sac;*	
2.8	*discuss the development of the seed and the fruit from the embryo sac and its contents, the ovule and the avary.*	*Types of fruits not required.*
3.	*<u>Sexual Reproduction in Humans</u>*	
Students should be able to:		
3.1	describe the structure and function of the male and female reproductive systems;	*Annotated* diagrams required.
3.2	<u>make drawings from prepared slides of the mammalian ovary and testis</u>;	
3.3	explain gametogenesis;	*Explain the difference between the secondary oocyte and ovum.*
3.4	*compare the structure of the ovum and the sperm;*	

UNIT 1
MODULE 3: REPRODUCTIVE BIOLOGY (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Sexual Reproduction in Humans **(cont'd)**		
3.5	*discuss how the structure of the ovum and the sperm suit their functions*;	
3.6	explain how hormones regulate gametogenesis;	
3.7	discuss the importance of hormones in the control of the menstrual cycle;	Emphasise the principle of negative feedback mechanisms.
3.8	describe how and where fertilization and implantation normally occur;	
3.9	discuss how knowledge of human reproductive anatomy and physiology has been applied to the development of contraceptive methods;	
3.10	*explain the structure and functions of the placenta*;	
3.11	discuss the functions of the amnion;	
3.12	discuss the possible effects of maternal behaviour on foetal development.	Include the role of nutrition, alcohol abuse, use of legal and illicit drugs and cigarette smoking.

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Examine a range of floral structures in order to clarify varying pollination methods.
2. Invite resource personnel skilled in plant biotechnology and human reproduction.
3. Visits to appropriate *Family Planning Centres, Plant Propagation Stations and Tissue Culture Units*.

RESOURCES

Carrington, S.	*Wild Flowers of Barbados*, London and Basingstoke: Macmillan Press Limited, 1999.
Honeychurch, P.	*Caribbean Wild Plants and their Uses*, London and Basingstoke: Macmillan Caribbean, 1986.
Raven, P., Evert, R. and Eichhorn, S.	*Biology of Plants,* New York: W.H. Freeman and Company Publishers, 2002.
Taylor, D.	*Growth Development and Reproduction*, Cambridge: Cambridge University Press Advanced Sciences, 2001.

UNIT 2: BIOENERGETICS, BIOSYSTEMS AND APPLICATIONS

MODULE 1: BIOENERGETICS

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the process of photosynthesis and its role in transforming light energy into chemical energy *in the form of Adenosine Triphosphate (ATP);*

2. *understand* the process of cellular respiration and its role in producing ATP;

3. *understand* energy flow and nutrient cycling in ecosystems and their role in maintaining the stability of these ecosystems;

4. *appreciate* the ecosystem as a dynamic system involving interaction of biotic and abiotic components;

5. *be aware of biodiversity and conservation.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. *Photosynthesis and ATP Synthesis*	
Students should be able to:	
1.1 describe the structure of a dicotyledonous leaf, a palisade cell and a chloroplast *relating* these structures to their roles in the process of photosynthesis;	*Annotated* diagrams required.
1.2 make drawings from prepared slides of a transverse section of a dicotyledonous leaf, and a palisade cell;	
1.3 *explain the process of photophosphorylation;*	*Include ATP's functions as the universal energy "currency" in all living organisms.* *Include the role of pigments, and electron carriers in the process. The conversion of light energy into chemical energy of ATP, the reduction of NADP and the evolution of oxygen as a by-product should be noted. No biochemical detail is required.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Photosynthesis and ATP Synthesis **(cont'd)**		
1.4	outline the essential stages of the Calvin cycle involving the light independent fixation of carbon dioxide;	Knowledge of C_4 plants not required. Include the fixation of carbon dioxide by ribulose bisphosphate to yield phosphoglyceric acid (glycerate-3-P) and the subsequent conversion to triose phosphate and other carbohydrates. Emphasise the roles of ATP and NADP.
1.5	discuss the concept of limiting factors in photosynthesis;	
1.6	*investigate the effect of limiting factors on the rate of photosynthesis*;	*Light intensity and carbon dioxide concentration.*
1.7	discuss the extent to which knowledge of limiting factors can be used to improve plant productivity.	
2.	*Cellular Respiration and ATP Synthesis*	
Students should be able to:		
2.1	*outline* the stepwise breakdown of glucose in cellular respiration;	*Names of enzymes not required.*
2.2	*explain* the sequence of steps in glycolysis;	*Include the initial phosphorylation of glucose, lysis into two 3-carbon compounds and the subsequent production of pyruvate, a small yield of ATP and reduced NAD. Recognition of simplified structural formulae intermediate.*
2.3	*describe the structure of a mitochondrion, relating its structure to its function*;	Diagram required.
2.4	*state the fate of pyruvate in the cytosol when oxygen is available*;	*Pyruvate enters the matrix and is converted to acetyl CoA via oxidative decarboxylation.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Cellular Respiration and ATP Synthesis **(cont'd)**	
2.5 *outline the Krebs cycle;*	*Details of structures of intermediates not required.*
2.6 *explain the significance of the Krebs cycle in ATP formation;*	*Emphasise production of NADH and $FADH_2$; oxidation and decarboxylation.*
2.7 *explain the process of oxidative phosphorylation with reference to the electron transport chain;*	*Include the roles of hydrogen and electron carriers; the synthesis of ATP and the role of oxygen. No details of the carriers are required. A summary of ATP production should be known.*
2.8 *investigate the rate of oxygen uptake during respiration using a simple respirometer;*	*Germinating seeds may be used. A control is needed.*
2.9 *compare the fate of pyruvate in the absence of oxygen in animals and yeast.*	*Fermentation allows for the regeneration of NAD so that glycolysis can continue in the absence of oxygen. Include the concept of oxygen debt in mammals; and note that lactate can be converted back (oxidised) to pyruvate when oxygen is again available. Include commercial uses of yeast.*
3. Energy Flow and Nutrient Cycling	
Students should be able to:	
3.1 *distinguish among the terms ecosystem, habitat, ecological niche;*	*Use examples.*
3.2 discuss the way in which energy flows in an ecosystem;	*Food chains and food webs. Emphasise the advantages of the food web.*
3.3 discuss the efficiency of energy transfer between trophic levels;	
3.4 discuss the concept of biological pyramids;	Include the limitations of the pyramids of numbers, biomass and energy.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Energy Flow and Nutrient Cycling (cont'd)	
3.5 *describe how nitrogen is cycled within an ecosystem;*	Include the role of microorganisms.
3.6 distinguish between energy flow and nutrient cycling within an ecosystem;	
3.7 explain how energy flow and nutrient cycling are important for ecosystems to remain self-sustaining units.	
4. *Ecological Systems, Biodiversity and Conservations*	
Students should be able to:	
4.1 *discuss how ecosystems function as dynamic systems;*	*Use a named example. Include interactions between biotic and abiotic factors.*
4.2 *explain the concept of biodiversity;*	*Discuss genetic diversity, species diversity and ecosystem diversity.*
4.3 *discuss the importance of the maintenance of biodiversity;*	*Intrinsic, direct and indirect values, including medicine, natural products, tourism.*
4.4 *discuss how species diversity is related to the stability of an ecosystem;*	
4.5 *explain how in situ and ex situ conservation methods are used to maintain biodiversity.*	*Protected areas and or reserves, seed banks, botanic gardens, zoos, sperm banks, embryo banks.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Review the general principles of oxidation, reduction and electron flow.

2. Use of charts and creation of concept maps rather than excessive biochemical details.

3. Use multimedia presentation and current information available in sources, such as Nature, National Geographic and Discovery to fully appreciate ecosystem dynamics.

4. *Refer to the Eden Project in the United Kingdom.*

5. *Organise fieldtrips or fieldwork to include the use of sampling techniques and measurement of abiotic factors.*

6. *Discuss human impact on biodiversity.*

RESOURCES

Reiss, M. and Chapman, J. *Ecology: Principles and Applications,* Cambridge: Cambridge University Press, 2003.

Websites

www.savethemanatee.org
www.ramsar.org/w.n.nariva
www.ramsar.org
www.wetlands.org

UNIT 2
MODULE 2: *BIOSYSTEMS MAINTENANCE*

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand* the mechanism by which plants absorb minerals and water through the roots and transport them through the xylem;

2. *understand* translocation in the phloem;

3. *understand* the organization, structure and transport function of the mammalian circulatory system;

4. *understand* the concept of homeostasis and hormonal action;

5. *understand* the role of the kidneys as excretory and regulatory organs;

6. *understand the role of the nervous system in systems maintenance.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
1.	*The Uptake and Transport of Water and Minerals*	
Students should be able to:		
1.1	*explain the uptake of ions by active transport in roots;*	Emphasise the role of the endodermis.
1.2	describe the entry of water into plant roots in terms of water potential;	
1.3	*relate the structure of xylem vessels to their function;*	Include transport and support roles.
1.4	make drawings from prepared slides of xylem vessels;	
1.5	*outline the ascent of water in plants;*	*Root pressure, capillarity, cohesion, adhesion and transpiration pull.* Include the role of stomata in transpiration.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
The Uptake and Transport of Water and Minerals (cont'd)	
1.6 investigate the impact of environmental factors *on the rate of transpiration*.	*Include light and air movements.*
2. Transport in the Phloem	
Students should be able to:	
2.1 *relate the structure of sieve tubes* and companion cells *to their function*;	
2.2 make drawings of sieve tubes and companion cells from prepared microscope slides;	
2.3 label pertinent features in an electron micrograph of a sieve tube and companion cell;	
2.4 *explain how phloem loading in the leaves occurs against a concentration gradient*;	
2.5 discuss mass (pressure) flow as a possible mechanism of translocation.	Experimental evidence for and against this hypothesis.
3. The Circulatory System of Mammals	
Students should be able to:	
3.1 describe the structure of arteries, veins and capillaries, *relating their structures to their functions;*	
3.2 make drawings of arteries and veins from prepared microscope slides;	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
The Circulatory System of Mammals (cont'd)		
3.3	*describe the structure of the heart*;	*Annotated diagram of the heart and associated major blood vessels.*
3.4	make drawings of *a longitudinal* section of the heart;	Use fresh or preserved specimens to emphasise the 3-D structure.
3.5	explain the cardiac cycle and its initiation;	
3.6	*discuss the internal factors that control heart action*;	
3.7	define the terms blood pressure and pulse;	
3.8	discuss factors affecting blood pressure;	
3.9	make drawings of erythrocytes and leucocytes from prepared slides;	
3.10	explain the role of haemoglobin in oxygen and carbon dioxide transport;	Flow charts not required.
3.11	*describe oxygen dissociation curves for adult haemoglobin*;	*Interpret data.*
3.12	explain the significance of the effect of carbon dioxide on oxygen dissociation curves (Bohr Effect).	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
4.	*Homeostasis and Hormonal Action*	
Students should be able to:		
4.1	discuss the *concept homeostasis*;	*Receptors, effectors, set point, feedback and homeostatic equilibrium. Emphasise the dynamics of feedback mechanisms.*
4.2	*outline the general principles of hormonal action in animals*;	*Include ductless glands in animals; target cells and receptors.*
4.3	*explain how insulin and glucagon regulate blood glucose concentration*;	
4.4	*explain the effect of the plant regular molecule, ethylene (ethene), on fruit ripening*;	*Mention the gaseous nature of ethylene and its effect on respiration. Types of fruits not required.*
4.5	*discuss the commercial use made of ethylene in supplying market-ready fruit.*	
5.	**The Kidney, Excretion and Osmoregulation**	
Students should be able to:		
5.1	explain the need to remove nitrogenous and other excretory products from the body;	*Review the formation of urea.*
5.2	describe the gross structure of the kidney and the detailed structure of the nephron and associated blood vessels;	*Annotated diagrams required.*
5.3	make drawings of sections of the kidney from prepared sides;	
5.4	explain the function of the kidney in terms of excretion and osmoregulation;	Include the role of ADH.
5.5	discuss the clinical significance of the presence of glucose and protein in the urine.	

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
6.	**Nervous Co-ordination**	
Students should be able to:		
6.1	describe the structure of motor and sensory neurones;	*Annotated* diagrams required.
6.2	explain the role of nerve cell membranes in establishing and maintaining the resting potential;	
6.3	describe the *conduction* of an action potential along the nerve cell membrane;	Emphasise the value of myelinated neurons in increasing the speed of transmission.
6.4	*explain synaptic transmission*;	*Structure of cholinergic synapse. Annotated diagrams required.*
6.5	outline the role of synapses.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. *Make slides of transverse and longitudinal sections of stems, roots and leaves from living tissue, selected by the students to investigate their microscopic structure.*

2. Use binocular microscopes to examine root hairs and stomata.

3. Set up experiments on transpiration in both cut stems and potted plants to show methods and results.

4. *If possible,* visit the hospital's cardiac unit to see how a pacemaker is fitted, a blood collection centre *and/or* a medical laboratory to observe blood testing.

5. Take blood pressure measurements, and investigate the effect of exercise, rest, excitement and temperature *on blood pressure*.

6. Use models of heart and kidneys to conceptualise 3-dimensional structure.

7. Make models of xylem, phloem, sections of Bowman's Capsules, nephrons, alveoli, arteries, veins and blood components, to scale.

8. Use multimedia, Discovery and Discovery Health television programs, access the local Education Unit's Audio Visual Resource Centre, and visit Websites using keywords and keep a record and or bookmarks of useful sites.

9. Allow or assist students to take photographs of microscope slides and make projector slides.

RESOURCES

Bradfield, P., Dodds, J. et al — *A2 Level Biology,* Essex: Pearson Education Limited, 2002.

Jones, A., Reed, R. and Weyers, J. — *Practical Skills in Biology*, 3rd Edition, New Jersey: Pearson Prentice Hall, Pearson Education Ltd., 2003.

Indge, B. — *Data and Data Handling for AS and A2 Biology,* London: Hodder and Murray Publishers, 2003.

Morgan, S. — *Practical Work for Biology,* London: Hodder and Stroughton, 2002.

Time, Newsweek, Nature, Discover
Insight Media Video & CD Rom Catalogue
(www.insight-media.com)
(email, cs@insight-media.com)

UNIT 2
MODULE 3: APPLICATIONS OF BIOLOGY

GENERAL OBJECTIVES

On completion of this Module, students should:

1. *understand the terms 'health' and 'disease'*;
2. *understand the principles of immunology*;
3. *be aware of the principles underlying social and preventative medicine*;
4. *understand drug abuse and its implications.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
1. <u>Health and Disease</u>	
Students should be able to:	
1.1 discuss the meaning of the term 'health';	*Focus on the physical, mental and social aspects of health.*
1.2 *explain the categories of disease or illness*;	Include physical, mental, social, chronic, infectious, degenerate, inherited, self-inflicted, deficiency, with an example of each. *Diseases will fit into more than one category.*
1.3 *discuss reasons for the regional distribution of Acquired Immune Deficiency Syndrome (AIDS), diabetes and cancer;*	*AIDS: include the biology of the virus; length of incubation period; roles of lifestyle, ease of travel, cost of drugs and lack of education on the spread of the virus.* *Diabetes: include the effects of diet, obesity and prenatal malnutrition.* *Cancer: include roles of environmental hazards, food additives, viruses, genetic factors; implications of symptom awareness and failure to seek treatment in management of the disease.*

SPECIFIC OBJECTIVES		EXPLANATORY NOTES
Health and Disease (cont'd)		
1.4	*analyze data involving incidence and mortality rates of disease.*	*Explain the meanings of incidence and mortality rates; students should interpret and analyse data and draw conclusions and or make predictions.*
2.	*Immunology*	
Students should be able to:		
2.1	*describe the mode of action of phagocytes;*	*Review phagocytosis; include role of mast cells and histamine production; complement; phagocytes as antigen-presenting cells.*
2.2	*define the term, "immune response";*	
2.3	*compare the origin and maturation of B- and T- lymphocytes;*	*Include the types of T-cells and their function (refer to HIV); B-cells and their function.*
2.4	*distinguish between the humoral and the cell-mediated immune responses;*	*Details required.*
2.5	*explain the role of memory cells in long-term immunity;*	*T- and B- memory cells.*
2.6	*relate the molecular structure of a typical antibody molecule to its function;*	*Labelled diagram of typical antibody showing its 'Y-shaped' structure; include the function of the various parts; specificity of antibody to antigen.*
2.7	*distinguish between active and passive immunity, natural and artificial immunity;*	*Include examples.*
2.8	*explain the role of vaccination in providing immunity;*	

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Immunology **(cont'd)**	
2.9 *state what is meant by a monoclonal antibody;*	
2.10 *describe the use of monoclonal antibodies in diagnosis and treatment.*	*The anticancer drug, MabThera; details required of the use of monoclonal antibodies in pregnancy testing.*
3. Social and Preventative Medicine	
Students should be able to:	
3.1 *discuss the causative relationship among diet, obesity and diabetes;*	*Review the concept of a balanced diet; Body Mass Index (BMI); Type 1 and Type 2 diabetes.*
3.2 *describe the effects of fats on the cardiovascular system;*	*Atherosclerosis, coronary heart disease, hypertension and stroke. Details of plaque formation.*
3.3 investigate the immediate effects of exercise on the body;	
3.4 *discuss the consequences of exercise on the body and the benefits of maintaining a physically fit body;*	*Include long-term and short-term consequences; relate benefits to the prevention of chronic diseases; refer to VO_2 max and cardiac efficiency.*
3.5 *describe the mechanisms of infection for AIDS and dengue fever and their causitive agents;*	*Include processes of infection; replication of the disease-causing organisms.*
3.6 *explain how AIDS and dengue fever are transmitted;*	*AIDS: mention lifestyle.* *Dengue fever: the vector is Aedes aegypti.*
3.7 assess the impacts of AIDS and dengue fever regionally;	*Include social and economic issues.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES
Social and Preventative Medicine (cont'd)	
3.8 *discuss the roles of social, economic and biological factors in the prevention and control of AIDS and dengue fever.*	
4. Substance Abuse	
Students should be able to:	
4.1 *discuss the meaning of the term, "drug abuse";*	Legal and illegal drugs.
4.2 *distinguish between psychological and physical dependence;*	
4.3 *describe the short-term and long-term consequences of alcohol consumption on the nervous system and the liver;*	*Short-term - fatty liver, hepatitis; long-term - cirrhosis, cancer, impaired nervous transmission, demyelination, dehydration of the brain cells.*
4.4 *discuss the social consequences of excessive alcohol use;*	*Drinking and driving, aggressive behaviour, intra-family violence, family breakdown and petty crime; Include a definition of 'a unit of alcohol'; Daily Alcohol Limits (DAL) – safe limits (that is, blood and breath limits)for driving.*
4.5 *describe the effects of the components of cigarette smoke on the respiratory and cardiovascular systems.*	*Passive smoking; effects of nicotine, tar and carbon monoxide on cilia, oxygen uptake, mucus secretion; development of hyperplasia, emphysema, chronic bronchitis, cancers including lung cancer; vasoconstriction, increase in number of erythrocytes, increase in blood viscosity, formation of blood clots.*

UNIT 2
MODULE 3: APPLICATIONS OF BIOLOGY (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Module, teachers are advised to engage students in the teaching and learning activities listed below.

1. Encourage students to read and use current information in this particular area, since it is constantly changing.

2. Visit centres of excellence, such as a field station, hospital or research institute from which students can gain practical experience in these areas.

3. View documentaries which deal with these issues.

4. Invite resource personnel.

5. Group presentations.

RESOURCE

Jones, M., Fosbery, R. and Taylor, D. *Biology 1,* Cambridge: Cambridge University Press, 2000.

◆OUTLINE OF ASSESSMENT

EXTERNAL ASSESSMENT (80%)

Paper 01 *(1 hour 30 minutes)*	*Forty-five multiple-choice items, 15 from each Module. Each item is worth 1 mark.*	*40%*
Paper 02 *(2 hours 30 minutes)*	*Section A - Three compulsory structured questions, one from each Module. Each question is worth 15 marks.* *Section B – Three compulsory essay questions one from each Module. Each question is worth 15 marks.*	*40%*

INTERNAL ASSESSMENT (20%)

The internal assessment will consist of selected practical laboratory exercises.

MODERATION OF INTERNAL ASSESSMENT

An Internal Assessment Record Sheet will be sent each year to schools submitting students for the examination.

All Internal Assessment Record Sheets and sample of assignments must be submitted to reach CXC by May 31 of the year of the examination. A sample of assignments will be requested by CXC for moderation purposes.

These assignments will be re-assessed by CXC Examiners who moderate the Internal Assessment. Teachers' marks may be adjusted as a result of moderation. The Examiners' comments will be sent to schools.

Copies of the students' assignment that are not submitted must be retained by the school until three months after publication by CXC of the examination results.

ASSESSMENT DETAILS

Each Unit of the syllabus is assessed as outlined below.

External Assessment by Written Papers (80% of Total Assessment)

1. There will be a combined question paper and answer booklet for Paper 01, and for Section A of Paper 02. A separate answer booklet will be provided for Section B of Paper 02.
2. S.I. Units will be used on all examination papers.
3. The use of silent non-programmable calculators will be allowed in the examination. Candidates are responsible for providing their own calculators.

Paper 01 (1 hour 30 minutes – 40% of Total Assessment)

1. **Composition of the Paper**

This paper will consist of forty-five multiple-choice items, fifteen from each Module. All questions are compulsory and knowledge of the entire Unit is expected. The paper will assess the candidate's knowledge across the breadth of the Unit.

The question will test KC and UK skills.

2. **Mark Allocation**

The paper will be worth 45 marks, with each question being allocated 1 mark.

3. **Question Type**

Questions may be presented using diagrams, data, graphs, prose or other stimulus material.

Paper 02 (2 hours 30 minutes - 40% of Total Assessment)

1. **Composition of Paper**

This paper will consist of two sections.

Questions on this paper test all three skills KC, UK and XS.

Section A will consist of three compulsory structured questions, one question from each Module.

Section B will consist of three compulsory essay questions, one from each Module. Knowledge of the entire Unit is expected.

2. **Mark Allocation**

The paper will be worth 90 marks.

Section A - each question	-	*15 marks*
Section B - each essay	-	*15 marks*
Total marks of Section A	-	*45 marks*
Total marks of Section B	-	*45 marks*

3. **Question Type**

Questions in Section A will be presented in a structured form. The questions will test KC and UK skills. Answers are to be written in a separate answer booklet.

Questions in Section B will be essays. The mark allocation for each section will be included. Answers for this section are to be written in a separate answer booklet. The questions will test KC, UK and XS skills.

Internal Assessment (20%)

Internal Assessment is an integral part of student assessment in the course covered by this syllabus. It is intended to assist students in acquiring certain knowledge, skills and attitudes that are associated with the subject.

During the course of study for the subject, students obtain marks for the competence they develop and demonstrate in undertaking their Internal Assessment assignments. These marks contribute to the final marks and grades that are awarded to students for their performance in the examination.

Internal Assessment provides an opportunity to individualise a part of the curriculum to meet the needs of students. It facilitates feedback to the student at various stages of the experience. This helps to build the self-confidence of students as they proceed with their studies. Internal Assessment also facilitates the development of the critical skills and abilities emphasised by this CAPE subject and enhances the validity of the examination on which candidate performance is reported. Internal Assessment, therefore, makes a significant and unique contribution to both the development of relevant skills and the testing and rewarding of students for the development of those skills.

The Caribbean Examinations Council seeks to ensure that the Internal Assessment scores that contribute to the overall scores of candidates are valid and reliable estimates of accomplishment. The guidelines provided in this syllabus are intended to assist in doing so.

Award of Marks

The following are the skills that will be assessed:

a. Analysis and Interpretation
b. Manipulation and Measurement
c. Observation, Recording and Reporting
d. Planning and Designing
e. Drawing

In each Unit, a total of 12 marks are to be allocated for each skill as indicated in the Table below.

Table
Internal Assessment Skills

Skill	Unit 1	Unit 2
*Observation, Recording and Reporting	12 marks	12 marks
Manipulation and Measurement	12 marks	-
Analysis and Interpretation	12 marks	12 marks
Planning and Designing	-	12 marks
Drawing	12 marks	12 marks
TOTAL	**48 marks**	**48 marks**

***Five of the 12 marks for Observation, Recording and Reporting (ORR) are to be awarded for communicating information in a logical way using correct grammar as described in the definition of the Observation, Recording and Reporting skill on pages 3 and 4. Teachers are required to provide criteria which clearly indicate how they award marks.**

Each Module will carry a maximum of 16 marks.

Each candidate's total Internal Assessment mark for any Unit should be divided in three and allocated to each Module equally.

Fractional marks should not be awarded. Wherever the Unit mark is not divisible by three, then

(a) when the remainder is 1 mark, it should be allocated to Module 1
(b) when the remainder is 2, one of the marks should be allocated to Module 2 and the other mark to Module 3.

Appropriate practical exercises for assessing any skill may be selected from any Module in the relevant Unit. Specific Objectives identified by single underlining are suitable for practical exploration.

Specific Guidelines for Teachers

1. Each candidate is required to keep a laboratory workbook which is to be marked by the teacher. Teachers are also expected to assess candidates as they perform practical exercises in which Manipulation and Measurement skills are required.

2. A maximum of TWO skills may be assessed by any one experiment.

3. The mark awarded for each skill assessed by practical exercises should be the average of at LEAST TWO separate assessments. The maximum mark for any skill will be 12. In each Unit, total marks awarded at the end of each Module will be 0 to 16.

4. Specific Objectives lending themselves to practical work are highlighted by single underlining. However teachers need not confine their practical exercises to these objectives.

INTERNAL ASSESSMENT – GENERAL GUIDELINES FOR TEACHERS

1. For each Unit marks must be submitted to CXC on the Internal Assessment forms provided. The forms should be despatched through the Local Registrar for submission to CXC by May 31 of the Year of the examination.

2. The Internal Assessment Forms for each Unit should be completed in duplicate. The original should be submitted to CXC and the copy retained by the school.

3. CXC will require a sample of the laboratory books for external moderation. Additional laboratory books may be required. These laboratory books must be retained by the school for at least 3 months after publication of examination results.

4. Candidates who do not fulfil the requirements for the Internal Assessment will be considered absent from the whole examination.

5. Teachers are asked to note the following:

   (i) candidates' laboratory books should contain all practical work undertaken during the course of study. Those exercises which are selected for use for the Internal Assessment should be clearly identified. The skill(s) tested in these selected practical exercises, the marks assigned and the scale used must be placed next to the relevant exercises;

   (ii) teachers' criteria and breakdown of marks for assessing a skill must be clearly stated and submitted with the laboratory books;

   (iii) the standard of marking should be consistent;

   (iv) the relationship between the marks in the laboratory books and those submitted to CXC on the Internal Assessment Form should be clearly shown.

◆REGULATIONS FOR PRIVATE CANDIDATES

1. Candidates who are registered privately will be required to sit Papers 01, 02 and 03B. Detailed information on Papers 01 and 02 is given on page 38 of this syllabus.

2. **Paper 03B (Alternate to Internal Assessment) - 20%**

   This paper will be of 2 hours duration and will consist of THREE questions as follows:

   (i) a practical based question to be executed by the candidate;
   (ii) a question based on data analysis;
   (iii) a planning and design exercise.

This paper will constitute 20% of the overall assessment of the candidates' performance on the Unit.

◆REGULATIONS FOR RESIT CANDIDATES

Candidates, who have earned a moderated score of at least 50% of the total marks for the Internal Assessment component, may elect not to repeat this component, provided they re-write the examination no later than TWO years following their first attempt. These resit candidates must complete Papers 01 and 02 of the examination for the year in which they register.

Resit candidates must be entered through a school or other approved educational institution.

Candidates who have obtained less than 50% of the marks for the Internal Assessment component must repeat the component at any subsequent sitting or write Paper 03B.

◆ASSESSMENT GRID

The Assessment Grid for each Unit contains marks assigned to papers and to Modules and percentage contribution of each paper to total scores.

Papers	*Module 1*	*Module 2*	*Module 3*	*Total*	*(%)*
External Assessment *Paper 01* *(1 hour 30 minutes)* *Multiple Choice*	*15* *30 (weighted)*	*15* *30 (weighted)*	*15* *30 (weighted)*	*45* *90 (weighted)*	*(40)*
Paper 02 *(2 hours 30 minutes)* *Section A - Structured questions* *Section B - Essay questions*	 *15* *15*	 *15* *15*	 *15* *15*	 *45* *45*	*(40)*
Internal Assessment *Papers 03A or 03B*	*16*	*16*	*16*	*48*	*(20)*
TOTAL	*76*	*76*	*76*	*228*	*(100)*

RESOURCES

The following is a list of books and other printed material that might be used for CAPE Biology. The list is by no means exhaustive. Each student should have access to at least one text.

Texts

Clegg, C.J. and Mackean, D.J.	*Advanced Biology – Principles and Applications*, London: John Murray, 2000.

Supplementary Texts and Teachers' Guide

Anon	*Preliminary Biology Study Guide*, University of the West Indies, Barbados: Distance Education Centre, 1997.
Bradfield, P., Dodds, J., Dodds, et al.	*AS & A2 Level Biology,* Essex: *Pearson Educational, 2002.*
Cadogan, A. and Best, G.	*Environment and Ecology: Biology Advanced Studies*, Glasgow and London: Nelson Blackie, 1992.
Chapman, J. L. and Reiss, M.	*Ecology*, Cambridge: Cambridge University Press, 1992.
Huxley, A.	*Green Inheritance*, London: Gaia Books, 1992.
Fosbery, R., Jones, M. and Taylor, D.	*Advanced Biology, Volume 1 and 2, Cambridge: Cambridge University Press, 2002.*
Jones, M., Fosbery, R. et al	*AS Level and A Level Biology,* Cambridge: Cambridge University Press, 2003.
Kent, M.	*Advanced Biology,* Oxford: Oxford Press, 2000.
Margulis, L. and Schwartz, K.	*Five Kingdoms*, New York: W.H. Freeman and Co., 1998.
Odlum, E.P.	*Ecology*: A *Bridge Between Science and Society*, Sunderland, USA: Sinauer Associates, 1997.
Toole, G. and Toole, S.	*New Understanding of Biology for Advanced Level,* Cheltenham: Stanley Thornes Pub. Ltd., 1997.

Reference Books for Field Study

Plant Identification

Barlow, V. — *The Nature of the Islands*, Florida, Dunedin: Cruising Guide Publications, 1998.

Fournet, J. and Hammerton, J. — *Weeds of the Lesser Antilles* and or Mauvaises herbs des petites antilles, INRA, Paris/CARDI, 1994.

Nellis, D. — *Seashore Plants of South Florida and the Caribbean*, Sarasota: Pineapple Press, 1994.

Whittaker, M. — *Medicinal Plants of St. Kitts and Nevis Part 1*, Basseterre, St. Kitts: College of Further Education, 1992.

Animal Identification

Raffaele, H. et al — *A Guide to Birds of the West Indies*, New Jersey: Princeton University Press, 2003.

Stirling, P. — *Butterflies and Other Insects of the Eastern Caribbean*, London: Macmillan Caribbean, 1986.

Stokes, F. — *Divers and Snorkleler's Guide to the Fishes and the Sea Life of the Caribbean, Florida, Bahamas and Bermuda*, Philadelphia: Academy of Natural Sciences of Philadelphia, 1984.

Sultry, L. — *Seashell Treasures of the Caribbean*, London: Macmillan Caribbean, 1986.

Sutty, L. — *Fauna of the Caribbean - Last Survivors*, London: Macmillan Press, 1993.

GLOSSARY

KEY TO ABBREVIATIONS

KC - Knowledge and Comprehension
UK - Use of Knowledge
XS - Experimental Skills

WORD	DEFINITION	NOTES
Analyse	*Examine in detail*	UK
Annotate	Add a brief note to a label	Simple phrase or a few words only
Apply	Use knowledge and or principles to solve problems	Make references/conclusions; UK
Assess	Present reasons for the importance of particular structures, relationships or processes	Compare the advantages and disadvantages or the merits and demerits of a particular structure, relationship or process; UK
Calculate	Arrive at the solution to a numerical problem	Steps should be shown; units must be included
Cite	Provide a quotation or a reference to the subject	KC
Classify	Divide into groups according to observable characteristics	UK
Comment	State opinion or view with supporting reasons	UK
Compare	State similarities and differences	An example of a significance of each similarity and the difference stated may be required for comparisons which are other than structural

WORD	DEFINITION	NOTES
Construct	Use a specific format to make and or draw a graph, histogram, pie chart or other representations using data or material provided or drawn from practical investigations; build (for example, a model), draw scale diagram	Such representations should normally bear a title, appropriate headings and legend; UK
Deduce	Make a logical connection between two or more pieces of information; use data to arrive at a conclusion	UK
Define	State concisely the meaning of a word or term	This should include the defining equation and or formula where relevant; UK
Demonstrate	Show; direct attention to …	KC
Describe	Provide detailed factual information of the appearance or arrangement of a specific structure or sequence of a specific process	Description may be words, drawings or diagrams or an appropriate combination. Drawings or diagrams should be annotated to show appropriate detail where necessary; KC
Design	Include planning and presentation with appropriate practical detail	UK
Determine	Find the value present with appropriate practical detail	Where hypotheses are stated or when tests are to be conducted, possible outcomes should be clearly shown and/or the way in which data will be analyzed and presented; XS
Develop	Expand or elaborate an idea or argument with supporting reasons	KC/UK
Diagram	Simplified representation showing the relationship between components	KC/UK
Differentiate or Distinguish	State or explain briefly those differences between or among items which can be used to define the items or place them into separate categories	KC
Discuss	Present reasoned argument; consider points both for and against; explain the relative merits of a case	UK

WORD	DEFINITION	NOTES
Draw	Make a line representation from specimens or apparatus which shows an accurate relation between the parts	In case of drawings from the specimens, the magnification must always be stated; KC/UK
Estimate	Make an approximate quantitative judgement	
Evaluate	Weigh evidence and make judgements based on given criteria	The use of logical supporting reasons for a particular point is more important than view held; usually both sides of an argument should be considered ;UK
Explain	Give reasons based on recall; account for	KC
Find	Locate a feature or obtain as from a graph	UK
Formulate	Devise hypotheses	UK
Identify	Name specific components or features	KC
Illustrate	Demonstrate clearly using appropriate examples or diagrams	KC
Interpret	Explain the meaning of	UK
Label	Add names to identify structures or parts indicated by pointers	
List	Itemise without detail	KC
Measure	Take accurate quantitative readings using appropriate instruments	XS
Name	Give only the name of	No additional information is required; KC
Note	Record observation	XS
Observe	Pay attention to details which characterise a specimen, reaction or change taking place; to examine and note scientifically	Observation may involve all the senses and/or extensions of them but would normally exclude the sense of taste; XS
Outline	Give basic steps only	XS
Plan	Prepare to conduct an exercise	XS

WORD	DEFINITION	NOTES
Predict	Use information provided to arrive at a likely conclusion or suggest a possible outcome	UK
Record	Write an accurate description of the full range of observations made during a given procedure	This includes the values for any variable being investigated; where appropriate, record; data may be depicted in graphs, histograms or tables; XS
Relate	Show connections between; explain how one set of facts or data depends on others or are determined by them	UK
Sketch	Make a simple freehand diagram showing relevant proportions and any important details	
State	Provide factual information in concise terms outlining explanations	KC
Suggest	Offer an explanation deduced from information provided or previous knowledge. (... a hypothesis; provides a generalization which offers a likely explanation for a set of data or observations.)	No correct or incorrect solution is presumed but suggestions must be acceptable within the limits of scientific knowledge; UK
Test	To find out, following set procedures	XS
Use	Implies the need to recall and apply in order to come to a conclusion	UK

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