APPENDIX III

CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®

SYLLABUS

INTEGRATED SCIENCE

CXC 23/G/SYLL *23*

Effective for examinations from May–June 20*25*

CSEC®

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NOTE TO TEACHERS AND LEARNERS

Please note that the syllabus was revised and amendments are indicated by italics.

Issued 1983
Revised in 1993, 2000, 2009, *2015, 2021, 2023*

Please check the website www.cxc.org for updates on **CXC®**'s syllabuses.

Please access relevant curated resources to support teaching and learning of the syllabus at https://learninghub.cxc.org/

For access to short courses, training opportunities and teacher orientation webinars and workshops go to our Learning Institute at https://cxclearninginstitute.org/

PLEASE NOTE

This icon is used throughout the syllabus to represent key features which teachers and learners may find useful.

Integrated Science Syllabus

♦ RATIONALE

The study of science provides the knowledge and skills which are intended to improve the quality of living. An understanding of science is central to young citizens' preparedness for life in modern society. It empowers individuals to engage in public discussions on issues related to science and technology; and to be critical consumers of scientific information related to everyday life. Integrated Science brings together the everyday context in which science operates. It encompasses biology, chemistry, physics, earth science, environmental science, and technology.

The **CSEC®** Integrated Science Syllabus is based on three themes, Organisms and *Life Processes, Energy, and Our Planet* which adequately reflect the common areas of human activity and experience. These themes form the unifying points of the syllabus which should, therefore be seen as a coherent unit. The syllabus is redesigned with a greater emphasis on the integration and application of scientific concepts and principles. *Integrated Science by the very nature of the subject facilitates* the inquiry-based approach and should be used to develop long-term transferable skills of ethical conduct, creativity, collaboration, problem-solving, critical thinking, and innovation and communication. This *syllabus* also encourages the use of modern technology and other *learner-centered teaching,* learning *and assessment* strategies to inculcate these skills that are useful in everyday life, while at the same time catering to multiple intelligences, and different learning styles and needs. *The **CSEC®** Integrated Science also prepares students to make relevant career choices in the pure and applied sciences and provides a foundation to build on as they pursue further studies.*

This syllabus will contribute to the development of the Ideal Caribbean Person, as articulated by the CARICOM Heads of Government*, that is* someone who has a positive work *ethic;* demonstrates respect for human life and awareness of the importance of living in harmony with the environment*; improves, maintains and promotes physical, mental, and social well-being and contributes to the health and welfare of the community, country and region;* demonstrates multiple literacies, independent and critical thinking; and questions the practices of past and present and brings this to bear on 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 know, learn how to do, learn to live together, *learn to be,* and learn to transform themselves and society.

♦ AIMS

This syllabus aims to:

1. develop scientifically literate students who *should be able to* engage in discussions on issues related to this field;

2. *develop an understanding of living organisms and how they function;*

3. *Increase students' awareness about the factors that contributes to food production;*

4. *develop* scientific knowledge, principles *and practical applications for use in* everyday *life* situations;

5. increase *students'* awareness of the importance of living in harmony with the environment *including the importance and benefits of the use of sustainable energy (renewable energy, energy efficiency and energy conservation) in the preservation of the natural environment;*

6. *empower students' to use scientific inquiry;*

7. develop *students'* critical thinking, problem-solving and collaborative skills;

8. develop competencies that will enable students to make appropriate *and ethical* decisions regarding health, safety and other everyday life problems; and,

9. *enable students to understand the importance of integrating* information, communication and technological tools and skills *in solving problems.*

♦ SUGGESTED TIMETABLE ALLOCATION

It is recommended that a minimum of ***five 40-minute periods per week over two academic years*** be allocated to the study of the Integrated Science Syllabus. This should include at least one double period each week. A minimum of two periods per week should be devoted to practical activities.

CLASS SIZE

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

♦ ORGANISATION OF THE SYLLABUS

The syllabus is arranged in three **SECTIONS** sub-divided into specific objectives, corresponding explanatory notes and suggested practical activities.

SECTION A - ORGANISM*S* AND *LIFE PROCESSES*

SECTION B - *ENERGY*

SECTION C - *OUR PLANET*

The arrangement of the syllabus does not necessarily represent a teaching order. Each section begins with a statement of general objectives that, along with the specific objectives, corresponding explanatory notes and suggested practical activities, are indicative of the content on which the examinations will be based. However, the specific objectives should not be treated in isolation as they are related to general objectives and syllabus aims.

♦ APPROACHES TO TEACHING THE SYLLABUS

The organisation of each Section in the syllabus is designed to facilitate inquiry-based learning and to ensure that connections among concepts are established. Teachers should introduce concepts familiar to the students and ensure that their lessons stimulate the use of all the senses and incorporate the use of technology where possible during the teaching and learning process. 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. Whenever possible, a practical approach should be employed, with special attention to the identification of variables and to the use of controls in investigations. The need for repeated investigation and observations to arrive at meaningful conclusions should be emphasised.

Greater emphasis should be placed on the integration and 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 the study of scientific principles to the environment *and integrate concepts using the reference links in the syllabus. These are included throughout the document to highlight and reinforce related content.*

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

The syllabus is offered for General Proficiency certification. A candidate's performance will be indicated on the certificate by an overall numerical grade on a six-point scale as well as a letter grade for each of three profile dimensions, namely, Knowledge and Comprehension, Use of Knowledge and *Experimental* Skills.

♦ DEFINITION OF PROFILES DIMENSIONS

On completion of the syllabus, students are expected to develop skills under three profile dimensions:

1. Knowledge and Comprehension (KC);

2. Use of Knowledge (UK); and,

3. *Experimental* Skills (*XS*).

Knowledge and Comprehension (KC)

	The ability to:
Remembering	identify, recall, state basic facts, concepts and principles; and,
Understanding	select appropriate ideas, match, and compare and cite examples of facts, concepts and principles in familiar situations.

Use of Knowledge (UK)

	The ability to:
Applying	transform data accurately and appropriately; use common characteristics as a basis for classification; use formulae accurately;
Analys*ing* and Interp*reting*	identify the component parts of a whole and interpret the relationships between those parts; identify casual factors and show how they interact with each other. *Use experimental data to infer, predict and draw conclusions; identify trends and patterns; make necessary and accurate calculations and recognise the limitations and assumptions of data;*
Evaluat*ing*	make reasoned judgments and recommendations based on the value of ideas and information and their implications; and,
Creating	*combine component parts to form a new meaningful whole; make predictions and solve problems.*

***Experimental* Skills (*XS*)**

	The ability to:
Observation Recording *and* Reporting	use the senses to perceive objects and events accurately; present a written and oral report, drawing *(make large, clear, labelled line representations of specimens, apparatus, or models)* or other graphical representation which *are* clear, concise, accurate and pertinent to the investigation; report and recheck unexpected results;
Manipulation *and* Measurement	set up and use carefully and competently simple laboratory apparatus and measuring instruments; appropriately prepare specimens and materials for observation/investigation; *and,*
Planning *and* Designing	develop hypotheses and devise means of carrying out investigations to test them; plan experimental procedures and operations within the time allotted in appropriate sequence of operations as a result of difficulties encountered in carrying out experiments or obtaining unexpected results.

Note: In addition to the *Experimental* skills, candidates are expected to utilise the skills listed under the Use of Knowledge profile dimension in their practical work.

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, and doing experiments. The **CSEC®** Integrated Science syllabus focuses on the following skills.

1. Planning and Designing (PD)

Student's ability to:

(a) Ask questions: how, what, which, why or where. (Students must be guided by their teachers to ask scientific questions).

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

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

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

(c) Design *experiments/investigations* to test the hypothesis; experimental procedure must include the following:

(i) an appropriate aim related to the hypothesis;

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

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

(iv) precautions to be taken;

(v) *identification of variables (controlled, manipulated, responding);*

(vi) method of controlling variables;

(vii) clear, concise and step by step *(sequential)* procedure *using instructional language (command verbs);*

(viii) display of *expected* results *using appropriate method (table, prose graph, drawings)*;

(ix) *possible* use of *expected/predicted/possible* results; and,

(x) possible limitations*, sources of errors and/or conclusions*.

(d) *Suggest alternative methods or modification to existing methods.*

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) clamp and stand/retort stand;

(iv) binocular and monocular light microscope;

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

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

(vii) thermometer;

(viii) ruler;

(ix) stop watch/clock;

(x) balance;

(xi) boiling tube;

(xii) test tubes and test tube holders;

(xiii) *spatula;*

(xiv) *funnel;*

(xv) *conical flasks;*

(xvi) hand lens/magnifying lens; and,

(xvii) 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; and,
- Non-numerical: headings correct, details present.

(iii) Graph

Axes labelled, correct scales, correct plotting *(use of dots, circles and crosses), smooth* curves/best fit lines, key to explain symbols if more than one dependent variable is being plotted. *The graphs **must** be plotted using a pencil.*

(iv) *Drawing*

The following guidelines should be used for drawing:

- *The drawing should be placed in a position on the page which will allow for neat and clear labelling.*
- *Drawings should be done in pencil. The use of coloured pencils is not recommended.*
- *The drawing should be large enough so that all structures can be clearly seen.*
- *The drawing should be correctly proportioned, and parts should be accurately positioned.*
- *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.*
- *When a large number of small structures are present in a specimen, draw only a few of them carefully, showing structural detail.*
- *Write labels in pencil.*
- *Labels should be annotated (that is, accompanied by brief explanatory notes).*
- *Label lines should never cross each other and should be horizontal where possible.*
- *In drawings where only a few structures **(less than FIVE)** are being labelled, all labels should be written on the right of the drawing.*
- *Drawings must have a full title. 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. Biological illustrations must include the magnification which is usually included in the title.*

(b) Reporting

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

(i) **Date** (date of experiment and date of write-up).

(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** *(representation of results using appropriate method [table, prose graph, drawings]).*

(vi) **Discussion** *(presentation of background information, analysis of the results).*

(vii) **Conclusion** *(statement of relevant inferences).*

4. Analysis and Interpretation

Student's ability to *analyse and interpret **results and observations** and make conclusions by:*

(a) *presenting relevant background information;*

(b) identify*ing* patterns and trends;

(c) *making* accurate calculations;

(d) identify*ing* limitations and sources of error;

(e) mak*ing* a conclusion to either support or refute the hypothesis *and/or in relation to the aim; and,*

(f) *discussing results in relation to the background/theoretical knowledge*.

♦ FORMAT OF THE EXAMINATIONS

Paper 01
(1 hour 15 minutes)

The Paper will consist of sixty *(60)* multiple-choice items drawn from all areas of the syllabus. *There will be forty-five (45) items testing the Knowledge and Comprehension Profile and fifteen (15) items testing the Use of Knowledge Profile. Each item is worth 1 mark.*

Paper 02
(2 hours 30 minutes)

The paper consists of SIX compulsory questions drawn from all areas of the syllabus. A question may require knowledge of several topics. However, all topics may not be given equal emphasis. This paper is arranged into two sections.

Section A will consist of FOUR compulsory structured questions. Question 1 will be a practical/investigative type question *worth 25 marks and Questions 2-4 are worth 15 marks each.*

Section B will consist of TWO compulsory *structured* essay type questions. *Question 5 and 6 are worth 15 marks each.*

Paper 031

The School-Based Assessment will evaluate the achievement of the candidates in the Practical Skills in the laboratory and field work. Candidates will be required to keep a laboratory notebook.

Paper 032
(2 hours 10 minutes)

This paper is an alternative *for the* Paper 031, the School-Based Assessment, *and is intended* for private candidates. *The paper consists of THREE compulsory questions.*

The paper will examine the same skills as those *assessed* in Paper 031. The focus, therefore, will be on Experimental Skills and Use of Knowledge (Analysis and Interpretation). This is a practical examination.

♦ ASSESSMENT GRID

The Assessment Grid shows the marks assigned to papers and to Profiles, and percentage contributions of each paper to the total scores.

Papers	Knowledge and Comprehension (KC)	Use of knowledge (UK)	Experimental skills (XS)	Total Weighted marks	Total %
Paper 01	*45*	*15*	-	60	30
Paper 02	*45*	*45*	*10*	100	50
Paper 031 OR	-	*10* (30 *raw)*	*30* (70 *raw)*	40	20
Paper 032		*10*	*40*		
Total (Weighted)	***90***	***70***	**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 EITHER Paper 031 OR Paper 032.

Paper 032 is a practical examination. 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 reregister.

SBA scores can be carried forward only ONCE and only during the year immediately following the first sitting. In order to assist candidates in making decisions about whether or not to reuse a moderated SBA score, the Council will continue to indicate on the preliminary results if a candidate's moderated SBA score is less than 50 *per cent* in a particular subject.

Candidates reusing SBA scores should register as "Resit candidates" and must provide the previous candidate number when registering.

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

♦ SECTION A: ORGANISMS AND LIFE PROCESSES

UNIT I: UNITS OF LIFE

GENERAL OBJECTIVES

On completion of this Section, students should:

1. be aware that *living organism comprise of cells and* particles moving *into and out of them;*
2. develop an appreciation for the interdependence of life processes;
3. *have an appreciation for the various factors that contribute to the production of food;*
4. *understand the need to control human population;*
5. understand *how humans respond* to environmen*tal changes*;
6. understand the relationship between *our sense organs* and *the* environment;
7. *be aware of communicable and non-communicable diseases and how they affect health;*
8. *be aware of the effect of lifestyle choices on health;*
9. *be cognisant of factors and techniques which reduce micro-organisms on the body and in food;*
10. *understand that food contaminants come from different sources; and,*
11. develop *collaborative,* investigative and problem-solving skills.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *analyse the processes of diffusion, osmosis and active transport;*	(a) *Definition of terms must include movement of particles and concentration gradient.* (b) *Role of diffusion, osmosis and active transport in moving substances in and out of cells and from one cell to another in all living organisms.*	*Conduct* simple investigations to *demonstrate the processes of diffusion and osmosis.*

SECTION A

UNIT I: *UNITS OF LIFE* (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(c) *Reference to the cell membrane as a selectively permeable membrane.* (d) *Examples of diffusion in artificial and natural environments to include but not limited to ash from volcanic eruptions, smog from car exhaust and industries, smoke from landfills.* R*efer to Sec. A, Unit IV, SO 1 – transport systems.* *Refer to Sec. B, Unit II, SO 7 – Gaseous exchange.*	
2. *examine animal and plant cells*;	(a) *Functions of the cell structures in animal and plant cells (Simple treatment only. For example, nucleus is responsible for cell division, making protein and contains genetic information).* (b) *Structures: cell wall, cell membrane, nucleus, cytoplasm, ribosomes, mitochondria, vacuoles, and chloroplast.* *Simple annotated diagrams are required (as seen under the light microscope).*	*Examine prepared slides of cells under a microscope and make simple drawings.*

SECTION A

UNIT I: *UNITS OF LIFE (cont'd)*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *View instructional video clips about concepts such as osmosis, diffusion, and active transport to support and reinforce learning. Have students complete worksheets requiring them to answer related questions.*

2. *Work in small groups to construct models, for example, of different types of cells using plasticine or other materials found around the home or laboratory. Each group should display and explain their models to the class.*

3. *D*raw and label simple diagrams *showing* the structure of unspecialised plant and animal cells.

SECTION A

UNIT II: REPRODUCTION AND *GROWTH IN PLANTS*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. distinguish between asexual and sexual reproduction;	(a) *Role of* cell division - *meiosis and mitosis* (*stages are* not required). (b) Advantages and disadvantages of asexual reproduction (variety, *adaptation,* livestock and crops).	
2. *examine* various methods of asexual reproduction in plants;	*Methods of asexual reproduction:* (a) *Natural vegetative propagation (examples of perennating organs):* (i) *corms;* (ii) *bulbs;* (iii) *rhizomes; and,* (iv) *runners.* *Details of structures not required.* (b) *Brief description of artificial methods of propagation:* (i) budding; (ii) cuttings; (iii) tissue culture; (iv) cloning; and, (v) *grafting*. *Refer to Sec. A, Unit III, SO 1 – Asexual reproduction in animals.*	*Examine and draw storage organs including corms, bulbs, rhizomes, runners, and cuttings.*

SECTION A

UNIT II: REPRODUCTION AND GROWTH *IN PLANTS* (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
3. *examine* the process of sexual reproduction in plants;	(a) *Structure and function of flowers.* (b) Pollination: (i) *definition;* (ii) *types – self and cross pollination (advantages of cross pollination); and,* (iii) agent of pollination (*wind, animal).* (c) Fertilisation. (d) Development of seeds/fruits (outline).	*Draw and label cross section of various types of flowers.* *Draw and label internal and external views of seeds and fruits.*
4. *analyse growth patterns in plants;*	(a) *Conditions necessary for the germination of seeds (temperature, oxygen and water).* (b) *Growth patterns of seeds of annual plants - bean and corn (maize). From germination to fruit formation.*	*Plot graph of plant growth at regular intervals of one week and extrapolate to predict height at future time.*
5. *describe the methods used in the production of crops;*	*Brief description of:* (a) *strip planting.* (b) *crop rotation.* (c) *greenhouse farming.* (d) *hydroponics.* (e) *tissue culture.* (f) *organic farming.* (g) *container gardening.*	

SECTION A

UNIT II: REPRODUCTION AND GROWTH *IN PLANTS* (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. *relate soil fertility to the physical and chemical properties of soil; and,*	(a) *Characteristics of sandy, clay, loam soils. (Include soil profiles).* (i) *soil composition;* (ii) *particle size;* (iii) *air content;* (iv) *pH of soil; and,* (v) *water holding capacity (drainage and retention).* (b) *Presence of soil organisms (earthworms, nematodes).* (c) *Role of nitrifying bacteria, denitrifying bacteria, and nitrogen-fixing bacteria.* (d) *Role of Humus.* (e) *Role of decomposers.* (f) *Role of composting.* *Refer to Sec. A, Unit VII, SO 1 – microbes.*	*Conduct sedimentation tests in order to make inferences about the amount of clay and sand in the soil. Draw a labelled diagram of a soil profile.* *Conduct soil tests to determine the percentage of air, pH of soils, drainage, and water retention.*
7. *evaluate the impact of soil erosion on food production.*	(a) *Cause and effect of soil erosion: wind, water. (Simple treatment).* (b) *Methods of prevention:* *(i) contour farming (ploughing, planting, cultivating, harvesting);* *(ii) terracing;* *(iii) crop rotation;* *(iv) wind breaks; and,* *(v) crop cover.* (c) *Impact on food production.*	

SECTION A

UNIT II: REPRODUCTION AND GROWTH *IN PLANTS* (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Draw and interpret growth curves. Students should be able to extrapolate to predict height/rate of growth. Have students discuss their predictions with a peer and then make a presentation to the class.*

2. *Participate in field trips and work in peers or small groups to engage in at least one of the following activities and creatively report on their findings/observations either orally or in writing. Have students:*

   (a) *Visit nearby farms to study common agricultural practices with emphasis on the production of crops.*

   (b) *Visit organic farms to observe their operations. Have students construction a table showing how organic farming differs from conventional farming.*

   (c) *Visit a central Agricultural Institution/Ministry of Agriculture in pairs to observe how budding, grafting, cutting and tissue culture are executed.*

   (d) *Observe strip farming, greenhouse farming and hydroponics farming and record the processes involved as well as the advantages and disadvantages of each type.*

   (e) *In situations where a physical visit cannot be facilitated, virtual simulations are encouraged.*

3. *Work in small groups to analyse soil profiles and determine the nature of the soil. Have students share their findings with other groups. A guided teacher led discussion should follow.*

4. *Review and analyse results of soil tests pertaining to fertility. Have students participate in a guided teacher led discussion around their conclusions.*

5. *Construct models demonstrating terracing, contour ploughing, and planting of catch crops to prevent soil erosion. This could be done as an individual or small group activity. Have students set up a display to showcase and explain their models.*

SECTION A

UNIT III: REPRODUCTION AND GROWTH IN ANIMALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. *outline various methods of asexual reproduction in animals;*	*Budding, binary fission, fragmentation, parthenogenesis.* *Refer to Sec. A, Unit II, SO 2 – Budding in plants.*		
2. *describe the structure and function of the sexual reproductive organs in humans;*	(a) *Functions of organs (structures) in the human reproductive system.* (i) *Female* - *Ovary;* - *Oviduct (fallopian tube);* - *Uterus;* - *Cervix; and,* - *Vagina.* (ii) *Male* (a) *Testes;* (b) *Scrotum;* (c) *Epididymis;* (d) *Vas deferens or sperm duct;* (e) *Seminal vesicle;* (f) *Prostate gland;* (g) *Cowper's gland;* (h) *Urethra; and,* (i) *Penis.*		

SECTION A

UNIT III: REPRODUCTION AND GROWTH IN ANIMALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
3. *analyse the menstrual cycle in humans;*	(a) *Ovulation (definition, and time of occurrence).* (b) *Roles and levels of oestrogen and progesterone (include changes in the uterine lining).* (c) *Menopause (definition, level of oestrogen).* *Refer to Sec. A, Unit VI, SO6 – The endocrine system.* *Graphs showing changes of the uterine lining during a 28-day menstrual cycle are required.*		
4. *discuss the stages of pregnancy;*	(a) *Stages of pregnancy:* (i) *fertilisation;* (ii) *implantation; and,* (iii) *simple description of the development of the foetus and birth with a brief description of:* - *contraction and dilation;* - *contraction, crowning and expulsion of foetus; and,* - *contraction and expulsion of the placenta.* (b) *Simplified diagrams to illustrate processes.*		

SECTION A

UNIT III: REPRODUCTION AND GROWTH IN ANIMALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
5. *discuss the methods of birth control;*	*Advantages and disadvantages:* (a) *Natural (rhythm, withdrawal, billings.* (b) *Barrier (male and female condom, diaphragm, cervical cap, Intrauterine devices).* (c) *Hormonal (pill, injections, patch, implants).* (d) *Surgical (vasectomy, hysterectomy, tubal ligation).* *Mention abstinence.*		
6. *assess* the importance of pre-natal and post-natal care of mothers and babies;	(a) The effects of nutrition, drugs, x-rays and diseases. (b) Advantages of breast feeding, and immunisation. (c) *Use and importance of ultrasound.*		
7. *compare growth patterns of males and females; and,*	*Analysis of data of height and weight with increase in age of boys and girls.* *Graphs are required.*		
8. discuss the need for human population control.	(a) *Problems arising from over population (*effects on quality of life): (i) world food production; *and,* (ii) *management of natural resources* and material resources.		

SECTION A

UNIT III: REPRODUCTION AND GROWTH IN ANIMALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) Effects of teenage pregnancy *and* birth control methods *on population growth*.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Participate in guest lectures from resource persons, for example, health professionals engaging them in interactive sessions on topics of interest such as the use of contraceptives. Have students review guided questions before the lecture and complete the worksheets after the lecture.*

2. *Observe teacher demonstrations using models/charts of human reproductive systems or watch guided videos introducing the concept. Have students locate and identify structures and label the human reproductive systems using print or online interactive resources. Have them share responses with each other or be guided in discussing what was observed in the videos.*

3. *Collect data on growth in humans, draw growth curves and interpret data. For example, measuring the heights of students of different ages within their class or school and draw bar charts using the data. Have students mount their graphs in the classroom.*

4. *Work in groups to analyse graphical representations of data showing effects of overpopulation. Students should then be engaged in a guided discussion regarding their analysis.*

SECTION A

UNIT *IV: TRANSPORT SYSTEMS*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *justify* the need for transport systems within a living organism;	(a) Surface area/volume ratio. (b) Movement of nutrients, *gases, excretory products, metabolic products*. (c) *Role of transpiration in plants.* R*efer to Sec. A, Unit I, SO 1 – Diffusion and osmosis.*	*Conduct* experiments to investigate diffusion *using* agar cubes of different sizes to show how surface area/volume ratio affects total diffusion. *Conduct experiments to investigate factors which affect the rate of transpiration.*
2. relate the structures in transport systems to their functions; *and,*	(a) Composition of blood *(plasma, blood proteins, blood cells, platelets).* (b) Types of blood cells and their functions: (i) *Red Blood Cells (mention blood doping); and,* (ii) *White Blood Cells (lymphocytes and phagocytes).* (c) *Internal* structures of the heart *(diagram required)*: (i) *left and right atria;* (ii) *left and right ventricles; and,* (iii) *valves* (tricuspid, bicuspid semi-lunar). (d) *Heart*beat (*diastole, atrial systole, ventricular systole).*	

SECTION A

UNIT *IV: TRANSPORT SYSTEMS* (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(e) Names of *major blood vessels (aorta, vena cava, pulmonary artery, and vein).*	
	(f) *Function of stem-xylem and phloem (simple explanation).*	
	Refer to SO 1 above.	
	Refer to Sec. A, Unit V, SO 2 – The excretory system.	
3. *distinguish among* the *different* blood groups.	(a) *Blood groups (*A, B, AB and O).	
	(b) Antigen and antibody for each group.	
	(c) Precaution in transfusion and handling; *include the term agglutination*.	
	(d) Rh factor - risk in pregnancy *and* precautions.	
	Mention that blood type is an inheritable trait.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos/simulations demonstrating the structures of a mammalian heart. Have students work in small groups to draw or construct and present a model of a mammalian heart.*

2. *Watch videos introducing concepts of how the heart pumps blood to the rest of the body. Have students review guided questions before watching the videos. Students should then be guided to discuss their observation.*

SECTION A

UNIT *IV: TRANSPORT SYSTEMS* (cont'd)

Suggested Teaching and Learning Activities

3. *Observe scenarios/situations with emphasis on transport systems in plants and animals. Have students work with a peer to discuss whether the transport systems in plants and animals can be compared to the transportation of goods in everyday life. Each pair should be asked to share their points in the class discussion.*

4. *Observe teacher demonstrations/simulations or watch guided videos on the concepts below. Have students record and discuss their observations. The concepts include:*

   (a) *Capillary action, use of herbaceous plant in coloured water;*

   (b) *Matching blood types using food colouring; and,*

   (c) *Prepared slides of blood cells. Students should make simple drawings of white and red blood cells.*

5. *Work in groups to create brochures, videos, podcasts or participate in a debate identifying and explaining issues that impact quality of life, for example, Rh factor and blood transfusion. Students should showcase their products in a class session.*

SECTION A

UNIT *V: EXCRETION*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *distinguish* between excretion and egestion;	(a) Definition *of terms excretion and egestion*. *Refer to Sec. B, Unit II, SO 2 – Digestion in humans.* (b) *Difference between excretion and egestion.*	
2. explain the mechanism of excretion by the lungs, skin and kidneys *in humans*; *and,*	(a) Relationship to metabolism, excretory organs and products: (i) *Lungs (carbon dioxide and water vapor);* (ii) *Skin (water and salt); and,* (iii) *Kidneys (water, salt, and urea).* (b) Kidney – structure of tubule related to ultra-filtration and re-absorption. Refer to *Sec. A, Unit VII,* SO 5 – *The circulatory system*. (c) Osmoregulatory function of kidneys *(role of anti-diuretic hormone ADH)*. (d) Dialysis *for malfunctioning Kidneys.* (e) *Label the diagram of skin and* relate structure of skin to its functions – *excretion, temperature control.* *Refer to Sec. B, Unit V, SO 4 – The cooling effects of evaporation.* *Refer to Sec. B, Unit II, SO 6 – The mechanism of breathing.*	

SECTION A

UNIT *V: EXCRETION CONT'D*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
3. identify the methods of excretion *in flowering plants.*	Waste products of respiration and photosynthesis only.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Construct models, for example, the kidney, the lungs, and the skin. Have students display their models along with explanatory notes.*

2. *Observe teacher demonstrations using cross section diagrams/models of the skin and kidneys of human beings. Have students examine the models and label the diagrams using annotations. This can be done as a peer/share activity after which selected persons/peers can share with the class.*

3. *Participate in a field trip to a hospital to observe the use of dialysis machines, attend lectures by resource persons, observe simulations or watch guided videos explaining how a dialysis machine works. Have students discuss their observations with a peer or complete a prescribed report template.*

SECTION A

UNIT *VI: SENSE ORGANS AND COORDINATION*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL

Students should be able to:

1. *describe the sense organs and their functions;*

Stimulus associated with sense organs:

(a) *eye (sight);*

(b) *ear (sound);*

(c) *tongue (taste);*

(d) *skin (touch); and,*

(e) *nose (smell).*

2. relate the structures of the mammalian eye to their functions;

(a) *Functions of the following Structures as it relates to sight:*

(i) *retina;*

(ii) *lens;*

(iii) *iris;*

(iv) *cornea;*

(v) *pupil;*

(vi) *choroid;*

(vii) *fovea;*

(viii) *sclera;*

(ix) *optic nerve; and,*

(x) *ciliary body (ciliary muscles and suspensory ligaments).*

(Annotated diagrams are required).

SECTION A

UNIT *VI: SENSE ORGANS AND COORDINATION (Cont'd)*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) *Formation of an image on the retina.*	
	(c) *Accommodation* and control of amount of light entering *the* eye.	
3. analyse *sight defects;*	(a) *Causes and correction/treatment for the following defects:* (i) *long and short-sightedness;* (ii) *glaucoma;* (iii) *cataracts; and,* (iv) *astigmatism (mention colour blindness).* (b) *Function of convex and concave lenses.* *Mention the effects of bright light and physical injury.*	*Conduct simple investigations using convex and concave lenses.*
4. relate the structures of the mammalian ear to their functions;	(a) *Functions of the following Structures of the ear:* (i) *Pinna;* (ii) *Ear canal;* (iii) *Ear drum;* (iv) *Ear bones (anvil, stirrup, hammer);* (v) *Eustachian tube;*	*Conduct* simple investigations on pitch and loudness.

SECTION A

UNIT *VI: SENSE ORGANS AND COORDINATION (cont'd)*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
	(vi) *Semi-circular canal;* (vii) *Cochlea; and,* (viii) *Auditory nerve.* (b) *Functions: hearing and balance.* (c) *Mention should be made of:* (i) the approximate audio frequency spectrum of the human ear; *and,* (ii) the effects of loudness and pitch on human beings. *(Annotated diagrams are required)*		
5. *relate* the structures *of the nervous system to their* functions; *and,*	*Structures of the central nervous system.* (a) *Functions of the brain with specific reference to:* (i) *cerebrum;* (ii) *cerebellum;* (iii) *medulla oblongata;* (iv) *pituitary gland; and,* (v) *hypothalamus.* *Brief description only.*		

SECTION A

UNIT VI: *SENSE ORGANS AND COORDINATION (cont'd)*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	Include simplified diagrams of the brain. (b) *Function of spinal cord.* *Brief description only.* (c) *Function of neurones (sensory neurone, relay neurone motor neurone). Adaptations to function not required.* (d) *Examples of voluntary and involuntary actions.* *Mention malfunctioning of system, for example, paralysis; physical disabilities.*	
6. *relate the structures of the endocrine system* to *their* functions.	(a) *Structural diagram – identifying the location of organs, hormones produced and their uses/effects.* (b) Endocrine – hormones as messengers: (i) thyroid *(thyroxine);* (ii) pancreas *(insulin)*; (iii) sex organs *(estrogen and testosterone);* (iv) adrenal glands *(adrenaline);* and, (v) pituitary glands *(Antidiuretic hormone ADH).* *Refer to Sec. A, Unit III, SO 3 – The menstrual cycle.*	

SECTION A

UNIT *VI: SENSE ORGANS AND COORDINATION (cont'd)*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Observe teacher demonstrations incorporating the use of diagrams/models of the eye, ear, brain, and neurones of human beings in their lesson. Have students complete a worksheet requiring them to label related diagrams.*

2. *Watch videos introduce, support, or reinforce concepts of how the eyes, ears and brain works. Have students creatively present to the class their understanding of how these organs work.*

3. *Observe teacher demonstrations of simple reflexes for example, knee jerk. Have students record and discuss in groups their observations.*

4. *Observe and discuss diagrams showing the positions of the endocrine glands. For example, a think-pair-share in which students are allowed to discuss with a peer and then share with the class.*

5. *Complete worksheets or quiz on the functions of endocrine glands. Have students complete this activity to support lessons as a culminating activity or as in-class assessment.*

6. *Observe presentations made by resource persons on eye defects and colour blindness. Have students complete a follow-up activity requiring them to answer questions based on their observations.*

SECTION A

UNIT VII: HEALTH

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL

Students should be able to:

1. *discuss selected microbes;*

Virus, bacteria, fungi;

Positive and negative effects.

Refer to Sec. A, Unit II, SO 6 – How organisms contribute to soil fertility; the role of decomposers in the soil.

Refer to Sec. A, Unit VII, SO 11 – Micro-organisms in food spoilage, production and processing.

2. *discuss communicable/infectious disease;*

(a) *Definitions of disease, and communicable disease (infectious).*

(b) *The causes, signs and symptoms; and prevention, control and treatment of sexually transmitted infections to include:*

(i) Bacterial – Syphilis, Gonorrhoea, *Chlamydia*;

(ii) Viral – Herpes, *Hepatitis, AIDS*; *and,*

(iii) Fungal – Candida.

Refer to Sec. A, Unit VII, SO 1 – microbes.

SECTION A

UNIT VII: HEALTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
3. *outline how the principles of immunisation are used in the control of communicable/infectious diseases;*	(a) *The immune system and how it is impacted by diseases.* (b) *Definition of immunity.* (c) *Role of white blood cells.* (d) *Types of immunity:* (i) *natural; and,* (ii) artificial *(Covid, Polio vaccines).*	
4. *discuss non-communicable/infectious diseases;*	(a) *Definition of non-infectious disease (non-communicable).* (b) *Examples of non-infectious Diseases (non-communicable diseases) to include:* (i) *allergies; and,* (ii) *autoimmune diseases (lupus, rheumatoid arthritis).* (c) *Diabetes and Hypertension (causes and effects).* *Refer to Sec. C, Unit VII, SO1 – effect of air pollution.*	
5. *examine the physiological effects of exercise;*	(a) *Effects on circulatory and respiratory systems, lifestyle diseases, effects on balancing energy input and output.* (b) *Effects of exercise on muscle toning.*	*Investigate the effect of exercise on the pulse rate.*

SECTION A

UNIT VII: HEALTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. *evaluate the effects of drug use;*	(a) *Definition of drugs:* (i) *prescription drugs (steroids, diet pills and hormonal injections); and,* (ii) *non-prescription drugs (alcohol, illegal drugs and recreational drugs).* (b) *Effects of drugs (stimulants, depressants, hallucinogens, and narcotics) on the nervous system.* (c) *Economic and social effects of drug use and abuse.*	
7. *discuss the importance of practising good personal hygiene;*	(a) *Practices: Elimination of body odours and care of genitalia.* (b) *Benefits: Social acceptance and prevention of infections.*	
8. discuss conditions that encourage the breeding of household pests and parasites;	(a) *Definition of* pests, parasites, pathogens *and vectors*. (b) *Conditions that encourage the breeding of:* Cockroaches, flies, rats, mosquitoes. (i) *impact of improper disposal of waste (industrial and domestic); and,* (ii) *improper household hygiene (household surfaces, storage of food).*	

SECTION A

UNIT VII: HEALTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
9. recommend *appropriate methods of pest control;*	(a) *Methods of pest control: Biological, chemical, sanitary and mechanical.* (b) *The relevant methods of control for each developmental stage in the life cycles of mosquitoes and houseflies.*	
10. *describe various types of food contaminants*;	*Types of food contaminants* (a) *Pathogens (virus, fungus, bacteria).* (b) *Chemical contaminant.* (c) *Physical contaminants.*	
11. *determine conditions which promote the growth of microorganisms; and,*	(a) *Conditions to include:* (i) *moisture;* (ii) *optimal temperature; and,* (iii) *nutrients.* (b) *The effects of microorganisms in food spoilage, production and processing.* (c) *Procedures for retarding and preventing the growth of bread mould.* *Refer to Sec. A, Unit VII, SO 1 – microbes.*	*Investigate growth of mould on bread under different conditions.*
12. *apply the principles used in food preservation.*	(a) *Definition of food preservation.*	*Investigate one of the methods for preserving food.*

SECTION A

UNIT VII: HEALTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) *Principles – altering condition to delay the growth of microorganisms or to delay microbial decomposition of the food; for example, removal of moisture, inactivating enzymes.* *Methods: salting, drying, pickling, heating, canning, curing, refrigeration, adding sugar and treating with other preservatives.* (i) *brief description of the methods; and,* (ii) *Application of principles to the methods.* (c) *Mention solar drying, energy efficient/inverter type refrigeration.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Complete and creatively present the findings from a group research project on communicable diseases to the class. For example, HIV Aids, Covid-19.*

2. *Participate by observing guest lectures from health professionals on issues related to health such as immunity, vaccination, and drugs. Have students prepare and ask questions or clarifications on the selected topic at the end of the lecture.*

SECTION A

UNIT VII: HEALTH (cont'd)

Suggested Teaching and Learning Activities

3. *Construct posters, videos, podcasts, or brochures that depict critical issues or principles covered in topics, for example, food preservation and pest control. These can be showcased as a class activity and graded.*

4. *Participate in guided activities requiring them to examine case studies, for example, on topics that relate to health and hygiene. Have students discuss their analysis in a think-pair-share-square activity and then have the reporter share with the class.*

5. *Work in small groups to investigate and creatively present findings to the class on the effectiveness of different food preservation methods.*

6. *Participate in class debates on issues such as food contamination and environmental wastes that impact the quality of life.*

7. *Complete accessible online activities to reinforce concepts taught. For example, Microorganisms activity may be accessed using this link:* https://legacy.e-bug.eu/junior_pack.aspx?cc=eng&ss=2&t=Introduction%20to%20Microbes

8. *Review and interpret health data by investigating the number of persons in their country who suffer from diabetes/hypertension. Guided questions can be given for example, what are the causes, incidence rates and treatments available in your area? Have students complete a worksheet.*

♦ *SECTION B: ENERGY*

UNIT I: CONSERVATION OF ENERGY

GENERAL OBJECTIVES

On completion of this Section, students should:

1. appreciate the importance of energy in everyday life;
2. understand the methods involved in the transfer of energy;
3. appreciate the inter-conversion and conversion of mass energy;
4. *understand the role photosynthesis plays in the transfer of energy;*
5. *understand the importance of energy in nutrition and respiration;*
6. *understand the impact of fossil fuels and suitable alternatives on the environment;*
7. appreciate the importance of electrical energy in everyday life;
8. understand the occurrence of accidents, hazardous situations and safety measures used in their prevention;
9. *understand the concept of heat transfer;*
10. understand the need for appropriate physical conditions in the home and workplace*; and,*
11. develop *collaborative,* investigative and problem-solving skills.

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *explain the concept of energy;*	(a) *Energy as an ability to produce a change/do work.* (b) *Types and forms of energy.* (c) *Unit of energy (Joules).*	
2. *discuss the inter-conversion and conservation of mass energy;*	(a) *Inter-conversion of energy for example:* (i) *in the sun;* (ii) *nuclear reactors; and,* (iii) *electrical devices.*	

SECTION B

UNIT I: CONSERVATION OF ENERGY (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:			
		(b) *Methods used to save energy supply to vehicles.* (c) *Effects of the internal combustion engine on the environment. Mention how they can be reduced.* *Refer to Sec. B, Unit I, SO 3 – Photosynthesis.* *Refer to Sec. B, Unit III, SO 2 – Alternative energy sources.* *Refer to Sec. C, Unit IV, SO 9 – Efficiency of machines.*	
3.	*examine the role of photosynthesis in the conversion of energy; and,*	(a) *Definition.* (b) *Identification of substrate, conditions and products; word and chemical equations.* (c) *Importance of:* (i) *substrates (carbon dioxide and water);* (ii) *conditions (light, chlorophyll) (photo chemical reactions); and,* (iii) *products (oxygen, glucose).* *Mention that glucose can be converted to other substances.* (d) *Awareness that light energy can be converted to chemical energy (glucose).* *Refer to Sec. A, Unit V, SO 3 – Excretion in plants.*	*Conduct experiments to establish conditions for photosynthesis (light and chlorophyll), tests for starch as a product of photosynthesis.*

SECTION B

UNIT I: CONSERVATION OF ENERGY (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:	*Refer to Sec. B, Unit 1, SO 2 – Inter-conversion of energy.*	
4. *analyse the transfer of energy in the environment.*	(a) *Producers, consumers (primary and secondary) decomposers, habitat, herbivores, carnivores, omnivores, population, community, ecosystem.* (b) *Food chains and food webs, trophic levels.* (c) *Ecological pyramids:* (i) *pyramid of numbers (species numbers);* (ii) *pyramid of biomass; and,* (iii) *pyramid of energy (energy efficiency).* *Make mention of ecological balance for environmental sustainability.* *Refer to Sec. C, Unit III, SO 5 – Water pollution.*	*Observe plants and animals in a nearby area or on the school grounds and classify them as producers, consumers, decomposers, herbivores, carnivores. Construct simple food chains and food webs in terrestrial and aquatic environments.*

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Complete graded activities, for example worksheets or quizzes:*
   (a) *identifying the different forms of energy in everyday life. This should include both renewable and non-renewable energy sources.*
   (b) *inter-conversion of energy.*

SECTION B

UNIT I: CONSERVATION OF ENERGY (cont'd)

Suggested Teaching and Learning Activities

2. *Carry out a lab activity to investigate the importance of the conditions of photosynthesis (light, chlorophyl, carbon dioxide, water). Have students record their observations.*

3. *Visit websites to watch movies, play games and do quizzes and activities on topics such as food chains and photosynthesis to support and reinforce learning. For example,* https://www.brainpop.com/science/

4. *Construct food chain, food webs and food pyramid in a terrestrial and aquatic environment. This can be done by using a worksheet or students could also go on participate in a field trip to gather data on flora and fauna. Students may be placed in groups and encouraged to use their gadgets to capture, images and videos and use the information to prepare a presentation to be shared in the class.*

SECTION B

UNIT II: ENERGY IN LIFE PROCESSES

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *examine the importance of food as a source of energy;*	(a) *The Caribbean food groups, their sources and functions of their main nutrients.* (i) *carbohydrates;* (ii) *proteins;* (iii) *fats;* (iv) *vitamins (A B_{12}, C, D); and,* (v) *minerals (calcium, iron, iodine).* (b) *Importance* of fibre and water to health. (c) *Define a balance diet.* (d) *Balanced diet related to age, gender, occupation/sport.* (e) *Food additives (artificial food colouring, salt, MSG, artificial sweeteners) and their effect on health.* (f) *Protein-energy malnutrition (PEM) deficiency disease, diabetes and obesity.*	*Conduct food tests – use local foods.* *Conduct experiments to measure energy value of food.*
2. *examine the process of digestion in humans;*	(a) *Mechanical and chemical digestion.* (b) *Definition and role of enzymes (activation energy).* (c) *Role of bile.*	*Conduct experiments to show the effects of temperature and pH on enzymes.*

SECTION B

UNIT II: ENERGY IN LIFE PROCESSES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(d) *Enzymes active at different stages (salivary, amylase, pepsin, renin, pancreatic, lipase, pancreatic amylase, trypsin, maltase, lactase, sucrose, galatase), substrates and products.* (e) *Effects of temperature and pH on enzymes.* (f) *Absorption.* (g) *Assimilation.* (h) *Egestion.* *Refer to Sec. A, Unit V, SO 1 – Difference between excretion and egestion.*	
3. *relate the structure of the teeth to their function in human digestion;*	(a) *Types of teeth and dental formula.* (b) *Structural and functional adaptation of the different types of teeth.* (c) *The role of mechanical digestion to increase surface area of food and diet.* (d) *Importance of the care of the teeth (brushing, flossing, rinsing, diet, visit to the dentist).*	*Investigate the external structure of a tooth and draw a tooth specimen.*

SECTION B

UNIT II: ENERGY IN LIFE PROCESSES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. *evaluate the importance of respiration in providing energy to organisms;*	(a) *Definition.* (b) *Substrate and products, word and chemical equation.* (c) *Site of respiration.* (d) *Importance of energy release.* (e) *Energy related to type of substrate.*	*Conduct experiments to show the release of energy and carbon dioxide by organisms.*
5. *distinguish between aerobic and anaerobic respiration;*	(a) *Compare amounts of energy produced, products and use.* (b) *Relevance of anaerobic respiration to sports and industries (bakeries/breweries).*	
6. *examine the mechanism of breathing;*	(a) *Inhalation and exhalation, pressure and volume changes, role of ribcage and diaphragm.* (b) *Composition of inhaled and exhaled air; structures of the lungs.* (c) *Using kinetic energy to bring air into and out of the lungs.* (d) *Stages of CPR.* *Refer to Sec. B, Unit IV, SO 7 – First aid methods.* *Refer to Sec. A, Unit V, SO 2 – The excretory system.*	

SECTION B

UNIT II: ENERGY IN THE LIFE PROCESSES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	Refer to Sec. C, Unit III, SO 10 – Effects of diving.	
7. *explain the importance of gaseous exchange in organisms; and,*	(a) *Features common to respiratory surfaces: alveoli, stomata, fish gills.* (b) *Significance of gaseous exchange.* *Refer to Sec. A, Unit I, SO I – Diffusion.*	*Drawings of the structures of stomata from prepared slides*
8. *explain the effects of smoking on the gaseous exchange process.*	(a) *Importance of smoke free environments.* (b) *Effect of second- hand smoke on the gaseous exchange process. (Tobacco, marijuana, vaping - electronic cigarettes).* *Refer to Sec. C, Unit VII, SO1 – effect of air pollution.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Collect food labels to discern nutritive content and caloric value. Have students work with a partner to discuss their labels and how they can be used to help them to make healthy choices.*
2. *Watch videos and observe models, or posters on how the digestive system works and the role of enzymes. Have student complete a worksheet requiring them to label and state the function of each part of the digestive system. They should also identify enzymes, digestive juices, and state acidity/alkalinity at each stage.*
3. *Collect and interpret data and do representations [mathematical] where necessary on concepts such as enzymes.*

SECTION B

UNIT II: ENERGY IN THE LIFE PROCESSES (cont'd)

Suggested Teaching and Learning Activities

4. *Participate in planned field trips to dental schools, dental offices or have a dentist serve as a resource person to reinforce content.*

5. *Visit site visits and/or go on field trips to a brewery or bakery, to observe the use of fermentation. Teachers could also demonstrate fermentation by preparing yeast bread in the lab and encourage students to record and discuss their observation.*

6. *Work collaboratively to construct models. For example:*

   (a) *Model lung to observe the mechanism of breathing.*

   (b) *Model of the teeth.*

7. *Observe the features of fish gills (specimen). Have students draw the features.*

8. *Work collaboratively to research the usage of Ventilator machines. Have students complete a report and present their findings.*

9. *Participate in an interactive virtual field trip demonstrating gaseous exchange in humans. For example, https://encounteredu.com/teacher-resources/google-expeditions-science-11-16-lesson-2-respiratory-system-gas-exchange-in-the-alveoli.*

10. *Work collaboratively to create a public service announcement encouraging teenagers to quit smoking or not to start smoking and/or the effects of second-hand smoke. They should be encouraged to creatively present information using graphics, video, or skits.*

11. *Observe demonstrations from resource persons on how to perform CPR. Have students work with a peer to demonstrate what was observed or use pictorial representations to explain.*

12. *Work collaboratively to research the effects of smoking cigarettes, marijuana and/or vaping.*

SECTION B

UNIT III: FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. *examine the use of fossil fuels; and,*	(a) *Types of fossil fuels: coal, natural gas, crude oil (petroleum derivates - diesel, kerosene, gasoline, fuel oil).* (b) *Interconversion of energy using fossil fuels (internal combustion engine, and power plant).* (c) *Advantages of using fossil fuels.* (d) *Disadvantages of using fossil fuels.* (i) *fossil fuels as a non-renewable and exhaustible resource.* (ii) *environmental effects (acid rain, greenhouse effect.* (iii) *the impact of emissions on air quality (sulphur dioxide, carbon dioxide, methane, carbon monoxide, lead).* *Refer to Sec. C, Unit VII, SO 1 – Effects of air pollution.*		
2. *appraise the extent to which alternative sources of energy can be used in the Caribbean.*	(a) *Description of alternative sources of energy: solar, wind, wave, biofuels (biogas, biomass, biodiesel, ethanol), geothermal, hydroelectric.*		

SECTION B

UNIT III: FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) *Uses of solar and wind energy: to include water heating, solar cells (photovoltaic cells), solar cookers/cooking.*	
	(c) *Sustainability of the use of alternative sources of energy: environmental, economic, social.*	
	Refer to Sec. B, Unit 1, SO 2 – Inter-conversion of energy.	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Students are encouraged to:

1. *Work collaboratively to design posters or flyers that depict the effects of fossil fuels on the environment and on the quality of life.*

2. *Watch videos depicting the effects of fossil fuel use on the environment and on the quality of life.*

3. *Participate by going on field trips to renewable energy projects in their country such as solar farms, wind farm, hydroelectric plant, geothermal plant, biogas plant to reinforce concept of alternative energy sources.*

4. *Work in small groups, to investigate the suitability of different form of renewable energy in the Caribbean. Each group should present their findings to the class.*

5. *Work in small groups to design scaled models of the various renewable energy sources used in the Caribbean.*

6. *Participate in a debate on the suitability/sustainability of alternative energy use in the Caribbean.*

SECTION B

UNIT III: FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY (cont'd)

Suggested Teaching and Learning Activities

7. *Visit websites to learn about renewable energy technologies such as biomass, geothermal, hydrogen, hydropower, ocean, solar, wind, zero-energy buildings* https://www.nrel.gov/research/learning.html

8. *Construct a solar cooker to demonstrate how the sun's energy can be used as an alternative source.*

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *examine* the use of conductors of electricity;	(a) Definition of conductors (good, semi and poor). (i) *Definition of insulators.* (ii) *Use of insulators (poor conductors such as rubber and plastics in covering electrical wires and connections).* *Refer to Sec. C, Unit III, SO 3 – Generation of electricity.*	*Investigate* to *determine how well materials conduct electricity.*
2. *examine the flow of electricity in* circuits;	(a) *Circuits:* (i) *electrical components of* circuits *and their symbols* (ammeter, cell, lamps, resistors, switch, transformer, voltmeter and fuse); (ii) *difference series and parallel circuits; and,* (iii) *simple circuits (must be able to draw simple circuits).* (b) *relationship between voltage (V), current (I)* and resistance (R): (i) *Units of electricity: Ampere, Volt, Watt and Ohm.* (ii) *Calculation of:* - *Wattage Power* (P), *given voltage and current, use of formula* $P = IV$. - *Voltage given current and resistance, use of formula* $V = IR$ *(for series circuit only).*	*Set up circuits to show properties; draw diagrams of series and parallel circuits.* *Use ammeters and volt-meters to show how different resistances affect current.* *Calculate wattage, given voltage and current.*

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
3. *assess the consumption of electricity in the home;*	(a) Energy consumption = power x time. (b) The cost of using heating appliances (clothes iron, stoves) and non-heating appliances (radio, fluorescent bulbs, fans). Unit = 1 kWh. *Costs contributing to electricity bills (meter rentals and fuel adjustments).*	
4. *discuss the safety features of electrical* devices;	(a) *Electrical devices:* (i) *fuse; and,* (ii) *wiring plug and flex.* (b) Colour code in wiring plug and choice of flex. (c) *D*angers of overloading circuit (overheating of wire that may cause insulation to burn). *Mention the use of thick wires as overhead cables and for heavy-duty appliances.*	
5. discuss energy conservation measures;	(a) *Definition of energy conservation.* (b) Energy wastage in faulty electrical appliances. *Light Emitting Diode (LED), Liquid Crystal Display (LCD), Plasma.* *Methods of energy conservation such as turning off lights, unplugging appliances not in use, the use of occupancy sensors.*	

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. compare *artificial sources of light*;	(a) *Artificial sources of light*: (i) fluorescent tubes; (ii) LED bulbs; (iii) *compact fluorescent bulbs;* and, (iv) filament lamps. (b) *Comparison of sources in (a) using:* (i) *shadow* formation; (ii) efficiency; (iii) ease of brightness control; and, (iv) similarity with daylight.	
7. *discuss first aid methods for treating electrical accidents;*	(a) *Description of methods to include principles of CPR.* (b) *Methods in relation to:* (i) *electrical shock; and,* (ii) *burns.* *Refer to Sec. B, Unit II, SO 6 – Mechanism of breathing.*	
8. *discuss the hazards associated with electricity;*	(a) *Hazards associated with powerlines to include:* (i) *Illegal connections;* (ii) *kite flying; and,* (iii) *picking of fruits.*	

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) *Mishandling of appliances to include:* (i) *radios;* (ii) *television sets;* (iii) *computers;and,* (iv) *microwaves.* *Refer to Sec B, Unit IV, SO 9 – Methods used in extinguishing fires.*	
9. *discuss the various methods of extinguishing fires; and,*	(a) *Elements required for fires (heat, fuel, oxygen).* (b) *Types of fires:* (i) *Electrical;* (ii) *Chemical; and,* (iii) *Bush fires.* (c) *Types of fire extinguishers:* (i) *Water;* (ii) *Foam;* (iii) *Carbon dioxide; and,* (iv) *Powder.* (d) *Methods of extinguishing fires:* (i) *Removing heat;* (ii) *Removing oxygen; and,* (iii) *Removing fuel source.*	

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	Refer to Sec B, Unit IV, SO 8 – Hazards associated with electricity. *Refer to Sec C, Unit VI, SO 1 – Chemicals are flammable, causing fires.* *Refer to Sec A, Unit II, SO 7 – Bush fires result in soil erosion.*	
10. *evaluate conventional protective gear/wear.*	*Including gears/wears in the home, school and workplace.* *Protective clothing – gloves, goggles, and helmets.* *Refer to Sec. C, Unit VII, SO 2 – Community hygiene.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Work with a peer to investigate the conductivity of different materials using a simple circuit. Have students document their observations.*

2. *Build circuits using parts from a flashlight (or other small device) to test which materials are conductors or insulators. Have students use materials (aluminium foil, rubber, plastic, wood, steel etc.) by putting them into the circuit to close the circuit. Have them observe if the material conducts electricity based on whether the bulb in the circuit lights up.*

3. *Conduct investigations and interpret data of results obtained, for example, on the use of electrical energy in the home/school. This can be done as a collaborative activity. Have students discuss their findings in a guided class discussion.*

4. *Visit websites to watch movies, play games and do quizzes and activities on topics such as electricity and lighting. For example, https://www.brainpop.com/science/*

SECTION B

UNIT IV: ELECTRICITY AND LIGHTING (cont'd)

Suggested Teaching and Learning Activities

5. *Construct simple circuits both series and parallel using easily accessible materials and determine the effect on current by adding different resistors. Have students showcase their work.*

6. *Students should be encouraged to do activities reinforcing content taught. For example:*

   (a) *Work out size of fuses for appliances.*

   (b) *Use actual measurements on energy consumption (units on meter) from different appliances.*

   (c) *Read both digital and analogue meters.*

7. *Work collaboratively to investigate the brightness of various filament lamps of different voltage and present their findings.*

8. *Participate by observing presentations made by resource persons, for example, firefighting personnel to engage students in interactive sessions on topics of interest, such as hazards associated with electricity in everyday activities, methods of extinguishing fires, protective gears to be used at home, school and workplace when handling electrical issues and safety features of electrical devices.*

9. *Participate by attending a field trip to a Fire Brigade station where they will observe or be engaged in activities on how to extinguish fires based on its origin (electrical, chemical).*

10. *Observe guest lectures by resource persons (nurse or doctor). Students could also visit the burn unit at a hospital where they would observe the necessary steps to treat electrical burns and shock. The Red Cross can also be invited where students are trained and certified in first aid.*

SECTION B

UNIT V: TEMPERATURE CONTROL AND VENTILLATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *examine the application of the methods of heat transfer;*	*Description and use of each heat transfer methods.* (a) *Conduction (Use of conductors in the home).* (b) *Convection (Mention land and sea breezes).* (c) *Radiation (Heat from the sun and fire).* *Refer to Sec. B, Unit V, SO 1– Heat transfer.*	*Perform simple experiments to show the conduction and convection.*
2. *outline the use of thermostats in household appliances;*	(a) *Principles by which thermostats operate.* (b) *Functions of thermostats in Electrical and gas ovens, electrical irons.*	
3. *compare the types of thermometers;*	(a) *Definition of temperature and unit of measurement.* (b) *Principles by which thermometers work.* (c) *The use and temperature range of the types of thermometers:* (i) *clinical;* (ii) *laboratory; and,* (iii) *digital.* (d) *Advantages and disadvantages of alcohol and mercury thermometers.*	

SECTION B

UNIT V: TEMPERATURE CONTROL AND VENTILLATION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
4. *describe temperature regulation in humans; and,*	(a) Sweating. Role of latent heat of vaporisation. (b) Effect of changes in body temperature on metabolic rate. *Refer to Sec. A, Unit V, SO 2 – The excretory system.*		
5. *explain the need for proper ventilation.*	(a) *The importance of ventilation to living organisms.* (b) *Identification of features of buildings which promote ventilation.* (c) *Types of ventilation (natural and mechanical including air conditioners and fans).* *Refer to Sec. C, Unit VII, SO 1 – Air pollution.*		

SECTION B

UNIT V: TEMPERATURE CONTROL AND VENTILLATION (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Observe, record and discuss demonstrations or simulations:*

   (a) *of conduction and convection.*

   (b) *to illustrate the principle of using a bimetallic strip. For example, https://www.youtube.com/watch?v=9AWKkTPqrJE*

2. *Participate in activities that will show them how to use thermometers properly. Students should be supervised while using the apparatus. Have students reflect on the activity.*

3. *Watch instructional videos and/or observe a model of the skin to reinforce the concept of temperature regulation. Have students write a poem on the importance of temperature regulation.*

4. *Conduct an investigation on the effects of wind, temperature, and humidity of the area on evaporation and drying of materials. Have students work collaboratively to creatively present their findings.*

5. *Participate in a discussion on features of buildings which promote ventilation. Have students explain how this is applicable within their own context (home/school).*

6. *Participate in guest lectures by resource persons, for example, contractors or engineers to engage them in interactive sessions on topics of interest such as the importance of ventilation features in the homes and school environment.*

♦ *SECTION C: OUR PLANET*

UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *understand the nature of the universe;*
2. appreciate the *solar systems and the* motions within *it;*
3. understand the rationale for space exploration;
4. *explore the factors that contribute to weather systems;*
5. understand the nature *of forces;*
6. *explore the factors that lead to natural hazards;*
7. *appreciate the value of water and its importance to aquatic eco systems;*
8. *develop an appreciation of the nature of matter;*
9. *explore the uses and effects of chemicals on the environment;*
10. *appreciate the importance of proper sanitation; and,*
11. *develop collaborative, investigative and problem-solving skills.*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *identify the components of the universe;*	(a) *Galaxies to include the Milky way galaxy.*	
	(b) *Solar system.*	
	(c) *Asteroids.*	
	(d) *Planets/Planetoids.*	
	(e) *Meteorites/Meteoroids.*	
	(f) *Comets.*	
	(g) *Stars.*	

SECTION C

UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
2. *explain how bodies stay in orbit;*	(a) *Gravitational pull.* (b) *Satellites (natural and artificial – geo stationary orbit).* *Refer to Sec. C, Unit IV, SO 2 – Centripetal force.*		
3. *describe the solar system;*	(a) *Planets, elliptical shape, number of moons; size of planets, ecliptic orbits.* (b) *The sun, in relation to the planets (distance of planets from the sun).* (c) *Location of the earth in the solar system.*		
4. *discuss how earth is affected by other bodies; and,*	(a) *Day and night.* (b) *Concept of shadow formation.* *Refer to Sec. B, Unit IV, SO 6.* (c) *Description of eclipses – Solar and Lunar.* (d) *Phases of the moon – new moon, first quarter, full moon, last quarter.* *Refer to Sec. C, Unit II, SO 3 – Tides.*		

SECTION C

UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
5. *discuss human's exploration of the universe.*	*Including:* (a) *Reasons for exploration of the universe.* (b) *Characteristics of outer space temperature, radiation, lack of oxygen and pressure, lack of gravity.* (c) *International space station.* (d) *James Webb and Hubble telescope.* (e) *Types of exploration of other planets (Mars, Jupiter; flyby, orbiter, rover (lander), humans).*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos to reinforce the concepts of the solar system and the bodies within.*

2. *Work in small groups to construct and display models:*

   (a) *of the solar system using recyclable materials; and,*

   (b) *to demonstrate the effects of the moon on the earth, for example, day and night and types of eclipses.*

3. *Conduct simple lab activities using light sources and screens to show shadow formation. Have students record their observation.*

SECTION C

UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM (cont'd)

Suggested Teaching and Learning Activities

4. *Observe the moon over a 30-day period noting changes in shape and percentage of light emitted. Engage students in a guided discussion on their findings.*

5. *Visit the NASA website and view photographs of outer space from the James Webb and Hubble space telescope. They should also be encouraged to access virtual tours.*

6. *Participate as a member of a group to debate issues that impact human life. For example, effects of space travel on astronauts.*

SECTION C

UNIT II: THE TERRESTRIAL ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. *examine the effects of air masses in the Caribbean;*	(a) *Types of air masses (maritime tropical, continental tropical, maritime polar, continental polar).* (b) Air masses affecting the Caribbean - the spread of Pollutants *(*radioactive fallout, volcanic dust, industrial waste, Sahara dust, landfill fumes*).* *Refer to Sec. C, Unit VII, SO 1 – Air pollution.* (c) *Types of fronts (to include definition) and their effect on the weather (cold, warm, stationary, occluded).*		
2. *examine the weather patterns in the Caribbean;*	(a) *Weather patterns (wet and dry seasons).* (b) *Definition of a cyclone – low pressure, wind speed, meeting of air masses.* (c) *Development of tropical depressions, tropical storms and hurricanes.*		

SECTION C

UNIT II: THE TERRESTRIAL ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
3. *examine the effects of* tides; *and,*	(a) *The types of tides - high, low, spring, neap tides.* (b) *The formation of tides.* (c) *The effects of tides (coastal erosion).* *Refer to Sec. C, Unit I, SO 4 - Eclipses.* (d) *Brief description of tidal waves.* (e) *Description and causes of a tsunami - underwater landslides, volcanic eruptions and earthquakes.*		
4. explain the causes of the different types of volcanic eruptions.	(a) *The types of volcanoes:* (i) *cinder cone or spatter cone;* (ii) *shield; and,* (iii) *composite or strato-volcano.* (b) The ecological consequences of volcanoes in the long and short- term. Include Kick-em-Jenny underwater volcano off the coast of Grenada, *La Soufriere in St Vincent*.		

SECTION C

UNIT II: THE TERRESTRIAL ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(c) *The relationship between earthquakes and volcanoes.*	
	(d) *The function of the seismograph. The Richter scale. Significance of the numbers on the Richter scale.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos to reinforce concepts on various topics, for example, cycles in nature, tidal waves, volcanic eruptions and climate change. Have students complete a worksheet at the end of the video presentations.*

2. *Use a website or weather app to observe and track weather systems across the Caribbean. Have students document and discuss their observations.*

3. *Attend field trips, where possible, to meteorological/weather stations to observe equipment used to monitor weather systems.*

4. *Work in small groups to conduct a study of plant and animal life on seashores or riverbanks with respect to tidal patterns. Have students creatively present their findings to the class.*

5. *Work in small groups to construct and present working models to show volcanic eruptions.*

6. *Work in small groups to research and demonstrate evacuation and safety procedures during an earthquake.*

SECTION C

UNIT III: WATER AND THE AQUATIC ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the properties of water;	(a) *Chemical properties of sea and fresh water.* (b) *Physical properties of sea and fresh water.* (c) Effects of sea and fresh water on aquatic life.	*Use boiling and melting points to compare the physical properties of salt water and fresh water.*
2. *distinguish between hard and soft water;*	(a) *Characteristics of hard and soft water.* (b) *Advantages and disadvantages of hard and soft water.*	*Conduct experiments to determine degree of hardness of water.* *Conduct experiments to soften samples of hard water by:* (i) *boiling;* (ii) *adding washing soda; and,* (iii) *distillation.*
3. explain the uses of water;	(a) Role in life processes - *excretion, digestion, transport of substances, respiration.* (b) *U*ses in home - *drinking, cooking, washing, cleaning* (consider wastage and conservation). (c) *Agriculture including hydroponics, aquaculture, mariculture.* (d) *Recreational activities.* (e) *F*irefighting. (f) *G*eneration of electricity.	*Perfom calculations to determine water consumption over a 30-day p*eriod.

SECTION C

UNIT III: WATER AND THE AQUATIC ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:			
		Refer to Sec. A, Unit II, SO 2 – Asexual reproduction in plants. *Refer to Sec. B, Unit IV, SO 1 – Conductors.*	
4.	*describe* the various methods used locally for fishing;	*Brief description of* methods, including by hand; spears/harpoons; netting (trawling, long- lining); pots or traps; fish farming.	
5.	*evaluate* the effects of water pollution on aquatic life;	(a) Sources of pollution, for example, nitrates, phosphates, various pesticides, oil spills. (b) *Effects of pollution on aquatic life to include but not limited to eutrophication, fish kill, destruction of the coral reef, mangroves and wetlands.* *Refer to Sec. B, Unit 1, SO 4 Energy transfer.*	*Investigate the effects of the removal of oxygen from water.*
6.	*Investigate* methods of purifying water;	(a) Sources of water. (b) *Methods of purifying water: the treatment of seawater for domestic use (desalination), boiling, filtration, chlorination, distillation and additives of alum and carbon.* *Refer to Sec. C, Unit VI, SO 5 – Separation techniques.*	*Conduct ex*periments to purify water.

SECTION C

UNIT III: WATER AND THE AQUATIC ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. *determine* the conditions for flotation;	(a) *Upthrust and density.* (b) Archimedes principle. (c) The Plimsoll line on boats and ships. *Refer to Sec. C, Unit IV, SO 3 – Maximum loading capacity.*	*Conduct experiments to compare* sinking and floating of similar materials in fresh and sea water. Simple measurements of densities.
8. *explain importance of* navigational devices used at sea;	(a) Compass*, sonar, radar, GPS* as devices. (b) *H*ow the magnetic compass works. (c) *Maritime* safety standards.	
9. identify water safety devices; and,	Life rafts and jackets, inflatable tubes.	
10. discuss the *effects of* diving *on the human body*.	*Effects of Scuba-diving and free-diving:* (a) Respiratory problems: damage to membrane due to high pressure. (b) *Decompression sickness:* The bends, nitrogen narcosis, *use of decompression chambers.* (c) *Embolism.* (d) *Baro trauma (ears, lungs).* *Refer to Sec. B, Unit II, SO 6 – Mechanism of breathing.*	

SECTION C

UNIT III: WATER AND THE AQUATIC ENVIRONMENT (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos to reinforce the concepts about the properties of water, fishing, water safety and floatation. Have students complete a worksheet or engage a peer in a guided discussion on their observations.*

2. *Attend site visits and/or field trips to seashores and riverbanks to observe life in the aquatic environment and water treatment plants to observe processes involved in purifying water. Have students document their observations.*

3. *Participate in guest lectures from resource personnel on fishing and/or water pollution to reinforce learning.*

4. *Attend a field trip to a fisheries complex or fish farm to observe types of fishing gears, navigation devices and boats and engage fisheries officers, and fishermen in discourse on their observations.*

5. *Use simple apparatus to illustrate the concept floating for example, density blocks.*

6. *Work in small groups to construct a working model of a compass. Have students present their models.*

7. *Compare water usage of their school during the term and during vacation using water bills. They should then calculate water consumption over a 30-day period. From their observations, students are encouraged to propose ways in which water can be conserved.*

8. *Participate in lectures by resource persons to discuss effects of diving. In cases where this is not possible, students should be encouraged to conduct research on the effects of diving.*

SECTION C

UNIT IV: FORCES

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *investigate* the principles of forces;	(a) *Definition of force* *Use of formula* $F = m \times a$. (b) *Types of forces – push, pull and twist.* (c) *Newton's third law* – Action-reaction principle applied in space transport. (d) *Forces in air* – the forward motion of jet aircrafts. Relationship between shape of wings of planes and birds and lift forces they experience while moving through air; the effects of wind speed and wind currents on the motion of aircraft. (e) Friction – motion of vehicles, road surfaces and tyres.	*Demonstrate friction* on different surfaces *using a ball.*
2. describe gravity as a force;	(a) Definition – *gravitational force, and non-contact force.* (b) *Newton's first law – Centrifugal forces, centripetal forces (satellites).* *Refer to Sec. C, Unit IV, SO 2 – Gravity.*	
3. *determine the* centre of gravity;	(a) *Definition of the centre of gravity.* (b) *The relationship between height of the center of gravity of an object and its stability; the implications for stability on the loading of vehicles in relation to their center of gravity; reasons for maximum loading capacity and tare.* *Refer to Sec. C, Unit III, SO 7 – Plimsoll line on boats.*	Use cardboard cutouts of triangles, rectangles, circles and irregular shapes to arrive at the approximate position of the center of gravity of objects of *different* shapes.

SECTION C

UNIT IV: FORCES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. *investigate equilibrium;*	(a) *Types of equilibrium – stable, unstable, neutral.*	
	(b) *Application of equilibrium in medicine (chemical balance in the body), chemistry (reversible chemical reaction), biology (homeostasis).*	
	(c) *Moments of a force about a point is the product of the force and the perpendicular distance of its line of action from a point.*	*Investigate using* rule suspended by a spring balance and kept horizontal by known suspended weights to show that:
	Use of formula M = F x d.	(i) the sum of the forces in one direction must equal the sum in the opposite direction; and,
	(d) *Conditions for equilibrium under parallel forces.*	(ii) the sum of the clockwise moments about a pivot must equal the sum of anti–clockwise *moments*.
5. *examine the principle of momentum conservation;*	(a) *Definition of momentum.*	
	(b) *The law of conservation of momentum. Total momentum before the collision is equal to the total momentum after the collision.*	
	(c) *Consider conservation of linear momentum (refer to vehicular collision, rocket engine, playing pool/billiards).*	
	Use of formula (p = m x v) to do simple calculations.	

SECTION C

UNIT IV: FORCES (cont'd)

SPECIFIC OBJECTIVES	*EXPLANATORY NOTES*	*SUGGESTED PRACTICAL ACTIVITIES*
Students should be able to:		
6. *explain the functions of simple machines;*	(a) *Functions of simple machines:* (i) *they make work easier; and,* (ii) *they are used as force multipliers for convenience of application of a force.* (b) *Types of simple machines:* (i) *levers:* - *classes of levers (organising load, effort and fulcrum in three different ways);* - *compare the different classes of levers; and,* - *simple levers in the mammalian skeleton.* (ii) *pulleys; and,* (iii) *inclined planes.* (c) *Simple machines used in or associated with vehicles, for example, motor cars, push carts, draglines, bicycles.* *Refer to Sec. C, Unit IV, SO 8 – Movement of the limbs in the skeleton.*	

SECTION C

UNIT *IV*: FORCES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. *relate the structure of the skeleton to its functions;*	(a) *Major bones of the human skeleton: Cranium, clavicle, scapula, vertebral column (cervical, thoracic, lumbar), humerus, radius, ulna, rib cage, sternum, pelvic girdle, femur, tibia, fibula.* *Movement, protection, support, breathing, protection of blood vessels.*	
8. *explain how the skeletal muscles function in the movement of the limb; and,*	(a) *Joints in the human body: Hinge joint, fixed joint, ball, socket and gliding.* (b) *Role of antagonistic muscles.* *Refer to Sec. C, Unit IV, SO 6 – Simple levers in the mammalian skeleton.*	
9. *examine the efficiency of simple machines.*	(a) *The principle of energy efficiency and energy conversion.* *Law of conservation of energy (energy is neither created nor destroyed it can be converted from one form to another).* *Use of the equation: work done = force x distance moved in the direction of the force.* (b) *The principle of mechanical advantage (ratio of the load to the effort applied).* *Use of the equation: mechanical advantage = load ÷ effort.*	

SECTION C

UNIT *IV*: FORCES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:	(c) *The factors that contribute to the inefficiencies of machines and ways of overcoming their influences. The motorcar, lawnmower, bicycle; factors such as rusting, corrosion and friction.* *Refer to Sec. B, Unit 1, SO 2 – Inter-conversion of energy.* *Refer to Sec. C, Unit V, SO 6 – Tarnishing of metals.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos to reinforce concepts such as force, gravity, equilibrium, momentum, and machines. Have students complete a worksheet or discuss with a peer their observations.*

2. *Observe teacher led demonstrations on forces. Students should then discuss their observations with classmates. For example,*

   (a) Action-reaction principle, for example, releasing an inflated balloon, using a pair of spring balances*, balloon rocket*.

   (b) Demonstrate by blowing over strips of paper held at one end.

   (c) *Demonstrate using* paper aircraft models and fan.

3. *Conduct investigations. For example:*

   (a) *Dropping a heavy and a light book from the same height at the same time and observe if they land at the same time or not. Discussion should ensue about the leaning tower of Pisa; and,*

   (b) *Determine if it is easier to balance a yardstick on your finger than a pencil or ruler.*

SECTION C

UNIT *IV*: FORCES (cont'd)

Suggested Teaching and Learning Activities

4. *Observe teacher demonstrations on the concept of gravity by:*

   (a) *Throwing a ball up and observing its motion.*

   (b) *Releasing objects attached to suspended spring/ not attached to anything.*

   (c) *Using models to demonstrate how an object can escape the pull of gravity if given enough kinetic energy by whirling around the head a rubber band attached to a weak thread.*

5. *Locate the centre of gravity of items such as pencils, rulers and solids with regular shapes. Have students reflect on the activity.*

6. *Observe demonstrations of simple machines (hammer, bottle opener, crowbar, scissors, nutcracker, wheelbarrow, fishing rod, tweezers as levers; pulleys, wheels, hydraulic press, screw) in use to reinforce theoretical concepts. Have students work with a partner to discuss their observations.*

7. *Complete worksheets requiring them to perform calculations on mechanical advantage with respect to simple machines.*

8. *Observe teacher demonstrations on:*

   (a) *The momentum conservation principle using simple qualitative trolley experiments, or they may incorporate the use of worksheets for students to complete.*

   (b) *The three types of equilibrium using a* small ball, a concave/ convex dish, or a cone shaped object and a flat surface.

SECTION C

UNIT V: METALS AND NON-METALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. relate *the physical properties* of metals and non-metals to their uses;	(a) Metals. (b) *Nonmetals to include plastics, wood, ceramics and textiles (natural and man-made).* (c) Properties such as electrical conductivity, thermal conductivity, melting point, density, tensile strength. (d) *Appropriateness of the* materials used in sports/sporting equipment.	*Measuring the elasticity of specific substances.*
2. *compare the reactivity of metals;*	Aluminium (Al); Copper (Cu); Iron (Fe); Tin (Sn); Silver (Ag); Zinc (Zn). *Refer to Sec. C, Unit VI, SO 6 – Household appliances.*	Observe which metals react *with dilute acid* and which do not; Write simple word equations to show their reaction.
3. discuss the advantages and disadvantages of using cooking or canning utensils made of aluminium;	(a) *Advantages.* (b) *Disadvantages* (consideration of toxicity and corrosion).	
4. discuss the benefits of using alloys to make household items;	(a) *Alloys* and examples of alloys commonly found in the home and workplace - steel, brass, soft solder and *electroplating*. (b) *Benefits of using Alloys.*	
5. *examine* the conditions which cause rusting; *and,*	(a) *Factors which affect the rate of rusting:* (i) *sea spray;* (ii) *emission from industrial plants; and,* (iii) *climate (tropical).*	*Investigate the conditions needed for rusting.*

SECTION C

UNIT V: METALS AND NON-METALS (cont'd)

SPECIFIC OBJECTIVES		EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:				
		(b) Tarnishing as a chemical process (oxidative). *Rusting in relation to iron and steel.* (c) *Word equation for rusting:* *Iron + Oxygen + Water → rust(Iron Oxide).*		
6.	discuss the methods used to reduce or prevent *tarnishing of metals*.	*The scientific principles of the following methods used to prevent tarnishing for commercial and household purposes:* (a) *Painting.* (b) *Covering with oil or plastic.* (c) *Proper storage (moisture free).* (d) *Use of drying agents (desiccants).* (e) *Electroplating.* (f) *Galvanizing.* (g) *Alloy (steel).* *Refer to Sec. C, Unit IV, SO 9 – Efficiency of machines.*		

SECTION C

UNIT V: METALS AND NON-METALS (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Watch videos to reinforce concepts such as properties of metals and nonmetals and alloys. For example:*
   https://www.youtube.com/watch?v=AJbe5THaNuU
   https://www.youtube.com/watch?v=PHu8hQBtPcY
   https://www.youtube.com/watch?v=Rc2JBp91V7o
   https://www.youtube.com/watch?v=TGPPPFczOj0&t=15s
   https://www.youtube.com/watch?v=KgUmNQD6m5Q

2. *Visit websites and use online resources to reinforce learning on the properties of metals and nonmetals. For example:*
   https://www.nagwa.com/en/lessons/280172486318/
   https://keslerscience.com/metals-nonmetals-and-metalloids-lesson-plan-a-complete-science-lesson-using-the-5e-method-of-instruction/

3. *Conduct research on the advantages and disadvantages of using aluminium and alloys in household items. They should work in small groups to present their findings in a creative way. For example, using flyers, brochures, or presentations.*

4. *Watch videos to reinforce the concept of rusting for example, https://www.youtube.com/watch?v=jQoE_9x37mQ*

5. *Watch teacher guided videos and simulations explaining the application of electrolysis in electroplating, galvanizing, and painting. Have students record and discuss their observations.*

6. *View pictures and/or samples of household items made from alloys. Have students observe the pictures/samples engage them in guided discussions on the advantages of alloys.*

   Visit websites to watch movies, play games and do quizzes and activities on topics such as metals. For example, https://www.brainpop.com/science/. Have students complete a worksheet at the end of the activity.

7. *Observe demonstrations in which nails are placed under different conditions. Students should then discuss the conditions causing rusting.*

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the uses of common household chemicals;	(a) *Water as the most common chemical in the home; water as a solvent used in many household chemicals.* (b) *Household chemicals and their uses (chemical and household names and eco-friendly products):* (i) *hard surface cleaners (disinfectant, ammonia, bleach, degreaser);* (ii) *personal hygiene (bath soap, body wash, deodorant, shampoos, antiperspirants, conditioners, toothpaste, mouthwash);* (iii) *laundry (soap, detergents, fabric softeners);* (iv) *kitchen (dishwashing liquid, oven cleaner, salt, vinegar, baking powder, baking soda); and,* (v) *health (antacid, antiseptic, pain killers, hand sanitizers, alcohol).*	

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(c) *Safety symbols (alert to potential hazards) - corrosive, toxic, flammable, explosive, oxidizing, harmful or irritant, radioactive.* *Refer to Sec B, Unit IV, SO 9 - Methods used in extinguishing fires.*	
	(d) *The safe use of household chemicals.*	
	(e) *The economic use of household chemicals (buying in bulk, using recommended quantities, long shelf life).*	
2. *examine the properties of* acids, bases and salts;	(a) The concept of pH *as it relates to the properties of acids, bases and salts.* (b) Classification of household chemicals into acids, bases and salts.	*Conduct* simple investigations to determine the pH values of *various household chemicals to determine whether they are acids, alkaline or neutral.* Use pH paper.
	(c) *Principle of neutralisation to include but not limited to:* (i) *agriculture;* (ii) *health;* (iii) *nutrition;* (iv) *cooking; and,* (v) *sanitation.*	*Conduct* simple experiments on neutralisation using droppers.
3. *differentiate among the properties of the states of matter;*	(a) *Characteristics of solid liquid and gas:*	*Conduct simple experiments to demonstrate the changes of state of matter (solid liquid and gas).*

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
	(i) *arrangement of particles;*		
	(ii) *shape and volume;*		
	(iii) *forces of attraction; and,*		
	(iv) *movement of particles.*		
	(b) *Changes of state (processes to include deposition, freezing, condensation, sublimation, evaporation, and melting).*		
	(c) *Plasma (simple definition and example) of plasma (the fourth state of matter).*		
4. *examine the properties of mixtures*;	Mixtures: solutions, suspensions and colloids.		
	(a) *Definition of the terms solutions, solute and solvent.*		
	(b) *Differences between a solution, a suspension and a colloid.*		
	(c) Classification of household chemicals in each category.		

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
5. *determine appropriate* separation techniques;	(a) *Difference between a*queous and non-aqueous solutions. (b) *Application of separation methods to home and workplace to include but not limited to:* (i) *d*istillation *(wine making)*; (ii) *f*iltration *(cooking);* (iii) chromatography *(bleeding colours in laundry);* (iv) *crystallization (honey to form sugar crystals, production of sugar from sugar cane); and,* (v) *evaporation (preparation of table salt).* (c) *Desalination plants (distillation and reverse osmosis).* *Refer to Sec. C, Unit III, SO 6 – Water purification.*	*Plan and design* experiments on stain removal - turpentine for paint; methylated spirit for glass; acetone for nail polish. *Conduct simple experiment to separate salt from a mixture of salt and sand.*
6. explain the *effects* of *cleaning agents* on household appliances; *and,*	(a) *Cleaning agents (scouring powders, detergents, rust removers, lime scale removers, oxidizing agents).*	

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(b) *Different reactions of cleaning agents: abrasive and chemical action.* (c) *Effects on appliances made from Aluminum (Al), Copper (Cu), Iron (Fe), Tin (Sn), Silver (Ag), Zinc (Zn).* *Refer to Sec. C, Unit V, SO 2 - Metals.*	
7. distinguish between soapy (soap) and soapless detergents.	(a) *Methods of production (soap – animal fats and oils; soapless – petroleum products).* (b) *Scum formation.* (c) *Advantages and disadvantages:* (i) *biodegradable and non-biodegradable;* (ii) *pollution;* (iii) *irritants and non-irritants; and,* (iv) *production cost.*	

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Make poster, brochures or flyers showing safety symbols and explaining the dangers of chemicals used in everyday life. Have students display their work.*

SECTION C

UNIT VI: HOUSEHOLD CHEMICALS (cont'd)

Suggested Teaching and Learning Activities

2. *Conduct a research on the functions of common household chemicals. Have students classify each into acid, bases, or salt.*

3. *Conduct a research on the use of salts in everyday life, for example, preservatives, controlling pests, medicines. This can be done as a collaborative or individual activity requiring students to creatively represent their findings.*

4. *Watch videos on concepts such as acid, bases, salts and principle of neutralization:*
https://www.youtube.com/watch?v=Ne8xQ4LGLf0
https://www.youtube.com/watch?v=mkAnvRIeATE
https://www.youtube.com/watch?v=vt8fB3MFzLk
https://www.youtube.com/watch?v=lBjwMcHUyBY
https://www.youtube.com/watch?v=RmnT9jwX4gQ

5. *Work in small groups to construct a 2D or 3D model of the states of matter. Have students use the models to explain the properties and changes of states of matter.*

6. *Watch video clips on plasma to enhance students learning. for example, https://www.youtube.com/watch?v=94tReSbyPYc&t=3s. Have students complete a worksheet at the end of the activity.*

7. *Observe teacher demonstrations showing the preparation and use simple preparations of solutions, suspensions, and colloids to compare the characteristics. Have students record and discuss their observations.*

8. *Watch videos and/or observe teacher demonstration on concepts such as separation techniques to enhance learning. For example:*
https://www.youtube.com/watch?v=vi_SJBnxmHo
https://www.youtube.com/watch?v=eQlnHr9g6Io
https://www.youtube.com/watch?v=TdJ57SQ6GAQ
https://www.youtube.com/watch?v=mEXzzlDCkoo

9. *Observe teacher demonstrations on the effects of cleaning agents. For example, experiments on stain removal such as applying bicarbonate of soda on fruit stains; borax for fruit, wine and tea stains; and the removal of rust marks on clothing. As well as the use of stain removal pens and teeth whiteners. Have students record and discuss their observations.*

10. *View websites to watch movies, play games and do quizzes and activities to reinforce learning on topics such as compound and mixture. For example, https://www.brainpop.com/science/. Have students complete a worksheet.*

11. *Engage in group activities to assess the impact of organic compounds used in everyday life on human health, society and the environment, for example, food additives, pharmaceuticals, detergents.*

SECTION C

UNIT VII: POLLUTANTS AND ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
1. *discuss the effects of air pollution;*	*Effects:* (a) *Health: Allergies, lung cancer, asthma, other respiratory disorders, emphysema.* (b) *Environmental: Acid rain, blocking stomata in plants.* *Refer to Sec. A, Unit VII, SO 4 - allergies.* *Refer to Sec. B, Unit II, SO 8 – second-hand smoke.* *Refer to Sec. B, Unit V, SO 5 - Ventilation.* *Refer to Sec. B, Unit III, SO 1 – Fossil fuels.* *Refer to Sec. C, Unit II, SO 1 – Air masses.*		
2. *justify the importance of community hygiene to the environment; and,*	(a) *Types of waste: Domestic, industrial, biological, chemical and electronic waste. Bio-degradable and non-bio-degradable waste.* (b) Impact *of improper waste disposal*: (i) Pollution of land and water (surface, ground and potable water); (ii) increase in pest population; (iii) prediction of their consequences; and, (iv) assessment of the effects of unsanitary conditions on the spread of pathogenic microorganisms and parasites such as worms.		

SECTION C

UNIT VII: POLLUTANTS AND THE ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
	(c) *Recommended Practices: Proper disposal of solid waste (refuse, reduce, reuse, repair, refill, repurpose, recycle), composting, biogas production, adequate toilet and sewage disposal facilities (septic tanks, cesspools soak aways and sewage treatment plants), garbage collection and disposal.*	
	(d) *Benefits: Prevention of infections, aesthetic value.*	
3. *discuss the use of plastics.*	(a) *Advantages of using plastics:* (i) *ease of production (manufacture and costs);* (ii) *durability; and,* (iii) *use of plastics in industry (medical, construction).*	
	(b) *Negative effects on the environment:* (i) *burning of plastics – release of toxic gases (dioxins) and respiratory illnesses;* (ii) *length of time taken to degrade; and,* (iii) *microplastics in the marine environment.*	
	(c) *Benefits of recycling.*	

SECTION C

UNIT VII: POLLUTANTS AND THE ENVIRONMENT (cont'd)

Suggested Teaching and Learning Activities

To facilitate students' attainment of the objectives of this Syllabus, 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.

Encourage students to:

1. *Attend guest lecturers by resource persons to reinforce concepts. For example, lectures by health professionals to engage students in interactive sessions on topics of interest such as issues related to health and sanitation.*

2. *Attend field trips to landfills and dumpsites to enhance learning on the importance of community hygiene. Have students document their observations.*

3. *Examine case studies, for example, on topics that relate to health and hygiene. Students should then be engaged in a guided discussion on their analysis. Have them present their own recommendations to treat with any issues identified.*

4. *Work in small groups to create posters or flyers depicting the advantages and negative effects of plastics on the environment. Have students display their work.*

5. *Watch the video "Losing Paradise" https://www.youtube.com/watch?v=vCanbznET3Y. Ask students to write and creatively present a report on how all stakeholders can tackle environmental issues [lack of recycling or accumulation of plastic waste].*

♦ GUIDELINES FOR SCHOOL-BASED ASSESSMENT

RATIONALE

The School-Based Assessment (SBA) is an integral part of student assessment in the course covered by this syllabus. It is intended to assist students in developing certain knowledge, skills and attributes that are critical to the subject. The activities for the School-Based Assessment are linked to the "Suggested Practical Activities" and should form part of the learning activities to enable the student to achieve the objectives of the syllabus. *Students are encouraged to work in groups.*

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

The guidelines provided in this syllabus for selecting appropriate tasks are intended to assist teachers and students in selecting assignments that are valid for the purpose of SBA. These guidelines are also intended to assist teachers in awarding marks according to the degree of achievement in the SBA component of the course. In order to ensure that the scores awarded by teachers are not out of line with **CXC®** standards, the Council undertakes the moderation of a sample of the SBA assignments marked by teachers.

School-Based Assessment provides an opportunity to individualise a part of the curriculum to meet the needs of students. It facilitates feedback to the students at various stages of experience. This helps to build the self-confidence, and critical thinking and problem-solving skills of the students as they proceed with their studies. School-Based Assessment further facilitates the development of essential communicative, investigative, and practical skills that allow students to function more effectively in their chosen vocation. School-Based Assessment, therefore, makes a significant and unique contribution to the development of relevant skills of the students. It also provides an instrument for *assessing* them and rewarding them for their achievements.

The general Aims of this syllabus can only be achieved by using a practical approach. Skills that are not being assessed at a particular time should, therefore, not be neglected. Note also, that not all practicals are used for assessment. Students should be given the opportunity to develop their skills and to feel free to ask for assistance without penalty.

PROCEDURES FOR CONDUCTING SBA

SBA assessments should be made in the context of normal practical coursework exercises. It is expected that the exercises would be designed to provide authentic learning experiences. Assessments should only be made after candidates have been taught the skills and given enough opportunity to develop them. **Eighteen** practical *activities* over the two-year period are recommended as the minimum number for candidates to **develop** their skills and on which to base realistic assessments. *Although **CXC®** will only moderate EACH skill TWICE, teachers are reminded that there is no upper limit to the number of assessments that should be conducted during the course of normal teaching.*

Each skill must be assessed at **least two times** over the two-year period, *with the exception of ORR which must be assessed **at least three times** over the two-year period. One of the practical activities for ORR **must** assess drawing.* Candidates should be encouraged to do corrections so that misconceptions will not persist. When assessing certain skills, especially those which require on-the-spot observation or

involve looking at several behaviours or criteria, teachers are advised to select not more than two skills in any activity. The practical exercises selected for assessment should make adequate demands on the candidates and the skills assessed should be appropriate for the exercises done. For the assessment of written work, the practical activity selected should be one that can be completed in the time allotted for the class and *it is recommended that* **the notebooks should be collected at the end of the period**.

Candidates who have not been assessed over the two-year period will be deemed absent from the whole examination. Under special circumstances, candidates who have not been assessed at all points may, at the discretion of **CXC®**, have their marks pro-rated (adjusted proportionately).

1. In preparation for an SBA practical, the teacher should:

(a) select tasks related to a given syllabus objective. These tasks may be chosen from the "Suggested Practical Activities" and should fit in with the normal work being done in that class;

(b) list the materials including quantities and equipment that will be needed for each student;

(c) carry out the experiment beforehand, if possible, to ascertain the suitability of materials, and the kind of results (observations, readings) which will be obtained, noting especially any unusual or unexpected results;

(d) list the steps which will be required by the candidates in performing the experiment. From this it will be clear to the teacher how the candidates should be arranged in the laboratory, whether any sharing of equipment or materials is necessary, the skills which can be assessed from the practical, and the instructions to be given;

(e) list the skills that may be assessed (for example, observation/recording/reporting, analysis and interpretation). **No more than two practical skills should be assessed from any one practical activity;**

(f) select the skills to be assessed on this occasion. Skills other than those required for that year should also be included for teaching purposes; and,

(g) *review* the criteria for assessing each skill.

2. The teacher should carry out the assessment and record the marks.

This is the most critical step in the assessment process. For a teacher to produce marks that are reliable, the marking must be consistent for all candidates and the marks should reflect the standard of performance at the level. The teacher must be able to justify the marks, and this occurs when there is a fixed set of conditions, factors or criteria for which the teacher looks. Marks should be submitted electronically to **CXC®** on a yearly basis on the SBA form provided. The forms should be dispatched through the Local Registrar to reach **CXC®** by 30 April of the year of the examination.

ASSESSMENT OF PRACTICAL SKILLS

School-Based Assessment will assess skills under the profiles Experimental Skills and Use of Knowledge (Analysis and Interpretation only).

The assessment will be conducted during Terms 1-5 of the two-year period following the programme indicated in the Table below.

SBA SKILLS TO BE ASSESSED FOR CXC® MODERATION

PROFILE	SKILLS	YEAR 1		YEAR 2		
		NO. OF TIMES SKILLS TO BE ASSESSED	MARKS	NO. OF TIMES SKILLS TO BE ASSESSED	MARKS	TOTAL
XS	Manipulation/ Measurement	1	10	1	10	20
	Observation Recording and Reporting	*2*	*20*	1	10	*30*
	Planning and Designing	1	10	1	10	20
UK	Analysis and Interpretation	1	10	1	20	30
	TOTAL	**5**	**50**	**4**	**50**	**100**

At least ONE practical for Observation Recording and Reporting in Year 1 ***must*** *assess the skill of* ***DRAWING****.*

Investigative project to be done in Year 2. The investigative project would be assessed for two skills, Planning and Design and Analysis and Interpretation. Students are encouraged to work in groups.

Investigative Project

Proposal (Planning and Design)

The maximum marks available for the Proposal is ***10 marks***

The format for this part is shown below.

Observation/Problem/Research question stated	
Hypothesis	*2 marks*
Aim	*1 mark*
Materials and Apparatus	*1 mark*
Method	*2 marks*
Controlled variables	*1 mark*
Expected Results	*2 marks*
Assumptions, Precautions/ Limitations	*1 mark*
TOTAL	***10 marks***

Implementation (Analysis and Interpretation)

The maximum marks available for the Implementation is ***20 marks***

The format for this part is shown below.

Method	*1 mark*
Results	*4 marks*
Discussion	*5 marks*
Limitation	*3 marks*
Reflection	*5 marks*
Conclusion	*2 marks*
TOTAL	***20 marks***

REPORTING FORMAT OF INVESTIGATION

PART A THE PROPOSAL (Planning and Design)

Statement of the Problem *– Can be an observation, a problem*
Hypothesis
Aim *– Should be related to the hypothesis*
Materials and Apparatus
Method *– Should also include variables*
Assumptions/Precautions
Expected Results

PART B THE IMPLEMENTATION (Analysis and Interpretation)

Method *– Linked to Part A (change of tense)*
Results
Discussion *– Explanations/Interpretations/Trends*
Limitations
Reflections
Conclusion

CRITERIA FOR ASSESSING INVESTIGATIVE SKILLS

A. PLANNING AND DESIGN

HYPOTHESIS		***2***
- Clearly stated	*1*	
- Testable	*1*	
AIM		***1***
- Related to hypothesis	*1*	
MATERIALS AND APPARATUS		***1***
- Appropriate materials and apparatus	*1*	
METHOD		***2***
- Suitable	*1*	
- At least one manipulated or responding variable	*1*	
CONTROLLED VARIABLE		***1***
- Controlled variable stated	*1*	
EXPECTED RESULTS		***2***
- Reasonable	*1*	
- Link with method	*1*	
ASSUMPTIONS/PRECAUTIONS/POSSIBLE SOURCES OF ERRORS		***1***
- Any one stated	*1*	
TOTAL		***(10)***

B.	***ANALYSIS AND INTERPRETATION***		
	METHOD		***1***
	- Linked to Proposal, Change of tense		
	RESULTS		***4***
	- Correct formulae and equations: *Accurate (2)* *Acceptable (1)*	*2*	
	- Accuracy of data: *Accurate (2)* *Acceptable (1)*	*2*	
	DISCUSSION		***5***
	- Explanation *Development of points:* *Thorough (2)* *Partial(1)*	*2*	
	- Interpretation *Fully supported by data (2)* *Partially supported by data (1)*	*2*	
	- Trends *Stated*	*1*	
	LIMITATIONS		***3***
	-Sources of error identified	*1*	
	-Precautions stated	*1*	
	-Limitation stated	*1*	
	REFLECTIONS		***5***
	- Relevance between the experiment and real life (self, society or environment)	*1*	
	- Impact of knowledge gain from experiment on self	*1*	
	- Justification for any adjustment made during experiment	*1*	
	- Communication of information *(Use of appropriate scientific language, grammar and clarity of expression all of the time (2); some of the time (1)*	*2*	
	CONCLUSION		***2***
	- Stated	*1*	
	- Related to the aim	*1*	
	TOTAL		***(20)***

EXEMPLAR OF INVESTIGATIVE PRACTICAL

EXEMPLAR 1

PART A – THE PROPOSAL

Observation: Some textile materials fade or loose colour after being washed repeatedly. In some cases, these fabrics including cotton, wool and linen, may be reused to make mats, cushions or other household decorations. How can these fabrics be made more brightly and creatively coloured? Which types of fabrics are best for dyeing with a selected natural dye that can be made from readily available plant materials?

Hypothesis: The woollen samples will have a more intense (brighter) colour when treated with the selected natural dye and a mordant, when compared with the linen fabric samples.

Aim: To determine which of three (3) strategies is best for providing brighter coloured fabrics after dyeing. To determine which type of fabric, cotton, wool or linen, produces a more intense colour when organic dyes are used with sodium chloride as a mordant.

Materials/Apparatus

Fabrics for dyeing: cotton, woollen and linen materials (6 x 6 cm^2 size samples)

1. Onion skin (6)
2. Beakers (4)
3. Filter paper
4. Filter funnel
5. Tripod and gauze
6. Glass rod
7. Scissors
8. Measuring cylinders
9. Tongs
10. Stopwatch
11. Potassium alumina sulfate
12. Balance

Method

This method may require 5 days.

1. Prepare your fabric samples, two samples per type of material: Cotton, woollen and linen (6 x 6 cm^2 size samples each).

2. Weigh the fabric samples to be dyed.

3. In tap water, dissolve the alum (10% of mass of fabric to be dyed) in 300 cm^3 water.

4. Boil the fabric for about 45-60 minutes then leave overnight to cool.

5. Drain the fabric and leave in a dark area for 3 days.

6. Label three beakers, C for cotton, W for wool and L for linen and place a sample of each fabric type into the corresponding beaker.

7. Prepare a sample of onion skin dye by soaking the onion skins in water overnight, then boiling for about 5 minutes in 500 cm^3 water until the water becomes coloured).

8. Using the filter paper and funnel, filter the dye mixture.

9. Pour 50 cm^3 of filtrate on to the fabric (cotton samples) in the beaker (C) and leave for 5 minutes of boiling or until the colour appears in the fabric.

10. Carefully remove the sample fabric pieces with the tongs then rinse in the beaker until the water appears clean.

11. Thoroughly rinse using distilled water and allow the sample to air dry for a day.

12. Repeat steps 9-11 above with samples L and W.

13. Compare the colour of each piece of fabric.

14. Repeat this procedure and compare your results. Record your results in the table relative to the colour of the dye solution (For example, Yellow with greater intensity of dye; Yellow with less intensity of dye).

Precautions: Exercise all precautionary procedures regarding heating. Ensure proper filtering techniques are used.

Variables

Controlled: Size of the materials, type of dye used, volume of each solution used, time allotted to selected portions of the procedure.

Manipulated: Type of fabric used.

Responding: The intensity of the colour.

Expected Result

Strategy:
The fabric with the most intense colouration after the procedure will be considered the best fabric to use. If the woollen fabric is the one with the most intense colouration, then the hypothesis will be accepted. If not, then the hypothesis will be rejected.

PART B – THE IMPLEMENTATION

Introduction

Some textile materials lose some of their colour after being washed repeatedly. In some cases, these materials including cotton, wool and linen, may be reused to make mats, cushions or other household decorations. How can these materials be made more brightly and creatively coloured? Which materials are best for dyeing with a selected natural dye that can be made from readily available plant materials?

The success of a dye on a fabric is highly dependent on the nature of the dye as well as on the nature of the fabric. An acidic dye tends to work best on protein-based fabrics such as wool or silk. The fibre reactive dye is generally better at staining non-protein-based fabrics such as cotton and linen.

In this experiment the relationship between the type of fabric and organic dye will be explored so as to offer an explanation to the observation made.

Some dyeing processes may require a mordant. The mordant allows for the fixing of the colour from the dye mixture into the fabric. Where a mordant is not essential, for dyeing to occur, the appearance of the outcome colour may be affected.

Method

Two phases are in this process: (a) Mordanting the fabric and (b) Dyeing.

1. Prepare your fabric samples, two samples per type of material: Cotton, woollen and linen (6 x 6 cm^2 size samples each).

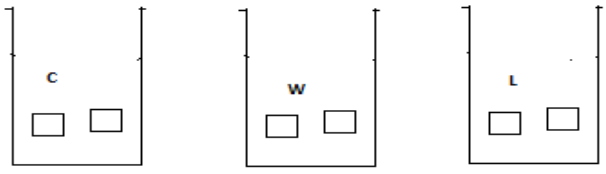
2. Weigh the fabric samples to be dyed.

3. In tap water, dissolve the alum (10% of mass of fabric to be dyed) in 300 cm^3 water.

4. Boil the fabric for about 45 – 60 minutes then leave overnight to cool.

5. Drain the fabric and leave in a dark area for 3 days.

6. Label three beakers, C for cotton, W for wool and L for linen and place a sample of each fabric type into the corresponding beaker.



Beakers with fabric samples

7. Prepare a sample of onion skin dye by soaking the onion skins in water overnight, then boiling for about 5 minutes in 500 cm^3 water until the water becomes coloured.

8. Using the filter paper and funnel, filter the dye mixture.

9. Pour 50 cm^3 of filtrate on to the fabric (cotton samples) in the beaker (C) and leave for 5 minutes of boiling or until the colour appears in the fabric.

10. Carefully remove the sample fabric pieces with the tongs then rinse in the beaker until the water appears clean.

11. Thoroughly rinse using distilled water and allow the sample to air dry for a day.

12. Repeat steps 9–11 above with samples L and W.

13. Compare the colour of each piece of fabric.

14. Repeat this procedure and compare your results. Record your results in the table relative to the colour of the dye solution (For example, Yellow with greater intensity of dye; Yellow with less intensity of dye).

Precaution: Exercise all precautionary procedures regarding heating of substances in the ball. Ensure proper filtering techniques are used.

Results

The table below shows the colour of dye seen on each fabric type investigated.

Type Of Fabric	Colour Description Due To Dyeing	
	Trial 1	Trial 2
Cotton		
Wool		
Linen		

Discussion

From this experiment it was noted that the cotton fabric had the brightest colour due to dyeing. This goes to show that the organic dye being fibre reactive may be used to stain these types of non-protein types of fabric. This is further assisted by the fact that the linen was also better stained than the wool.

The fact that organic dyes show covalent type bonding within its structure makes them similar in nature to the non-protein fabrics.

Clothing made from such materials will take a longer time to lose their colour as they were better stained in the first place.

Limitation

Every effort was taken to ensure that the experiment was error free. However, there was one limitation. The concentration of the dye could not have been strong enough to properly stain the fabric in order to give a definitive colour distinction.

Reflection

This experiment has taught me that the probability of clothing keeping their brightness is dependent on the type of fabric which makes it up and the nature of the dye used to colour it.
The experiment was carried out as designed.

Conclusion

Durability of colouring on fabric is dependent on the compatibility of the fabric and the dye used to stain the material.

CRITERIA FOR ASSESSING INVESTIGATIVE SKILLS	PLANNING AND DESIGN
HYPOTHESIS	**2**
- Clearly stated	*1*
- Testable	*1*
AIM	**1**
- Related to hypothesis	*1*
MATERIALS AND APPARATUS	**1**
- Appropriate materials and apparatus	*1*
METHOD	**2**
- Suitable	*1*
- At least one manipulated or responding variable	*1*
CONTROLLED VARIABLE	**1**
- Controlled variable stated	*1*
EXPECTED RESULTS	**2**
- Reasonable	*1*
- Link with method	*1*
ASSUMPTIONS/PRECAUTIONS/POSSIBLE SOURCES OF ERRORS	**1**
- Any one stated	*1*
TOTAL	**10**

Implementation (Analysis and Interpretation)

The maximum marks available for Implementation is 20.

The format for this part is shown below.

Method	*1 mark*
Results	*4 marks*
Discussion	*5 marks*
Limitation	*3 marks*
Reflection	5 marks
Conclusion	*2 marks*
TOTAL	***20 marks***

EXEMPLAR 2

PART A: THE PROPOSAL

Observation: Farmers often choose larger seeds for propagating/replanting crops while discarding or rejecting smaller seeds. When asked, the typical farmer would say that bigger seeds give bigger crops. Is this only a myth? Will there be significant growth differences in crops propagated with larger or smaller seeds?

Hypothesis: Crops propagated from larger seeds will grow more than those propagated from smaller seeds.

Aim: To determine whether crops grown from larger seeds will grow more than crops grown from smaller seeds.

Materials/Apparatus

1. 8 peanuts with masses **greater than or equal to** 5g
2. 8 peanuts with masses **less than or equal to** 3g
3. 16 pots or planting bags (same size)
4. Loam soil
5. Hand trowel
6. Measuring cylinder
7. Tap water
8. Labelling tape
9. Permanent marker

10. Wheelbarrow

11. 30 cm ruler

12. Scale (that measures in grams)

Variables

Manipulated Variable: Size of seeds.

Responding Variable: Growth (length/height and number of leaves).

Controlled Variables: Equal amounts of water, soil and sunlight. Same type of soil. Same time/duration.

Method

1. Collect loam soil in the wheelbarrow.

2. Use the hand trowel to mix the soil thoroughly while still in the wheelbarrow.

3. Three-quarters (¾) fill each pot/bag with the thoroughly mixed soil.

4. Examine the 16 shelled peanuts for defects (bites, scratches). Discard and replace samples where necessary.

5. Group peanuts into two groups according to size. The 8 peanuts that are ≥ 5g will form the **L group** and those ≤ 3 g will form the **S group**.

6. Place **each** of the 8 large peanuts in separate pots. Each peanut should be covered with approximately 1 cm of soil. Use the tape and marker to label these eight pots **'L-1' to 'L-8'**.

7. Repeat step 6 but with the smaller peanuts and label these pots **'S-1' to 'S-8'.**

8. Use the measuring cylinder to gently add 40cm^3 of tap water to each pot. Repeat the watering process so that each pot is watered twice per day at approximately the same time daily.

9. Once the seeds have germinated, place all pots in open sunlight and continue to water twice per day.

10. Allow the experiment to proceed for 6 weeks.

DATA CAPTURE

1. Height

(a) Record the heights of each crop after each week (every 7 days). Tabulate the results for six weeks as shown below.

TABLE 1: HEIGHTS OF PLANTS

	Heights in cm of Plants Grown from Seeds ≥ 5 g								*Heights in cm* of Plants Grown from Seeds ≤ 3 g							
WEEK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1																
2																
3																
4																
5																
6																

(b) Calculate the average heights for plants grown from peanuts ≥ 5 g for each week. Do the same for plants grown from seeds ≤ 3 g. Record the results in Table 2. **Round off values to one decimal place.**

TABLE 2: AVERAGE HEIGHTS

WEEK	*Average Heights in cm* of Plants Grown from Seeds ≥ 5 g (Large)	*Average Heights in cm* of Plants Grown from Seeds ≤ 3 g (Small)
1		
2		
3		
4		
5		
6		

(c) Using weeks and average heights from Table 2, draw an appropriate graph to represent the growth of plants grown from larger seeds and those grown from smaller seeds. **Represent this data on ONE graph.**

2. Number of Leaves

(a) Record the number of **fully opened leaves** of each crop each week (every 7 days) after sowing the seeds. Tabulate the results for 6 weeks as shown below.

TABLE 3: NUMBER OF FULLY OPENED LEAVES

	Number of Leaves on Plants Grown from Seeds ≥ 5 g								*Number of Leaves* on Plants Grown from Seeds ≤ 3 g							
WEEK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1																
2																
3																
4																
5																
6																

(b) Calculate the average number of leaves found on plants grown from peanuts ≥ 5 g for each week. Do the same for plants grown from seeds ≤ 3 g. Tabulate the results in the table below. **Round off averages to the nearest whole number.**

TABLE 4: AVERAGE NUMBER OF LEAVES

WEEK	*Average Number of leaves* Found on Plants Grown from Seeds ≥ 5 g	*Average Number of leaves* Found on Plants Grown from Seeds ≤ 3 g
1		
2		
3		
4		
5		
6		

(c) Using the weeks and average number of leaves from Table 4, draw an appropriate graph to represent the growth of plants grown from larger seeds and those grown from smaller seeds. **Represent this data on ONE graph. The Graph MUST be of a different type from the one drawn for height.**

Precautions: Handle the hand trowel with care. Take extreme care not to break the week old seedlings when measuring heights.

Assumption: Seeds were free from pest and parasites.

Expected Results

1. The plants grown from the larger seeds (≥ 5 g) should grow taller than those grown from smaller seeds (≤ 3 g) after a six-week period.

2. The plants grown from the larger seeds ≥ 5 g should have more leaves than those grown from smaller seeds ≤ 3 g after a six-week period.

PART B: THE IMPLEMENTATION

Introduction

Growth may be defined as a permanent increase in size. It is often measured using units of length or by counting numbers of structures.

Farmers normally plant larger seeds with the assumption that larger crops will be produced. This experiment investigates whether or not the size of seeds used for propagation make a difference in the growth of crops. Height differences for plants grown with small seeds will be compared with the heights of those from larger seeds. In addition, the number of leaves present will be counted as a function of growth over a period of time.

Method

1. Loam soil was collected in the wheelbarrow.

2. The hand trowel was used to thoroughly mix the soil while it was still in the wheelbarrow.

3. Each pot was filled up to three quarters with the thoroughly mixed soil.

4. The 16 peanuts were examined for defects (bites, scratches). Defective samples were discarded and replaced where necessary.

5. Peanuts were grouped into two groups according to size. Eight peanuts with masses ≥ 5 g were piled together and considered the **L group** while eight peanuts with masses ≤ 3 g were piled together as the **S group**.

6. E**ach** of the eight large peanuts was placed in separate pots. Each peanut was covered with approximately 1 cm of soil. The tape and marker were used to label these eight pots **'L-1' to 'L-8'**.

7. Step 6 was repeated with the smaller peanuts and the pots were labelled **'S-1' to 'S-8'**.

8. The measuring cylinder was used to gently add 40 cm^3 of tap water to each pot. The watering process was repeated so that each pot was watered twice per day at approximately the same time daily.

9. After the seeds germinated, they were placed in open sunlight and were watered twice per day.

10. The experiment continued for six weeks.

Results

1. Height

TABLE 1: HEIGHT OF PLANTS TAKEN OVER A SIX-WEEK PERIOD

	Heights in cm of Plants Grown from Seeds ≥ 5 g								*Heights in cm* of Plants Grown from Seeds ≤ 3 g							
WEEK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1	2	1.5	2	3	3	2.5	2	3	1	1	2	1	2	2	1.5	1.5
2	3	2	3	4	4	3	3	3	2	2	2	2	3	2	2.5	2
3	4	3	4	5	5	3.5	3.5	5	3	3	3	4	5	4	4	5
4	6	6	5	6	7	6	5	6	5	5	5	5.5	7	6	5	6
5	8	7	6	8	9	7	7	8	6	6	7	7	8	7	7	7
6	10	9	8	9	11	10	9	11	7	8	7	8	9	8	8	8

TABLE 2: AVERAGE HEIGHT OF PLANTS TAKEN OVER A SIX-WEEK PERIOD

WEEK	*Average Heights in cm* of Plants Grown from Seeds ≥ 5 g (Large)	*Average Heights in cm* of Plants Grown from Seeds ≤ 3g (Small)
1	2.4	1.5
2	3.1	2.2
3	4.1	3.9
4	5.9	5.7
5	7.5	6.9
6	9.6	7.9

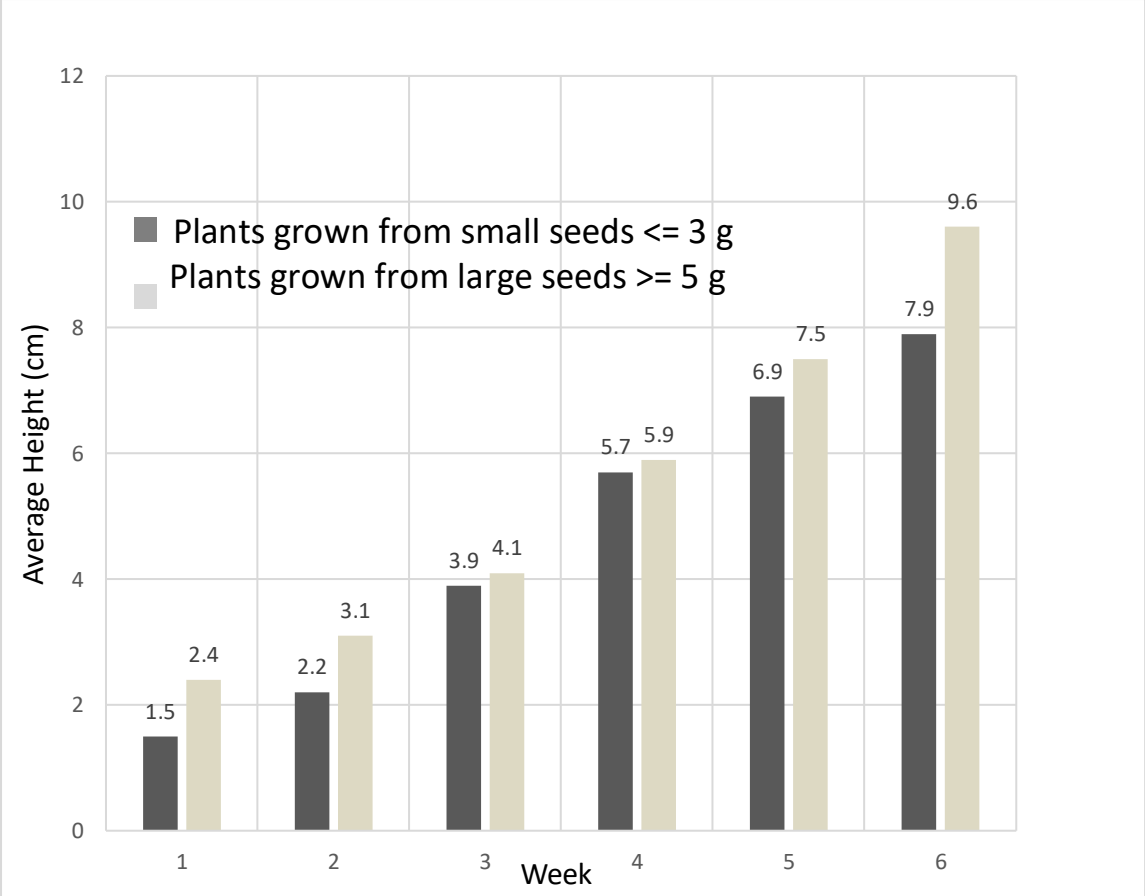


Figure 1: Average Height for Small Seeds and Large Seeds over a Six-week Period

2. Number of Leaves

TABLE 3: NUMBER OF LEAVES ON PLANTS TAKEN OVER A SIX-WEEK PERIOD

	Number of Leaves **on Plants Grown from Seeds ≥ 5g**								***Number of Leaves*** **on Plants Grown from Seeds ≤ 3g**							
WEEK	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
1	3	3	3	3	2	2	2	3	2	3	2	2	2	3	2	3
2	4	6	6	6	5	6	5	6	4	4	4	3	4	4	5	4
3	8	10	12	10	10	11	10	10	6	6	6	5	6	6	7	6
4	12	14	15	16	15	16	13	13	10	11	10	10	11	9	9	8
5	16	18	18	19	18	21	17	17	12	13	13	14	13	12	13	12
6	20	25	25	27	26	25	23	24	16	17	18	20	19	17	18	16

TABLE 4: AVERAGE NUMBER OF LEAVES ON PLANTS TAKEN OVER A SIX-WEEK PERIOD

WEEK	*Average Number of Leaves* Found on Plants Grown from Seeds ≥ 5 g	*Average Number of Leaves* Found on Plants Grown from Seeds ≤ 3 g
1	3	2
2	6	4
3	10	6
4	14	10
5	18	13
6	23	18

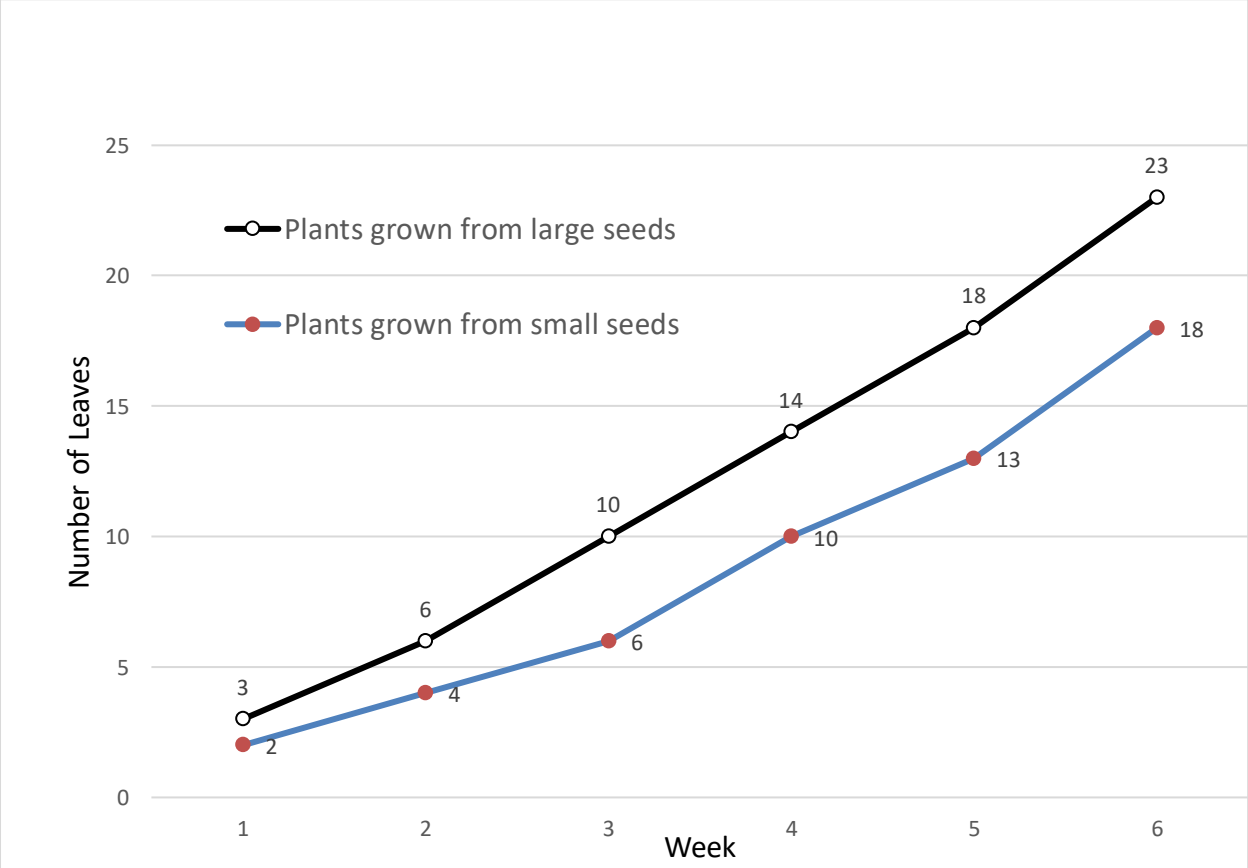


Figure 2: Average Number of Leaves Found on Plants Grown from Small Seeds and Large Seeds over a Six-Week Period

Discussion

Growth is a permanent increase in size. Growth in plants originate from areas called meristems found in shoots or buds. The cells in these areas divide by a process called mitosis where each successive cell is identical to the original cell with respect to the number of chromosomes.

In this experiment, one would readily observe that plants grown from larger seeds tend to grow taller than those grown from smaller seeds (9.6 cm for larger seeds and 7.9 cm for smaller seeds) at the end

of week six. The height of a plant is significant as taller plants have the advantage of trapping sunlight more efficiently as they outgrow competing weeds. This translates to an increase in the rate of photosynthesis. This is important to farmers as greater yields are expected when photosynthesis rates are higher.

Also, crops grown from larger seeds on average had more leaves at the end of six weeks (23 leaves) than crops grown from smaller seeds (18 leaves). This represents a difference of 27.8 per cent. (See Tables 3 and 4 and Graph 2).

Having leaves is advantageous to a plant. Leaves are the sites for photosynthesis. With more leaves, the rate of photosynthesis increases and so does the amount of food storage. This will result in more and/or bigger vegetables and fruits.

Greater numbers of leaves also provide better ground cover which reduces evaporation of ground water. Water is essential for photosynthesis. Therefore, more water which is needed for photosynthesis is available to plants with more leaves.

The fact that the growth rate was consistently greater in plants grown from larger seeds may speak to genetic influences and not environmental factors.

Limitations

- Defects to internal structures could not be ascertained.
- Pest and parasites may have unknowingly attacked samples causing inaccurate results.
- No attention was given to the types or varieties of peanuts.
- Some varieties naturally grow larger so results could be skewed if more than one variety was in the sample.

Reflection

This investigation has given me an appreciation for traditional farming in my country. The daunting task of helping relatives sort out larger seeds for planting was always a meaningless exercise to me until I did this investigation. I now understand their strategy. It means that less fertilisers could be used to boost growth because of the fact that larger seeds naturally grow larger. This investigation also revealed to me that plants grown from larger seeds produce more leaves so I now understand how we can produce more food in my country by simply selecting larger seeds for planting.

Conclusion

Peanut plants produce bigger crops when larger seeds are used for propagation as opposed to when smaller seeds are used.

General Notes to the Teacher/Student

1. Figures in this exemplar are not to be taken literally. Figures were deliberately not drawn to scale to discourage plagiarism. Your actual experimental data will differ.

2. This investigation could be modified to determine the relationship between the propagating seed size and fruit production/yields.

3. Other species of seeds may be substituted in this investigation. Depending on the species of plant seeds used, there would not be any significant growth differences or the conclusion stated above may be completely reversed.

Safety

Teachers should observe all the following safety precautions before conducting laboratory work:

1. Investigations involving human blood and other fresh human material (for example, cheek cell, and saliva) should NOT be conducted.

2. Extreme care should be taken when handling live animals. Wild rodents should not be handled since they pass on disease by biting or through their urine. These diseases include leptospirosis.

3. A fire extinguisher or fire blanket must be readily accessible. Both teacher and student should know how to use them. The extinguisher purchased should be appropriate for a biology laboratory.

4. **A first aid kit should be kept in the laboratory and should be checked regularly.**

5. **Corrosive** solutions and inflammable solvents (for example, concentrated acids, alcohols) should be clearly labelled as such and handled with great care and should be locked away when not in use.

6. Candidates should know the correct way to light and use a Bunsen burner. Flints rather than matches are safer to use.

7. Electrical equipment and fittings should be regularly checked and serviced. Electrical outlets should be properly labelled (example 110v and 220v).

8. A laboratory safety manual should be available.

9. All safety precautions should be maintained regarding field trips.

Audio-Visual Aids

The dynamic nature of Integrated Science requires the teacher to make use of a variety of resource materials as teaching aids. Audio-visual aids are particularly useful to reinforce and deepen understanding.

Teachers are encouraged to use the following aids:

1. Film projectors
2. Slide projectors
3. Overhead projectors
4. Videotape machines (VCR)
5. Tape recorders (Cassette)
6. CD-ROM and other interactive media
7. Multi-media projector
8. Camcorders
9. Digital cameras

Cost might prohibit departmental ownership but hardware may be kept in a common pool for use within a school or among a group of schools.

Sources or resource materials include:

1. Overseas information services, for example, USIS, UNESCO, and High Commissions;
2. Government ministries;
3. The media; and,
4. The Internet.

Moderation of School-Based Assessment

The reliability (consistency) of the marks awarded by teachers on the School-Based Assessment is an important characteristic of high quality assessment. To assist in this process, the Council undertakes on-site moderation of the School-Based Assessment conducted by visiting external Moderators.

During the Term 2 of Year 2, the Moderator will make a visit. Teachers must make available to the Moderator ***ALL*** *Assessment Sheets (Record of Marks, Mark Schemes and the report on the Investigation).* ***Teachers are NOT required to submit to CXC® samples of candidates' work, unless specifically requested to do so by the Council BUT will be required to submit the candidates' marks electronically.***

The Moderator will remark the skills, and investigation reports for a sample of five candidates, who are selected using the guidelines listed below.

1. *Candidates' total marks on the SBA are arranged in descending order (highest to lowest).*

2. *The sample comprises the work of the candidates scoring the:*

   (a) *highest Total mark;*
   (b) *middle Total mark;*
   (c) *lowest Total mark;*
   (d) *mark midway between the highest and middle Total mark; and,*
   (e) *mark midway between the middle and lowest Total mark.*

3. *The candidates selected above may be required to demonstrate some practical skills.*

Teachers' marks may be adjusted as a result of the moderation and feedback will be provided by the Moderator to the teachers.

The Moderator may re-mark the assignments of additional candidates. Where the total number of candidates is five or fewer, the Moderator will remark ***ALL****.*

The Moderator will submit the Assessment Sheets, moderation of SBA Sample and the moderation reports to the Local Registrar by April 30 of the year of the examination. A copy of the Assessment Sheets and candidates' work must be retained by the school for three months after the examination results are published by ***CXC®****.*

School-Based Assessment Record Sheets are available online via the ***CXC®****'s website* www.cxc.org.

All School-Based Assessment Record of marks must be submitted online using the SBA data capture module of the Online Registration System (ORS).

CRITERIA FOR THE ASSESSMENT OF EACH SBA SKILL

The syllabus is grounded in the philosophy and methodology of all science disciplines. The teaching strategies that are recommended for its delivery are dictated by the scientist's approach to a task. A problem to be identified will be examined in the light of available evidence and suggestions or hypothesis as to its solution formulated. These will then be tested by repeated practical observations, modified or discarded as necessary until a hypothesis that does offer a solution is found.

The history of scientific thought shows that new ideas replace old ones that were previously accepted as factual. Students must be made to realise that no solution is final and infallible since modifications are continually made in light of new knowledge and technology.

EXPERIMENTAL SKILLS:

Observation/Recording/Reporting [ORR]

1. Organisation and Conciseness

   (a) Logical sequence of the report.
   (b) Sections named – Aim, Apparatus and Materials, Procedure/Method, Observation, Discussion, Conclusion - all present in correct sequence/correct content under each heading.
   (c) Correct terminology and expressions – few or no grammatical errors.
   (d) Proper use of tables.

2. Tables (Numerical)

   (a) Physical quantity in heading.
   (b) Units stated in heading.
   (c) Abbreviations/symbols.
   (d) Decimal points.

3. Tables (Non-Numerical)

   (a) Headings correct.
   (b) Attention to kinds of data.
   (c) Details of data present.

4. Use of diagrams where appropriate (shading, three dimensional and free hand drawings are unacceptable).

5. Graphs

   (a) Axes labelled.
   (b) Appropriate scales used.
   (c) Accurate plotting.
   (d) Smooth curve or best straight line drawn.

6. Makes accurate recordings and observations.
   Significant changes recorded: extent or degree of change recorded.

7. Prose/other

   (a) Attention to kinds of data.
   (b) Attention to details of data.

Analysis and Interpretation [A/I]

1. Summary data

   (a) Accurately identify trends, patterns, relationships.
   (b) Include labels and annotations of structures.
   (c) Make accurate calculations and draw logical conclusion.
   (d) Makes predictions and logical inferences - limitations between observation and data – relationships between results and original hypothesis.

2. Evaluate data, including sources of error.

Drawing [D]

1. Clarity – clean continuous lines of even thickness in pencil with no shading or unnecessary details. Reasonable size.

   (a) Make large drawing.
   (b) Have clear accurate line representations.
   (c) State title(s) adequately.
   (d) Be two dimensional.
   (e) Appropriate labelling and annotations.

2. Accuracy – faithfulness of reproduction, structures are typical of specimen.

   (a) Reasonable proportions.
   (b) Magnification stated correctly.
   (c) View stated correctly.

3. Labelling/Labelling Lines.

   (a) Neat, drawn with a ruler.
   (b) Straight and do not cross.
   (c) Title listed.

Planning and Designing [P/D]

1. Hypothesis

   (a) Clear statement of hypothesis on basis of observation(s).
   (b) Testable/manageable.

2. Design

(a) Generally workable/suitable.
(b) inclusion of apparatus/materials to be used.
(c) Description of procedures.
(d) Modification(s) where necessary.
(e) Attention to details can be duplicated.
(f) Precautions taken, repeated measurements, controls and limitations.

Manipulation and Measurement [M/M]

1. Use of basic laboratory equipment with competence and skill.

(a) Handle selected measuring devices – balance, thermometer, measuring cylinder, burette, syringe, watch/clock or any timing device, voltmeter, ammeter, reagent bottles, Bunsen burner.
(b) Makes accurate reading.

2. Mastering of laboratory techniques – simple distillation, heating of solids and liquids in test tubes, detection of gases, filtration, constructing simple series and parallel electrical circuits.

3. (a) Prepare biological materials for observation or investigation.
(b) Handle living things with care.

CONVERSION OF MARKS

The 11-point scale ranges from 10 to 0 thus the maximum mark for each skill at any assessment point is 10. Always marking out of 10 or multiples of 10 make conversion easy but this is not necessary, as this may be readily calculated by hand or by means of a calculator. Conversion of the scale can be done for each assessment, but this is not the only possibility. The raw marks out of the totals used must be recorded and these marks totalled for each skill and the conversion done only when their submission to **CXC®** is required.

The following hypothetical results for the assessment of a student on a particular skill may be used as an example. If the marks obtained for observation/recording/reporting are:

5/7, 4/6, 5/5, 7/9, 6/8

The total marks are out of a possible 35 marks. This may be converted by calculation as follows:

$\frac{27}{35} \times 10 = 7.71$ (approximately)
= 8 for CXC purposes

VALIDITY AND RELIABILITY OF TEACHERS MARKS

The reliability of marks awarded is a significant factor in SBA and has far-reaching implications for the candidate's final grade. Teachers are asked to note the following:

1. The criteria for assessing a skill should be clearly identified. A mark scheme must be submitted with the sample of books sent for moderation. Failure to do this could result in the candidates being unavoidably penalised.

2. The relationship between the SBA marks in the practical workbooks and those submitted to **CXC®** on the SBA forms must be clearly shown. It is important that the marks awarded reflect the degree of mastery of the skills assessed.

3. Workbooks should contain all practical work and those exercises used for SBA marks should be clearly identified.

4. The standard of marking must be consistent, hence the need for a mark scheme.

5. Collaboration among teachers especially in the same centre is urged to minimise the discrepancy in the standard of assessment between teachers.

RECORD-KEEPING

Each candidate is required to keep a practical workbook containing all practicals done over the two-year period prior to the examination. Those assessed for **CXC®** will be used to determine the standard of marking by the teacher. A mark scheme must be sent with each set of books. All practicals should be dated and an index made by the candidates of the practicals done. Those assessed for **CXC®** should be clearly indicated along with the marks awarded for each skill.

Candidates' workbooks should be durable and neatness should be encouraged. The pages should be numbered and all exercises should be dated. The workbook should contain a contents page providing the following information concerning the practicals:

1. page number;

2. date;

3. aim of practical;

4. an indication by an asterisk, of which practicals were assessed for **CXC®**; and,

5. the skills assessed.

Teachers

An example of the teacher's records follows:

Recording Marks for SBA

TEACHER'S MARK BOOK

SKILLS	OBSERVATION RECORDING/ REPORTING			DRAWING			MANIPULATION/ MEASUREMENT			ANALYSIS AND INTERPRETATION			TOTAL YR1
NAMES	31/ 11	14/ 4	Avg. (10)	2/1 2	23/2	Avg. (10)	15/1 0	1/5	Avg. (10)	11/3	9/5	Avg. (10)	40
Allen, Veronica	6	8	7	2	8	5	8	10	9	6	7	7	28
Williams, Ann	4	4	4	7	7	7	6	9	8	7	9	8	27
Cuthbert, Bryan	5	5	5	3	10	7	9	7	8	3	8	6	26
Moore, Jason	9	9	9	2	3	3	0	8	7	5	7	6	25
Worte, Stewart	3	6	5	9	0	5	3	5	4	4	5	5	19

The average for each skill and total figures will be transferred to the **CXC®** School-Based Assessment Form and the latter will be submitted to **CXC®** by April 30 of the year of examination.

Note that no special assessment exercises need to be planned. The teachers will, as is customary, be recording periodic "marks" for all students. The difference is that, since these "marks" will now contribute to an assessment external to the school, they need to be more carefully arranged to clearly stated criteria.

The Record Card

The SBA Record Book will show each candidate's average mark for each skill/quality at the end of the year. Where the candidate's total mark includes a decimal of .5 or above, the total should be resolved upwards to the nearest whole number. Where the candidate's total mark includes a decimal less than .5, the total should be rounded to the nearest whole number. The Record Card should be completed in duplicate. The original of the Card is to be submitted to **CXC®** and the copy retained by the school.

SBA Record Card should be dispatched through the Local Registrar to reach **CXC®** by April 30 of the year of the examination.

A sample of the Record Card is included in Appendix 1 to this syllabus.

Teachers will also be expected to supply to **CXC®** a record of tasks set for School-Based Assessment and the corresponding mark schemes used.

♦ RESOURCES

The following is a list of books, which may be used for **CXC®**'s Integrated Science syllabus. This list is neither exhaustive nor prescriptive but indicates some possible sources which teachers and students may use as appropriate.

Atwaroo-Ali, L.	*CXC Biology,* Oxford: Macmillan Publishers Limited, 2003.
Avison, J., Henry, D., and Neeranjan, D.	*Physics for CSEC 2nd Revised Ed.,* London: *@Oxford University Press, 2014*.
Tindale, A., and Murray, J.	*Chemistry for CSEC 2nd Ed.,* London: *Oxford University Press, 2014*.
Chung-Harris, T.	*Integrated Science for CSEC Examinations 2nd Ed.,* Oxford: Macmillan Caribbean, 2010.
Farley, A., and Trotz, C.	*CXC Physics,* Oxford: Macmillan Education, 2007.
Gadd, P.	*CXC Human and Social Biology,* Oxford: Macmillan Education, 2007.
Kirby, P., Madhosingh, L., and Morrison, K.	*Biology for CSEC,* London: Nelson Thornes Limited, 2008.
Koh, A., Hong, C., and Jai, L. M.	*CSEC Integrated Science***,** Trinidad and Tobago: Caribbean Educational Publishers, 2008.
McMonagie, D., and Anning, P.	*Integrated Science for CSEC® 2nd Ed., Oxford, 2016.*
Potter, S. and Oliver, R.	*Integrated Science for CSEC*, London: Pearson Longman Publishing, 2003.
Ragoobirsingh, D.	*Longman Human and Social Biology for CSEC***,** London: Pearson Education Limited, 2007.
Taylor, M., and Chung-Harris, T.	*CXC Chemistry,* Oxford: Macmillan Education, 2006.
Tindale, A., and Murray, J.	*Chemistry for CSEC 2nd Ed.,* London: *Oxford University Press, 2014*.

♦ GLOSSARY OF EXAMINATION TERMS

WORD/TERM	DEFINITION/MEANING	NOTES
annotate	Add a brief note to a label.	(Simple phrase or a few words only: UK)
apply	Use knowledge/principles to solve problems.	(make inferences/ conclusions; UK)
appraise	To judge the quality or worth of.	(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 relationship or process; UK)
calculate	Arrive at the solution to a numerical problem.	(steps should be shown; units must be included; UK)
classify	Divide into groups according to observable characteristics.	(UK)
comment	State opinion or view with supporting reasons.	(UK)
compare	State similarities and differences.	(an explanation of the significance of each similarity and difference stated may be required for comparisons which are other than structural, KC/UK)
construct	Use a specific format to make and/or draw a graph, histogram, pie chart or other representation 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)

WORD/TERM	DEFINITION/MEANING	NOTES
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/formula where relevant; (KC).
demonstrate	Show clearly by giving proof or evidence; direct attention to.	(KC)
derive	To deduce; determine or extract from data by a set of logical steps some relationship, formula or result.	(This relationship may be general or specific). (UK)
describe	Provide detailed factual information of the appearance or arrangement of a specific structure or the sequence of a specific process.	Descriptions may be in words, drawings or diagrams or any appropriate combination. Drawings or diagrams should be annotated to show appropriate detail where necessary; (KC).
determine	Find the value of a physical quantity.	(PS)
design	Plan, and present with appropriate practical detail.	(Where hypotheses are stated or when tests are to be conducted, possible outcomes should be clearly stated and/or the way in which data will be analyzed and presented; PS).
develop	Expand or elaborate an idea or argument with supporting reasons.	(KC/UK)
differentiate/distinguish (between/among)	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)

WORD/TERM	DEFINITION/MEANING	NOTES
discuss	Present reasoned arguments; consider points both for and against; explain the relative merits of a case.	(UK)
draw	Make a line representation from specimens or apparatus that shows an accurate relationship between the parts.	(In case of drawings from specimens, the magnification must always be stated. A diagram is a simplified representation showing the relationship between components; KC/UK).
estimate	Make an approximate quantitative judgment.	
evaluate	Weigh evidence and make judgments based on given criteria.	(The use of logical supporting reasons for a particular point of view is more important than the 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	To express in a formula or in a systematic manner.	(UK)
identify	Name or point out specific components or features.	(KC)
illustrate	Show clearly by using appropriate examples or diagrams, sketches.	(KC/UK)
investigate	Use simple systematic procedures to observe, record data and draw logical conclusions.	(PS)

WORD/TERM	DEFINITION/MEANING	NOTES
justify	To prove a statement or claim true.	(UK)
label	Add names to identify structures or parts indicated by pointers.	(UK)
list	Itemise without detail.	(KC)
measure	Take accurate quantitative readings using appropriate instrument.	(PS)
name	Give only the name of.	(No additional information is required).
note	Write down observations.	(PS)
observe	Pay attention to details which characterise a specimen, reaction or change taking place; to examine and note scientifically.	(Observations may involve all the senses and/or extensions of them, but would normally exclude the sense of taste) (PS).
plan	Prepare to conduct an exercise.	(PS)
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 recorded data may be depicted in graphs, histograms or tables; (PS).
relate	Show connections between; explain how one set of facts or data depend on others or are determined by them.	(UK)
sketch	Make a simple freehand diagram showing relevant proportions and any important details.	(KC)

WORD/TERM	DEFINITION/MEANING	NOTES
state	Provide factual information in concise terms, omitting explanation.	(KC)
suggest	Offer an explanation deduced from information or previous knowledge.	(No correct or incorrect solution is presumed but suggestions must be acceptable within the limits of scientific knowledge; UK).
suggest an hypothesis	Provide a generalisation which offers a likely explanation for a set of data or observations.	(UK)
test	To find out by following set procedures.	(PS)

APPENDIX I

♦ NOTE TO TEACHERS

MEASUREMENT

The SI system is used in this syllabus and will be used in all examination papers. Common multiples and sub-multiples of base units (for example, kilometres, centimetres and millimetres) will also be used.

SCHOOL-BASED ASSESSMENT

Preparing the Candidate

During Term 1 of the two-year period, teachers should ensure that the candidates are familiar with the assessment criteria and the mark scheme. Involving the candidates in practice assessments might accomplish this.

The teacher should also ensure during the first term that all candidates use their practical notebooks to record the relevant activities and that such records are made in a systematic way.

Assessing 'Manipulation/Measurement' and 'Observation'

In assessing 'Manipulation/Measurement' and 'Observation' the teacher should ensure that the candidate has had at least two prior experiences in manipulating/measuring or observing with the apparatus or in making other observations for recording, before the candidate is assessed on these criteria.

Sample of Teachers' Records

The following three pages are samples of the Record Card and Record Book.

CARIBBEAN EXAMINATIONS COUNCIL

SCHOOL BASED ASESSMENT IN INTEGRATED SCIENCE

NAME OF SCHOOL:_____ SCHOOL CODE:_____ YEAR OF FINAL EXAMINATION: _____

NAME OF TEACHER:_____ COUNTRY:

CANDIDATES NUMBERS	**CANDIDATES NAMES**	**YEAR I**						**YEAR II**					GRAND TOTAL ***100***	**REMARKS**
		O/R/R	**Dr**	**M/M**	**A/I**	**P/D**	**TOTAL YEAR 1**	**O/R/R**	**M/M**	**A/I**	**P/D**	**TOTAL YEAR 2**		
		10	**10**	**10**	**10**	**10**	**50**	**10**	**10**	***20***	**10**	***50***		

TEACHER'S SIGNATURE: _____ PRINCIPAL'S NAME: _____

DATE: _____ PRINCIPAL'S SIGNATURE: _____

APPENDIX II

♦ SOME GUIDELINES CONCERNING PRACTICAL WORK

It is a syllabus requirement that practical work be done from all *three* sections of the syllabus.

The work done is to be recorded in a practical notebook. To satisfy syllabus stipulations, a minimum of eighteen (18) such pieces of work should be written up. There is no maximum limit. Each write-up should reflect the candidate's own work and analysis. When practical work is done in groups, the candidates must still write up his or her own report.

KINDS OF PRACTICAL WORK

Practical work usually falls into three broad categories that sometimes overlap. The categories are described below.

Practical Exercises

These are the types that are most often done. They are usually done to help students develop certain practical skills or gain insights into scientific concepts.

Investigations/Information Gathering

In this kind of work, students use their skills to investigate a problem or to find out about a certain phenomenon *or* area of interest. Investigations are best done in areas in which students are interested. There is much scope for planning and designing in this kind of experiment.

Technology

Students may also be interested in using their knowledge of science in making simple devices or in solving simple problems. Emphasis is on using readily available materials (even discards) and appropriate techniques of a very simple nature. Devices constructed should usually be tested by the student and performance data recorded and evaluated.

A minimum of one (1) practical exercise must be of a technological nature and a minimum of four (4) must be investigative. In writing up practical exercises, candidates must be encouraged to discuss the relevance of their work and be made aware of the limitations of their methods and conclusions.

APPENDIX III

♦ SUGGESTED CHEMICALS/MATERIALS LIST

Acetone
Agar
Agar, Nutrient
Aluminium foil
Ammonia solution
Benedict's solution
Bicarbonate indicator solution
Cobalt Chloride
Calcium Carbonate, precipitated
Charcoal powder
Chloroform
Copper, thick wire/strings/ turnings
Copper Sulphate
Crude oil
Ethanol
Ethanoic (acetic) acid
Formaldehyde solution
Glucose
Hydrochloric Acid (dilute)
Hydrogen Peroxide (20 volume)
Iodine
Iron filings
Iron Nails
Lead foil
Litmus paper, blue
Litmus paper, red
Magnesium ribbon
Manganese Dioxide
Methylated spirit
Nitric Acid
Phenolphthalein
Potassium Iodide/Sodium Iodide
Potassium Nitrate
Potassium Permanganate
Pyrogallol 40% w/v
Silver Chloride/nitrate
Sodium Carbonate
Sodium Carbonate hydrated (washing soda)
Sodium Chloride
Sodium Hydrogen Carbonate (baking soda)
Sodium Hydroxide (caustic soda)
Sodium Sulphate
Starch
Steel wool
Sucrose
Sulphuric Acid
Turpentine
Universal indicator paper
Universal indicator solution
Zinc (granulated)

APPENDIX IV

♦ SUGGESTED EQUIPMENT LIST

Abrasives

Ammeters
Aquaria
Balances (range 1 kg, sensitivity 0.1 g)
Balances, spring (10N, 100N)
Beakers, 250 cm^2 (graduated)
Beakers, 400 cm^3/500 cm^3 (graduated)
Bell jars with bungs (solid, one hole, two holes)
Borers, cork
Bottles, dropping
Bottles, reagent, assorted
Boxes, ray
Brass
Bronze
Buckets, plastic, with covers
Burners, Bunsen or alcohol
Box Camera
Carbon microphone
Cardboard (for making charts)

Clock (or stopwatch)

Compasses, magnetic
Computer
Coverslips
Crocodile clips
Crucibles with lids
Cylinders, measuring, assorted

Desiccators
Dishes, petri, glass
Droppers, teat
E – beam

Ear, model of

Mirrors, plane (concave, f = 15 cm; convex, f = 15 cm)
Multimedia projectors
Needles, dissecting
Nets for collecting specimens
*Oscilloscope
Paper, chromatography
Paper, filter
Pipettes

Plugs, 3-pin
Poster board (for displaying charts and articles)
Potometres
Power packs (main or batteries) low voltage d.c
Press, plant
Prism, triangular and rectangular
Pulleys (single, stepped, block and tackle)
Pumps, filter
Quadrats
Racks, test tube
Resistors (assorted 1ohm up to 1000 ohm at 1W rating)
Ripple tanks (with accessories for demonstrating rectilinear propagation plane and curved reflection, refraction, diffraction)
Rules, metre/half metre
Scalpels/razor blades/knives/scissors
Shelves, beehive
Skeleton, mammalian, complete
Slides, microscope (plain)
Slides, prepared
- Leaf, T.S;
- Human Blood smear; and,
- Dicot root, T.S.

Sockets, lamp
Solar system, model of
Solder
Sonometer (commercial or improvised – a guitar can work)
Stands, retort with clamps

APPENDIX IV (cont'd)

SUGGESTED EQUIPMENT LIST (Cont'd)

Eye, model of

Flash Drives
Flasks, conical 250 ml
Forceps
Funnels, filter
Fuses household
Heart, model of
Hi-fi equipment data (catalogues of)
Holders, lens (convex)
Holders, mirror
Holders, test tube
Jars, gas with cover plates
Jars, with plastic screw top lids
Lamps, low voltage
Lenses, concave cylindrical
Lenses, concave spherical
Lenses, convex cylindrical
Lenses, convex spherical (f=5 cm, f = 30 cm)

Lenses, hand, large (x 6 or more)
Lungs, bell jar model of
Magnets, bar
Masses, sets of (10, 100, 200, 500, 1000g)
*Metre, joule
Microscope, light, Magnification x 300
Stands, tripod (heights must be suitable for use with Bunsen burners)
Switches
Telephone, earpiece and mouthpiece
Thermometers -10°C - 110°C
Tongs, crucible
Trays, sorting
Trolleys
Test Tubes (assorted sizes)
Tubes, Y-piece connectors
Capillary Tubing
Glass Tubing (assorted lengths)
Rubber Tubing
Vertebrae (different types)
Voltmeter (d.c. dual range 0 - 5v, 0 - 15v)
White metal
Electrical Wire (flex) colour coded, connecting
Wire gauzes with insulated centres
Nichrome Wire (assorted) 1056 ohm m-1 – 156 ohm -1

Items with an asterisk (*) need not be bought but may be borrowed for the relevant lesson.

Western Zone Office
18 April 2023