APPENDIX III

CARIBBEAN EXAMINATIONS COUNCIL

Caribbean Secondary Education Certificate®
CSEC®

INTEGRATED SCIENCE SYLLABUS

Effective for examinations from May–June 2017

Published by the Caribbean Examinations Council.

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SECTION C: *EARTH'S PLACE IN THE UNIVERSE*

This document CXC 23/G/SYLL 09 replaces CXC 23/O/SYLL 00 issued in 2000.

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

Issued1983
Revised in 1993, 2000, 2009, *2015*

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

Integrated Science Syllabus

♦ RATIONALE

An understanding of science is central for young citizens' preparedness for life in modern society. The study of science provides the knowledge and skills which are intended to improve the quality of living. 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. It is critical that science education should involve teaching and learning through inquiry. Integrated Science by the very nature of the subject facilitates this inquiry-based approach.

The CSEC Integrated Science Syllabus is based on three themes, The Organism and Its Environment, The Home and Workplace, and Earth's Place in the Universe 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. Such an approach is adopted to develop those long-term transferable skills of ethical conduct, team work, problem-solving, critical thinking, and innovation and communication. It encourages the use of modern technology and other teaching and learning strategies to inculcate these skills that will prove useful in everyday life, while at the same time catering to multiple intelligence, and different learning styles and needs.

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

♦ AIMS

This syllabus aims to:

1. *develop scientifically and technologically literate students who will engage in public discussions on issues related to these fields;*

2. *use* scientific *knowledge* and principles *in* everyday *life* situations;

3. *increase awareness of the importance of living in harmony with the environment and appreciate the need to preserve the natural environment;*

4. *design and evaluate scientific inquiry;*

5. *interpret data and evidence scientifically;*

6. *develop critical thinking, problem-solving and collaborative skills;*

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

8. *Integrate information, communication and technological tools and skills.*

♦ CANDIDATE POPULATION

It is assumed that candidates would have studied Integrated Science or its equivalent up to the end of the first three years of secondary school. *CSEC* Mathematics and English A or their equivalents are also strongly recommended as allied subjects to be studied.

CLASS SIZE

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

Suggested Time Allocation

It is recommended that a minimum of ***five 40-minute periods per week over two academic years*** be allocated to the study of 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.

♦ 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 - THE ORGANISM AND ITS ENVIRONMENT

SECTION B - THE HOME AND WORKPLACE

SECTION C - *EARTH'S PLACE IN THE UNIVERSE*

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.

♦ SUGGESTIONS FOR 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 of the senses in learning. 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 given 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.

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

♦ CERTIFICATION AND DEFINITION OF PROFILES DIMENSIONS

The subject will be examined for certification at the General Proficiency.

In addition to the overall grade, there will be a profile report that reflects the performance of each candidate under the following headings:

1. Knowledge and Comprehension;
2. Use of Knowledge;
3. *Experimental* Skills.

Knowledge and Comprehension (KC)

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

Use of Knowledge (UK)

	The ability to:
Application	transform data accurately and appropriately; use common characteristics as a basis for classification; use formulae accurately;
Analysis and Interpretation	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;
Synthesis	combine component parts to form a new meaningful whole; make predictions and solve problems;
Evaluation	make reasoned judgments and recommendations based on the value of ideas and information and their implications.

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

	The ability to:
Observation/Recording/ Reporting	use the senses to perceive objects and events accurately; present a written and oral report, drawing or other graphical representation which is clear, concise, accurate and pertinent to the investigation; report and recheck unexpected results;
Drawing	make large, clear, labelled line representations of specimens, apparatus or models;
Manipulation/Measurement	set up and use carefully and competently simple laboratory apparatus and measuring instruments; appropriately prepare specimens and materials for observation/investigation;
Planning/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;
Analysis and Interpretation	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.

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.

♦ FORMAT OF THE EXAMINATIONS

Paper 01 (1 hour 15 minutes)	Sixty multiple-choice items drawn from all areas of the syllabus.
Paper 02 *(2 hours 30 minutes)*	Part A Four compulsory structured questions drawn from all areas of the syllabus. Question 1 will be a practical/investigative type question. Part B Two compulsory essay type questions.
Paper 031 *School-Based Assessment*	*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 *(School-Based Assessment For private candidates only)* *(2 hours 10 minutes)*	*Alternative to the School-Based Assessment for private candidates. This paper will examine the same skills as those tested in Paper 031. The focus, therefore, will be on Experimental Skills and Use of Knowledge (Analysis and Interpretation). This paper is a practical paper.*

TABLE 1

ALLOCATION OF MARKS ACROSS PAPERS AND PROFILE DIMENSIONS*PROFILES*	***PAPER 01***	***PAPER 02***	***SBA PAPER 03***	***TOTAL***
Knowledge and Comprehension (KC)	60	34	-	94
Use of Knowledge (UK)	-	58	30	88
Experimental Skills (XS)	-	8	***70***	***78***
Total-Raw marks	60	100	***100***	***260***
Total- Weighted marks	***60***	***100***	***40***	***200***
Total %	***30***	***50***	***20***	***100***

♦ REGULATIONS FOR RESIT CANDIDATES

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

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

A candidate who rewrites the examination within two years may reuse the moderated SBA score earned in the previous sitting within the preceding two years. Candidates reusing SBA scores in this way must register as "Resit candidates" and provide the previous candidate number.

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

♦ 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.

♦ *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)

(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 an experiment 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) method of controlling variables;

(vi) *clear and concise step by step procedure;*

(vii) *display of results;*

(viii) *use of results;*

(ix) *possible limitations.*

2. *Measurement and Manipulation (MM)*

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

The list of equipment is:

(i) *Bunsen burner;*

(ii) *Tripod stand with wire gauze;*

(iii) *Binocular and monocular light microscope;*

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

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

(vi) *thermometer;*

(vii) *ruler;*

(viii) *stop watch/clock;*

(ix) *balance;*

(x) *boiling tube;*

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

(xii) *hand lens;*

(xiii) *syringe.*

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

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

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

(a) *Recording*
Student's ability to record observations and to collect, organise and present data. Observations and data may be recorded in the following format:

(i) *Prose*

Written description of observations in the correct tense.

(ii) Table (Neatly enclosed)

Numerical: physical quantities in heading, units stated in heading, symbols, decimal points.
Non-numerical: headings correct, details present.

(iii) Graph

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

Drawing of apparatus as set up for use.

(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****.*

(vi) ***Discussion and Conclusion****.*

4. Analysis and Interpretation

Student's ability to:

(a) *identify patterns and trends;*

(b) *make accurate calculations;*

(c) *identify limitations and sources of error;*

(d) *make a conclusion to either support or refute the hypothesis;*

(e) *compare actual results with expected results based on background/theoretical knowledge if they are different;*

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

(g) *analyse and interpret results and observations and making conclusions.*

5. *Drawing (Dr)*

The following guidelines should be used for drawing.

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

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

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

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

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

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

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

(h) *Write labels in pencil.*

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

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

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

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

♦ SECTION A: THE ORGANISM AND ITS ENVIRONMENT

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *be aware that matter is made up of particles;*
2. develop an appreciation for the interdependence of life processes;
3. understand the relationship between the organism and its environment;
4. understand the relationship between the structures and functions of the systems within an organism;
5. *appreciate the importance of proper sanitation;*
6. develop investigative and problem-solving skills.

UNIT I: MATTER

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the properties of the states of matter;	*Arrangement of particles; shape and volume; forces of attraction; movement of particles; change of state. Mention plasma.*	*Simple experiments to illustrate*.
2. draw simple diagrams to show the structure of unspecialised plant and animal cells;	Cell wall, cell membrane, nucleus, cytoplasm, vacuoles, mitochondria, *ribosomes*, chloroplast. Details of structures as seen in electron micrographs not required.	Construct models using plasticine or other materials found around the home or laboratory.
3. explain the *function* of the cell wall, cell membrane, nucleus, chromosomes, cytoplasm, *ribosomes,* mitochondria, vacuoles and chloroplast;	*Simple treatment only. For example, chromosomes carry genetic information in DNA.*	

SECTION A

UNIT I: MATTER (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. *discuss the importance of selected microbes;*	*Virus, bacteria, fungi;* *Positive and negative effects.*	
5. *explain the processes of diffusion, osmosis and active transport.*	*Definition of terms.* Importance of diffusion, osmosis *and active transport* in *moving* substances in and out of cells and from one cell to another in all living organisms. Reference to the cell membrane as a partially permeable membrane. Refer to Sec. A, Unit IV, SO 1.	Carry out simple investigations to illustrate the movement of particles (molecules and ions).

SECTION A

UNIT II: REPRODUCTION AND GROWTH

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. distinguish between asexual and sexual reproduction;	Simple cell division - Details of meiosis and mitosis not required. Comparison of asexual and sexual reproduction, advantages and disadvantages of asexual reproduction (variety, *adaptation,* livestock and crops).	Examine and draw storage organs including corms, bulbs, rhizomes, runners, and cuttings. Use models/charts of human reproductive system to locate and identify structures.
2. describe various methods of asexual reproduction in plants and animals;	Budding, cuttings, runners, tissue culture, cloning, *grafting*. *Refer to Sec. A, Unit III, SO 2.*	*Carry out one of the methods.* *Conduct research on the appropriateness of each method.*
3. describe the process of sexual reproduction in plants and in humans;	Flowers: name and functions of parts; pollination: types, advantages of cross pollination, agents of; fertilisation and development of seeds/fruits (outline); human reproductive systems: names and function of parts.	*Draw and label cross section of various types of flowers.* *Label the human reproductive systems.*
4. describe the menstrual cycle;	Roles of estrogen and progesterone; mention menopause.	
5. discuss ovulation, fertilisation, implantation, development of the foetus and birth;	*Simplified diagrams to illustrate processes.*	
6. discuss the advantages and disadvantages of various methods of birth control;	Natural, barrier, hormonal, surgical.	*Internet research for new methodologies.*

SECTION A

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. discuss the importance of pre and post natal care of mothers and babies;	The effects of nutrition, drugs, x-rays and diseases; advantages of breast feeding, and immunisation. *Use of ultrasound.* Refer to Sec. A, Unit IV, SO 3.	
8. discuss the causes, symptoms, prevention and control of sexually transmitted infections [STI's];	Herpes, Gonorrhoea, Syphilis, Hepatitis, AIDS. Bacterial - Syphilis or Gonorrhoea; Viral - Herpes; Fungal – Candida. *Refer to Sec. A, Unit I, SO 4.* *Refer to Sec. A, Unit IV, SO 5.*	Use charts/tables compare information of STI's.
9. compare growth patterns in selected organisms;	Seeds of annual plants - balsam, bean and corn (maize). Germination in plants.	Plot graph of plant growth at regular intervals of one week and extrapolate to predict height at future time; construct and analyse graphs of height and weight with increase in age of boys and girls; attempt to verify prediction for plants and human beings.
10. discuss the need for human population control.	Effects of population pressures on quality of life, world food production and limited material resources; consideration of the effects of teenage pregnancy; birth control methods.	*Graphical representations of data showing effects of overpopulation.*

SECTION A

UNIT III: FOOD AND NUTRITION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. describe the process of photosynthesis;	Definition, identification of substrate, conditions and products; word and chemical equations; outline of process; importance of light, *(photo chemical reactions)* chlorophyll, carbon dioxide and awareness that light energy can be converted to chemical energy.	Experiments to establish conditions for photosynthesis, *tests* for starch as a product of photosynthesis.
2. *describe the methods used in the production of crops;*	*Brief description of strip planting, contour ploughing, terracing, crop rotation, contouring, greenhouse farming, hydroponics; tissue culture, rooftop farming; indoor farming; organic farming; container gardening;* *Refer to Sec. A, Unit II, SO 2.*	*Visits to nearby farms; study of common agricultural practices needed to maintain crop growth; need for conservation.*
3. *discuss food chains and food webs found in an environment;*	*Producers, consumers (primary and secondary) decomposers, habitat, herbivores, carnivores, omnivores, population, community, ecosystem.*	*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.*
4. explain the importance of food;	The Caribbean food groups, their sources and functions of their main nutrients. Food additives and their effect on health. Balanced and unbalanced diets. Balanced diet related to age, gender, *occupation/sport;* PEM deficiency diseases, *diabetes* and obesity.	Food tests – *use local foods.* Collect food labels to discern nutritive content. Experiments to measure energy value of food.

SECTION A

UNIT III: FOOD AND NUTRITION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
5. *describe the conditions which promote the growth of microorganisms;*	*Procedures for retarding and preventing the growth of bread mould. The effects of microorganisms in food.* *Refer to Sec. A, Unit I, SO 4.*	*Investigate growth of mould on bread under different conditions.*
6. *discuss the principles used in food preservation;*	*Methods – salting, drying, pickling, heating, refrigeration, adding sugar and treating with other preservatives.*	*Investigate one of the methods for preserving food.*
7. explain the process of digestion in humans;	Mechanical and chemical digestion; *definition and* role of enzymes; *role of bile*; enzymes active at different stages *(salivary, amylase, pepsin, renin, pancreatic, lipase, pancreatic amylase, trypsin, maltase, lactase, sucrose, galatase),* substrates and products; absorption; assimilation; egestion.	Label the digestive system and state the function of each part; identify enzymes, digestive juices and state acidity/alkalinity at each stage; experiments to show effects of temperature and pH on enzymes.
8. explain the role of teeth in digestion *of humans.*	*Types of* teeth and dental formula; relate structures to function *and diet.* *Care of teeth.*	Draw and label a diagram of a vertical section of a tooth; examine models of individual teeth.

SECTION A

UNIT IV: *TRANSPORT SYSTEMS*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the need for transport systems within a living organism;	Circulatory system: necessity, surface area/volume ratio; transport in plants, transpiration, movement of nutrients. R*efer to Sec. A, Unit I, SO 5.*	Experiments on diffusion with agar cubes of different sizes to show how surface area/volume ratio affects total diffusion. *Capillary action – use herbaceous plant in coloured water.*
2. relate the structures in transport systems to their functions;	Composition of blood and types of blood cells and their functions; structures of the heart; heart beat; names of *major blood vessels and organs associated with the circulatory system.* *Function of stem-xylem and phloem (simple explanation). Refer to SO 1 above.*	*Examine the structures of a mammalian heart.* *Draw or construct a model of a mammalian heart.*
3. identify the blood groups;	A, B, AB and O*:* antigen and antibody for each group, precaution in transfusion and handling; Rh factor- risk in pregnancy *and* precautions.	Use information gathered from clinics, hospitals and doctors.
4. explain possible causes of *cardiovascular diseases;*	*(a) Hypertension;* *(b) Heart attack;* *(c) Stroke.*	
5. explain how the principles of immunisation are used in the control of communicable diseases;	*(a) Natural;* (b) Artificial; *(c) Vaccines;* (d) An awareness of AIDS as a disease which results from damages to the immune system; *(e) Retroviral (HIV/AIDS).*	Research on the effect of retrovirals on person's living with HIV/AIDS.

SECTION A

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. *discuss the physiological, and social and economic effects of drug use;*	*Definition of drugs.* *(a) Alcohol;* *(b) Prescription drugs;* *(c) Non-prescription drugs;* *(d) Illegal drugs;* *(e) Steroids;* *(f) Diet pills;* (g) *Hormonal injections (HCG).* Blood doping [increase the number of red blood cells]. Refer to Sec. A, Unit II, SO 4, Sec. A, Unit VI, SO 2.	Research and report on use and mis-use of drugs.
7. discuss the physiological effects of exercise;	Effects on circulatory and respiratory systems, effects on balancing energy input and output.	*Investigate the effect of exercise on the pulse rate.*
8. *identify the major bones of the human skeleton;*	*Cranium clavicle, scapula, vertebral column, humerus, radius, ulna, rib cage, sternum, pelvic girdle, femur, tibia, fibula.*	
9. *relate the structure of the skeleton to its functions;*	*Movement, protection, support, breathing, protection of blood vessels.*	
10. *identify different joints in the human body;*	*Hinge joint, fixed joint, ball and socket.*	
11. *explain how the skeletal muscles function in the movement of the limb.*	*Role of antagonistic muscles.* *Effect of exercise on muscle toning.* *Refer to Sec. A, Unit IV, SO 7.*	

SECTION A

UNIT V: RESPIRATION AND AIR POLLUTION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the mechanism of breathing;	Inhalation and exhalation, pressure and volume changes, role of ribcage and diaphragm; composition of inhaled and exhaled air; *structures of lungs.* *Mention CPR.* *Refer to Sec. B, Unit III, SO 9.*	Bell jar *demonstration.* *Research usage of Ventilator machine.*
2. discuss the process of gaseous exchange;	*Features common to respiratory surfaces in humans and plants.*	*Diagrams of the structures of alveoli and stomata.*
3. discuss the importance of respiration to organisms;	Definition, substrate and products, word and chemical equation; site, types and importance of energy release; energy related to type of substrate.	Experiments to show release of energy and carbon dioxide by organisms.
4. *distinguish between* aerobic and anaerobic respiration;	*Compare amounts of energy produced, products and use; relevance of anaerobic respiration to sports and industries (bakeries/breweries).*	*Food lab-baking, wine production.* *Field trips to related industries.*
5. identify the causes of air pollution;	*Fossil fuels, natural activities, fires, sulphur dioxide, carbon dioxide, methane, carbon monoxide, lead; affinity of carbon monoxide to haemoglobin of red blood cells.* *Refer to Sec. A, Unit IV, SO 2.*	
6. discuss *problem*s that are caused by air pollution;	Allergies, lung cancer, *asthma,* other respiratory disorders, *emphysema. Acid rain, blocking stomata in plants.* *Refer to Sec. A, Unit II, SO 1.* *Refer to Sec. B, Unit I, SO 5.*	*Conduct research on cases of respiratory disorders associated with air pollution and smoking.*

SECTION A

UNIT V: RESPIRATION AND AIR POLLUTION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. explain the effects of smoking on the respiratory system.	Importance of smoke free environments: *effect of second hand smoke.*	

SECTION A

UNIT VI: EXCRETION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. distinguish between excretion and egestion;	Definitions. *Refer to Sec. A, Unit III, SO 8.*	
2. explain the mechanism of excretion by the lungs, skin and kidneys *in humans*;	Relationship to metabolism, excretory organs and products; kidney - structure of tubule related to ultra-filtration and re-absorption; Refer to *Sec. A, Unit IV,* SO 2.	Examine cross section diagrams/models of the skin and kidneys of human beings.
	Osmoregulatory function of kidneys; dialysis. Relate structure of skin to its functions – *excretion, temperature control.* *Refer to Sec. B, Unit I, SO 5.*	*Field trip to hospital – dialysis machine.*
3. identify the waste products of flowering plants and their methods of excretion.	Waste products of respiration and photosynthesis only. *Osmoregulation related to environmental factors; plants - waste products, gaseous exchange and its importance, leaf fall and storage in bark.* *Refer to Sec. A, Unit III, SO 1.*	

SECTION A

UNIT VII: *SENSE ORGANS AND COORDINATION*

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *describe the sense organs and their functions;*	*Stimulus associated with sense organs.* *Refer to Sec. A, Unit IV, SO 2.*	
2. relate the structures of the mammalian eye to their functions;	Accommodation and control of amount of light entering eye.	Compare a model of the eye with a camera (Pin hole).
3. distinguish between natural and artificial lighting;	*Effects on colours of objects.*	
4. distinguish among transparent, translucent and opaque materials;		
5. describe how to separate white light into its component colours;		*Glass or water prisms can be used.*
6. explain sight defects and their corrections;	Long and short sightedness; Effects of bright light and physical injury; Function of convex and concave lenses. G*laucoma; cataracts.*	Carry out simple investigations using convex and concave lenses.
7. relate the structures of the mammalian ear to their functions;	The approximate audio frequency spectrum of the human ear; the effects of loudness and pitch on human beings.	Carry out simple investigations on pitch and loudness.
8. describe the structures and functions of the nervous system;	*Simplified diagrams showing structures of brain and neurons.* *Examples of* voluntary and involuntary actions. *Mention malfunctioning of system, for example,* paralysis; *physical disabilities;*	Simple reflex arc, for example, knee jerk.

SECTION A

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
9. describe the functions of the endocrine system.	Endocrine - hormones as messengers; thyroid, pancreas, sex organs, adrenal glands and pituitary glands. *Refer to Sec. A, Unit II, SO 4.*	Structural diagram – identify location of organs; list hormones produced and their uses/effects.

SECTION A

UNIT VIII: HEALTH AND SANITATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *discuss the need to practice good personal and community hygiene;*	*Elimination of body odours; social acceptance; prevention of infections; care of genitalia.* *The importance of proper disposal of waste, adequate toilet and sewage disposal facilities, garbage collection and disposal.*	*Diseases associated with poor hygienic conditions.*
2. discuss conditions that encourage the breeding of household pests and parasites;	Differentiate between pests, parasites and pathogens. Cockroaches, flies, rats, mosquitoes.	
3. *suggest appropriate methods of control in the lifecycle of a mosquito or housefly;*	*Identification of stages in the lifecycle.* *Biological, chemical and mechanical control.*	
4. discuss the implications of uncontrolled methods used to prevent food contamination;	Infections by pathogens; *Ways in which food is contaminated.*	
5. discuss control methods *of pests*;	Biological, mechanical, chemical and sanitary controls.	
6. discuss the different types of waste;	Domestic, industrial, biological, *chemical* and electronic waste. *Reduce, reuse, and recycle.* Biogas production. Bio-degradable and non bio-degradable waste. *Refer to Sec. B, Unit III, SO 12.*	

SECTION A

***UNIT VIII: HEALTH AND SANITATION* (cont'd)**

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. *discuss the impact of solid waste on the environment.*	Pollution of potable water, increase in pest population; prediction of their consequences; assessment of the effects of unsanitary conditions on the spread of pathogenic microorganisms and parasites such as worms.	

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.

1. *Use video clips to introduction to concepts, and to support and reinforce learning.*
2. *Have students cultivate local crops where possible and use a portfolio to present documentation.*
3. *Arrange site visits and/or field trips when appropriate to enrich the learning experience.*
4. *Invite guest lectures and resource persons to engage students in interactive sessions on topics of interest.*
5. *Organise debates on issues that impact on quality of life, for example, Rh factor and HIV-Aids.*
6. *Make posters or flyers that depict critical issues or principles involved in topics, for example, food preservation.*
7. *Design and construct models on concepts taught.*
8. *Have students collect and interpret data, and do representations [mathematical] where necessary.*
9. *Conduct research and make presentations on topics that lend themselves to these activities.*
10. *Examine case studies, for example, on topics that relate to health and hygiene.*
11. *Identify credible sources on microbes.*

12. *Relate to transport in everyday life.*

13. *Use the internet to examine 3D structures of atoms. Create models of structures of atoms using everyday recyclable materials.*

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

15. *Visit the Malaria website http://nobelprize.org/educational/medicine/malaria and play both the "Mosquito" and the "Parasite" games on the site. This will enable a better understanding of the diseases spread by mosquitoes.*

16. *Have students work in groups to write short newspaper articles on the human body systems and the diseases that affect each [for example, the reproductive system – STIs, prostate cancer, cervical cancer].*

17. *Interpret health data by investigating the number of persons in your country who suffer from diabetes and cancer. What are the causes, incidence rates and treatments available in your area? Research report should be provided by students.*

18. *Use role play to demonstrate the behaviour of energy particles in the different states of matter.*

♦ SECTION B: THE HOME AND WORKPLACE

GENERAL OBJECTIVES

On completion of this Section, students should:

1. appreciate the importance of energy in everyday life;

2. understand the relationship between human beings and the environment in which they live and work;

3. understand the need for appropriate physical conditions in the home and workplace;

4. understand the methods involved in the transfer of energy;

5. appreciate the importance of electrical energy in everyday life;

6. understand the occurrence of accidents, hazardous situations and safety measures used in their prevention;

7. appreciate the inter-conversion and conversion of mass energy and momentum;

8. develop investigative and problem solving skills.

UNIT I: TEMPERATURE CONTROL AND VENTILATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. describe the methods of heat transfer and their applications;	Conduction, convection, radiation. Mention land and sea breezes.	Perform simple experiments.
2. explain the principle by which thermostatically controlled household appliances operate;	Electrical and gas ovens, electrical irons.	Demonstration to illustrate the principle using a bimetallic strip.
3. describe the *types* of thermometers *in relation to* the principles by which they work;	*Temperature and unit of measurement.* *Clinical, laboratory, digital, minimum and maximum thermometers, alcohol and mercury thermometers.*	Perform simple experiments to demonstrate use. Safe handling techniques should be encouraged.

SECTION B

UNIT I: TEMPERATURE CONTROL AND VENTILATION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. explain the cooling effects of evaporation;	Latent heat of vaporisation, sweating and metabolic rate. *Refer to Sec. A, Unit VI, SO 2.*	*Investigate the effects of wind, temperature and humidity of the area on evaporation and drying of materials.*
5. explain the need for proper ventilation.	Effects of ventilation. Include air conditioner and humidifier.	Identify features of buildings which promote ventilation.

SECTION B

UNIT II: CONSERVATION OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the concept *and unit of* energy;	Energy as an ability to produce a change.	Activities involving change of state (chemical composition, temperature, and motion).
2. discuss the inter-conversion and conservation of mass energy;	Consideration that energy can be inter-converted, stored by physical or chemical means, put into motion or used to do work, for example, in the sun: nuclear reactors, bombs; energy supply in space; *mention* photosynthesis; methods used to save energy supply to vehicles and measures that may be taken to decrease the effects of the internal combustion engine on life and the environment. Refer to Sec. A, Unit *IV*, SO 5.	Consider - telephones; springs; lamps; shock absorbers in vehicles; batteries; electric motors, calculators, computers.
3. discuss the transport and transfer of energy;	Vehicular collisions; transfer of energy by a wave method; Energy reflected and brought to focus.	Moving stationary objects by means of rolling on swinging spheres. Use of ripple tank, shaking rope or slinky as demonstration; use of dish aerials, mirrors, headlamps.
4. explain the principles of momentum conservation.	Consider conservation of linear momentum (refer to vehicular collision). *Use of formula ($p = m \times v$) to do simple calculations.*	Use the momentum conservation principle to predict the outcomes of collision. Use simple qualitative trolley experiments.

SECTION B

UNIT III: ELECTRICITY AND LIGHTING

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the use of good and poor conductors of electricity;	Definition of conductors (good, semi and poor). Use of rubber and plastics in covering electrical wires and connections.	Simple experiments to detect good, *semi* and poor conductors.
2. explain the relationship between voltage, current and resistance in circuits;	Use of formula V=IR to find unknown; units of electricity: Ampere, Volt, Watt, and Ohm; mention symbols for ammeter, cell, lamps, resistors, switch, transformer, voltmeter and fuse.	*Set up circuits to show properties; draw diagrams of series and parallel circuits; calculate wattage given voltage and current; use ammeters and volt-meters to show how different resistances affect current.*
3. explain how a fuse works as a safety device;	Colour code in wiring plug and choice of flex; dangers of overloading circuit (overheating of wire that may cause insulation to burn).	Wiring of a plug.
4. calculate the amperage for fuses and flexes needed for household appliances;	Use of formula I=W/V; consider use of thick wires as overhead cables and for heavy-duty appliances. Energy consumption = power x time.	Work out size of fuses for appliances.
5. calculate the energy consumption of different electrical appliances;	The cost of using heating appliances (clothes iron, stoves) and non-heating appliances (radio, fluorescent bulbs, fans). Unit = 1 kWh.	*Use actual measurements on energy consumption (units on meter) from different appliances.*
6. calculate electricity bills;	Various costs which must be considered when making up electricity bills, including meter rentals and fuel adjustment charges.	Read both digital and analogue meters.

SECTION B

UNIT III: ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. discuss energy conservation measures;	Energy wastage in faulty electrical appliances. *Light Emitting Diode (LED), Liquid Crystal Display (LCD), Plasma.*	*Investigate energy use in school and present the results in a comparison table.*
8. compare the use of fluorescent tubes, LED bulbs and filament lamps in providing light;	Shadow formation, efficiency, ease of brightness control and similarity with daylight.	*Investigate* the brightness of various filament lamps of different voltage.
9. *evaluate first aid methods for treating accidents;*	*Electrical shock, burns and principles of mouth to mouth resuscitation.* *Refer to Sec. A, Unit V, SO 1.*	
10. *discuss the various methods used in extinguishing fires;*	*Electrical, chemical and bush fires.*	*Design and make a simple carbon dioxide fire extinguisher.*
11. *discuss the hazards caused by careless handling of appliances and other equipment;*	*Radiation and voltage hazards.* *Radios, television sets, computers, mobiles and microwaves.*	
12. *evaluate conventional protective gear/wear.*	*Including in home, school and workplace.* *Protective clothing – gloves, goggles, helmets, chest masks.* *Refer to Sec. A, Unit VIII, SO 6.*	

SECTION B

UNIT IV:* MACHINES *AND MOVEMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *compare* the different types of levers;	Organising load, effort and fulcrum in three different ways.	Actual use or observation of the use of the hammer, bottle opener, crowbar, scissors, nutcracker, wheelbarrow, fishing rod, tweezers as levers; pulleys, wheels, hydraulic press, screw.
2. explain the functions of simple machines;	Levers, pulleys and inclined planes with reference to the way they make work easier; use as force multipliers for convenience of application of a force; simple machines used in or associated with vehicles, for example, motor cars, push carts, draglines, bicycles; simple levers in the mammalian skeleton.	
3. discuss the principles of mechanical advantage and energy conversion;	Use of the equations: mechanical advantage = load ÷ effort; energy converted = force x distance moved in the direction of the force.	Use inclined planes to assist movement of objects from one level to another; perform calculations on mechanical advantage and energy conversion with respect to simple machines.
4. discuss 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 V, SO 8.*	

SECTION B

UNIT V: METALS AND NON METALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. relate the uses of metals and non-metals to their properties;	Metals, plastics and wood; properties such as electrical conductivity, thermal conductivity, melting point, density, tensile strength. Materials used in sports/sporting equipment.	
2. discuss the advantages and disadvantages of using plastics;	Negative effects on the environment. *Recycling.*	
3. *compare the reactivity of metals;*	Aluminum (Al); Copper (Cu); Iron (Fe); Tin (Sn); Silver (Ag); Zinc (Zn).	Observe which metals react *with dilute acid* and which do not; simple word equations to show their reaction.
4. discuss the advantages and disadvantages of using cooking or canning utensils made of aluminum;	Consideration of toxicity and corrosion.	
5. discuss the benefits of using alloys to make household items;	Alloys and examples of alloys commonly found in the home and workplace - steel, brass, soft solder and *electroplating*.	
6. discuss the conditions which cause rusting;	Tarnishing as a chemical process (oxidative).	
7. identify the factors which affect the rate of rusting;	Problems of rusting metal fixtures in houses located near the sea or an industrial plant.	*Controlled experiments to show that air and water are necessary for rusting.*

SECTION B

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
8. discuss the methods used to reduce or prevent rusting of iron or steel.	*The scientific principles involved in painting, covering with oil or plastic, electroplating; galvanizing, for commercial as well as household.*		

SECTION B

UNIT VI: ACIDS, BASES AND MIXTURES

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the uses of some common household chemicals;	Chemical and trade names; water as the most common chemical in the home; water as a solvent used in many household chemicals. *Safety symbols - corrosive, toxic, flammable, explosive.*	
2. distinguish among acids, bases and salts;	The concept of pH. Classification of household chemicals into acids bases and salts. Principle of neutralisation.	Simple investigations to determine the pH values of various brands of toothpaste and infer the effect of the pH on bacteria found in the mouth. Use pH paper. Simple experiments on neutralisation using droppers. Experiments on stain removal - bicarbonate of soda for fruit stains; borax for fruit, wine and tea stains.
3. distinguish among solutions, suspensions and colloids;	Classification of household chemicals in each category.	Simple preparations of solutions, suspensions and colloids.
4. describe separation techniques;	Aqueous and non-aqueous solutions. (a) Distillation. (b) Filtration. (c) Chromatography. *Refer to Sec. C, Unit III, SO 2.* *Desalination plants.*	*Plan and design* experiments on stain removal - turpentine for paint; methylated spirit for glass; acetone for nail polish. Demonstrate ways of removing rust marks on clothing. *The use of stain removal pens and teeth whiteners.*

SECTION B

UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
5. discuss the safe and economic use of some common household chemicals;	The action of disinfectants, antiseptics, deodorisers, *household bleach, hydrogen peroxide, vinegar.*	
6. explain the cleaning actions of scouring powders and detergents on household appliances;	Constituents of scouring powders and detergents, *rust removers, lime scale removers, oxidizing agents. Appliances made from Al, Cu, Fe, Sn, Ag, Zn.*	
7. distinguish between hard and soft water;	Advantages and disadvantages of hard and soft water.	Experiment to determine degree of hardness of water. Experiments to soften samples of hard water by (a) boiling (b) adding washing soda (c) distillation.
8. distinguish between soapy (soap) and soapless detergents.	*Mode of cleaning*; the effects of detergents on the environment biodegradable and non-biodegradable detergents; *oxidizing agents used in laundering.*	

<u>Suggested Teaching and Learning Activities</u>

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.

1. *Organise debate on issues that impact on quality of life, for example, food contamination and environmental wastes.*

2. *Make posters and flyers on equations of reactions, alloys and their uses and the prevention of rusting.*

3. *Use video clips to enhance students learning.*

SECTION B

UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

4. *Carry out investigations and interpret data of results obtained.*

5. *Organise debates on topical and controversial issues that effects or impact on life and the surroundings.*

6. *Invite guest lectures to conduct demonstration workshops, for example, emergency medical services or fire department.*

7. *Design and construct models to demonstrate machines and movement, and new technology applications.*

8. *Organise visits to emergency medical services and the fire department/ Red Cross.*

9. *Research trade names of common household chemicals.*

10. *Visit industrial sites where protective gear is used.*

11. *Conduct research on the use of salts in everyday life, for example, preservatives, controlling pests, medicines.*

12. *Invite a policeman to demonstrate the use of the breathalyser machine to test for alcohol.*

13. *Research, present, and discuss acid-base reactions and oxidation-reduction reactions in everyday life.*

14. *Create pamphlets to alert the school community on the dangers of chemicals used in everyday life.*

15. *Students bring labels from home in order to stimulate discussions and analyse chemical information.*

16. *Use video clips explaining the application of electrolysis in electroplating, anodising and purification.*

17. *Assess the impact of organic compounds used in everyday life on human health, society and the environment, for example, plastics, food additives, pharmaceuticals, detergents.*

18. *Students display samples of alloys used at home.*

19. *Use different forms of presentations by students to demonstrate an understanding of the dangers of metals and non-metals on living systems and the environment.*

SECTION B

UNIT VI: ACIDS, BASES AND MIXTURES (cont'd)

20. View the following websites:

http://www.brainpop.com/science/
http://www.bbcscience.net

21. Play the online educational game in identifying the range of temperatures in different scales.

22. Write an essay on how Direct Current [DC] and Alternating Current [AC] were discovered.

23. Why did the AC prevail? List the items in your homes that use AC and those that use DC. http://www.teachersdomain.org/resource/phy03.sci.phys.mfw.acdc/

24. Observe the Ohm's law simulation at
http://micro.magnet.fsu.edu/electromag/java/ohmslaw/index.html

25. Make a list of items in the home that require a transformer when plugged in and explain why this is so.

26. Discuss how raindrops and prisms have similar effect with light in forming rainbows and spectrum respectively using diagrams. Observe the simulation at the website.

27. http://micro.fsu.edu/optics/activities/students/prisms.html

28. Research assignment by students: In the Caribbean islands, note where the air conditioning units are typically placed in rooms. Where would heaters be located in rooms in cold countries? Explain the reason[s] for your decision using principles of Physics.

♦ SECTION C: EARTH'S PLACE IN THE UNIVERSE

GENERAL OBJECTIVES

On completion of this Section, students should:

1. *understand where we are in space;*
2. *appreciate the motions within our solar system;*
3. *understand the rationale for space exploration;*
4. *appreciate that the soil and the sea are the two most important outdoor environments in the Caribbean;*
5. *understand the nature of gravitational force;*
6. *appreciate the impact of human use of natural resources on the environment;*
7. *understand that positive human interventions are necessary for sustenance of life on this planet;*
8. *develop investigative and problem-solving skills.*

UNIT I: THE UNIVERSE AND OUR SOLAR SYSTEM

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. *identify earth's location in the universe;*	(a) *Milky way galaxy* (b) *Many other galaxies* (c) *Solar system*	
2. *explain how bodies stay in orbit;*	(a) *Characteristics of space* (b) *Satellites*	*Use models to show how planets orbit the sun.*
3. *describe the solar system;*	*Eight (8) planets, elliptical shape; the sun, distance of planets from the sun: number of moons; size of planets, ecliptic orbits.*	*Use the internet to observe different models of the solar system.* *Make model of the solar system using recyclable materials.*
4. *explain how earth is affected by other bodies;*	(a) *Day and night* (b) *Eclipses – Solar and Lunar*	*Observation of moon over 30 day period noting changes in shape and percentage of light emitted.*

SECTION C

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
5. discuss human's exploration of the universe.	*Including:* *(a) international space station; and* *(b) exploration of Mars.*		

SECTION C

UNIT II: **THE TERRESTRIAL ENVIRONMENT**

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the factors which influence soil formation*;*	Physical and chemical weathering and biological action.	
2. compare the types and functions of soils;	Sand, loam and clay; drainage, air content. *Soil profiles.*	Sedimentation tests. Percentage of air, pH of soils, drainage, water retention. *Label diagram of soil profile.*
3. relate soil fertility to the physical and chemical properties of soil;	Presence of soil organisms (earthworms, *nematodes*), soil pH, composition of humus.	Quantitative work with humus. Make inferences about plant growth after doing soil tests.
4. identify causes of soil erosion and methods of prevention;	Evaluation of the soil as an important natural resource. *Impact on food production.*	
5. describe the oxygen, carbon, water and nitrogen cycles;	The role of decomposers including nitrogen-fixing bacteria in soil.	Construct models of various cycles *using recyclable materials.*
6. describe the various types of air masses;	Air masses affecting the Caribbean; the spread of pollutants; radioactive fallout; volcanic dust, industrial waste, Sahara dust, landfill fumes. *Refer to Sec. A, Unit V, SO 6.*	
7. distinguish among the four types of local fronts;	Consider how they affect weather.	Listen to weather reports and formulate charts to show variations.
8. describe the characteristics of a cyclonic storm;	*(a) Seasons* *(b) Weather patterns* (c) *Hurricanes*	*Observe the hurricane tracks across the Caribbean.*
9. describe tidal waves;	*Brief description of the causes* - underwater landslides, volcanoes and earthquakes, tsunami.	

SECTION C

UNIT II: **THE TERRESTRIAL ENVIRONMENT (cont'd)**

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
10. explain the causes of the different types of volcanic eruptions;	The ecological consequences of volcanoes in the long and short term. Include Kick-em-Jenny underwater volcano off the coast of Grenada.	Use models to show volcanic eruptions.
11. discuss the relationship between earthquakes and volcanoes;	The function of seismograph The Richter scale. Significance of the numbers on the Richter scale.	
12. describe how tides are formed.	The effects of tides *(coastal erosion)*. Include high, low, spring, neap tides. *Refer Sec. C, Unit I, SO 4.*	Study of plant and animal life on seashores or river banks with respect to tidal patterns.

SECTION C

UNIT III: **WATER AND THE AQUATIC ENVIRONMENT**

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. explain the uses of water;	Role in life processes, uses in home (consider wastage and conservation). Growing crops *including hydroponics*; drinking, firefighting, generation of electricity. *Refer Sec. A, Unit II, SO 2.*	*Calculating water consumption over a 30 day pe*riod.
2. describe methods of purifying water;	Sources of water; the treatment of seawater for domestic use. *Refer to Sec. B, Unit VI, SO 4.*	Experiments to purify water by boiling, filtration, chlorination, distillation, and additives of alum *and carbon.*
3. discuss the chemical and physical properties of water;	Sea and fresh water. Effects of sea and fresh water on aquatic life.	*Comparing the physical properties of salt water and fresh water using boiling and melting points.*
4. state the conditions for flotation;	*Upthrust and density.* Archimedes principle. The Plimsoll line on boats and ships.	Comparing sinking and floating of similar materials in fresh and seawater. Simple measurements of densities.
5. discuss the effects of water pollution on aquatic life;	Sources of pollution, for example, nitrates, phosphates, [eutrophication] various pesticides, oil spills.	*Investigate effects of the removal of oxygen from water.*
6. describe the various methods used locally for fishing;	Compare the various methods. Including by hand; spears/harpoons; netting (trawling, purse seining, long-lining, dredging); lining; pots or traps; fish farming.	
7. describe the various navigational devices used at sea;	Compass as a device; how the magnetic compass works; safety standards set by regional boards. Sonar, radar, GPS.	*Make model of a compass.*

SECTION C

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED ACTIVITIES	PRACTICAL
Students should be able to:			
8. identify water safety devices;	Life rafts and jackets, inflatable tubes.		
9. discuss the hazards associated with scuba-diving.	Respiratory problems: damage to membrane due to high pressure. The bends, nitrogen narcosis, embolism. *Refer to Sec. A, Unit V, SO 1.*		

SECTION C

UNIT IV: FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. identify the various types of fossil fuels;		
2. identify the energy obtained from petroleum as stored energy;		
3. discuss problems associated with the use of fossil fuels;	Fossil fuels as a non-renewable resource; environmental effects of acid rain, global warming. *Refer to Sec. A, Unit V, SO 6.*	
4. identify alternative sources of *energy;*	Solar, biogas, wind, wave, biofuels, geothermal, hydroelectric, biodiesel.	
5. discuss the uses of solar *and wind* energy;	Include water heating, solar cells (photovoltaic cells), solar cookers/cooking; air heating (cold temperature), lighting, solar driers (meat, fish, fruits, crops).	Make simple *models of* solar cells, solar panels *and wind turbines, using recyclable materials.*
6. discuss variables affecting solar *and wind* energy;	(a) Conduction, convection and radiation. Refer to Sec. B, Unit I, SO 1. (b) *Location – weather patterns*.	*Use simple models from SO5 in different locations and record findings.*
7. appraise the extent to which *alternative sources of* energy can be used *in the Caribbean.*	Loss of energy during conversion; Devices such as solar water heaters, solar cells.	

SECTION C

UNIT V: FORCES

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. discuss the basic principles of forces;	*Types of forces – push, pull and twist.* Action-reaction principle applied in space transport *(Newton's first law)*; 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 importance of friction; motion of vehicles, road surfaces and tyres; the effects of wind speed and wind currents on the motion of aircraft.	Action-reaction principle, for example, releasing an inflated balloon, using a pair of spring balances; Demonstrate by blowing over strips of paper held at one end; use of ball on different surfaces; use of paper aircraft models and fan.
2. describe gravity as a force;	Definition, centripetal forces *(satellites);* 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.	Show how an object can escape the pull of gravity; throwing a ball up and observing its motion; releasing objects attached to suspended spring/ not attached to anything; 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.
3. explain centre of gravity;	Conditions for equilibrium under parallel forces.	Use of 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; items such as pencils, rulers and solids with regular shapes should be used to locate the center of gravity.

SECTION C

UNIT V: FORCES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
4. *explain the types of equilibrium.*	(a) *Stable* (b) *Unstable* (c) *Neutral*	Use of small ball, a concave/ convex dish, or a cone shaped object and a flat surface to demonstrate the three types of equilibrium; use of rule suspended by a spring balance and kept horizontal by known suspended weights to show that: (i) the sum of the forces in one direction must equal the sum in the opposite direction; (ii) the sum of the clockwise moments about a pivot must equal the sum of anti–clockwise movements.

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 caters to students with various learning styles.

1. *Visit the NASA website and view photographs from the Hubble telescope.*

2. *Watch documentaries on various topics, for example, cycles in nature, tidal waves, volcanic eruptions, global warming and climate change.*

3. *Organise site visits and/or field trips to weather stations, seashores and riverbanks and water treatment plants.*

4. *Organise debates of issues that impact human life, for example, effects of space travel on astronauts.*

5. *Create compost heap.*

6. *Invite guest lecturers or resource personnel to speak about fishing and/or water pollution.*

7. *Conduct demonstration experiments on soil profiles, magnetic attraction and repulsion, and the recompression chamber.*

SECTION C

UNIT V: FORCES (cont'd)

8. *Make models to demonstrate the effects of the moon on the earth, for example, day and night and types of eclipses.*

9. *Conduct demonstration experiments on push and pull, balancing object and alternative energy.*

10. *Research and discuss evacuation and safety procedures.*

11. *Investigate Caribbean navigation devices.*

12. *Investigate the availability of alternative energy sources in the Caribbean.*

13. *Arrange a field trip to a petroleum industry complex and examine the chemical processes or view a video clip of the processes involved in the separation of crude oil.*

14. *The Caribbean is regarded as one of the world's biodiversity "hotspots". See website http://hqweb.unep.org/geo/pdfs/Caribbean_EO_final.pdf . Make a collage which showcases the biodiversity in your country.*

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

16. *Have students drop 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 experiment.*

17. *Is it easier or harder to balance a yardstick on your finger than a pencil or ruler? Perform the experiment and try to figure out why. Can you make a pencil easier to balance on your finger by adding weight at the top? Explain. "Centre of gravity: Pencil balance" from ZOOM should be viewed as a class activity.*

18. *What will it take to make a floating submarine sink to the bottom of a bathtub? Conduct an experiment based on your understanding of the factors that influence an object's buoyancy to test this interactive brainteaser from the NOVA website.*

19. *Divide the class into groups, with each group being assigned a different form of renewable energy to research and investigate its suitability in the Caribbean. Design scaled models of their renewable energy options assigned.*
http://www.teachersdomain.org/resource/phy03.sci.engin.systems.lp_renew/ "What is the design process/"
http://www.teachersdomain.org/resource/phy03.sci.engin.design.desprocess/caribbean-icons.org/profiles/rudranath.capildeo.htm

SECTION C

UNIT V: FORCES (cont'd)

20. *The water cycle is the process that moves water around the Earth. In this video segment adopted from ZOOM, cast members use a homemade solar still to mimic this natural process, separating pure water from a saltwater mixture. The class can make this homemade solar still as a project and see the processes of condensation and evaporation and its relevance on planet earth. http://www.teachersdomain.org/resource/ess05.sci.ess.watercyc.solarstill1/*

21. *Create a small booklet highlighting the biography and the contribution of Professor Oliver Headley in the applications of solar energy in the Caribbean: see website http://www.caribbean-icons-org/profiles/oliver-headley.htm*

22. *Show how earthquakes are located. How tsunami waves are formed and why are they so much larger than normal sea waves? This video segment from Nature examines the anatomy of the tsunami and the possibility that animals can sense the coming waves of destruction. http://www.teachersdomain.org/resource/nat08.earth.geol.tec.waves/*

♦ 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.

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 testing them and rewarding them for their achievements.

School-Based Assessment should be made in the context of normal practical coursework exercises. It is not intended that the exercises used for assessment should be artificial and meaningless. Assessment should only be made after the candidates have been taught the skills and given enough opportunity to develop them. Although CXC requires the reporting of 18 practical assignments for moderation, teachers are reminded that there is no upper limit to the number of assessments that should be conducted during the course of normal teaching.

The general Aims of this syllabus can only be achieved by using a practical approach and 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 provide authentic learning experiences. Assessments should only be made after candidates have been taught the skills and given enough opportunity to develop them.* ***Eighteen*** *practicals over the two-year period would be considered the minimum number for candidates to develop their skills and on which to base realistic assessments.*

Each skill must be assessed at ***least two times*** *over the two-year period. Candidates should be encouraged to do corrections so that misconceptions will not persist. As the assessment of certain skills, especially those requiring on-the-spot observation or involve looking at several behaviours or criteria, teachers are advised to select not more than two skills to be assessed in any activity. The practical exercises selected to be used 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 selected should be one that can be completed in the time allotted for the class and* ***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 should be 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 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;

(g) work out the criteria for assessing each skill. This will form the basis of a mark scheme and a checklist.

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/ Reporting	*1*	*10*	*1*	*10*	*20*
	Planning and Designing	*1*	*10*	*1*	*10*	*20*
	Drawing	*1*	*10*	*-*	*-*	*10*
UK	*Analysis and Interpretation*	*1*	*10*	*1*	*20*	*30*
	TOTAL	*5*	*50*	*4*	*50*	*100*

****Weighted mark***

Investigative project to be done in Year 2.

The investigative project would be assessed for two skills, Planning and Design and Analysis and Interpretation.

Assessment of Investigation Skills

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 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 types of materials are best for dyeing with a selected natural dye that can be made from readily available plant materials?

Hypothesis: The woollen samples will have 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 materials after dyeing. To determine which type of material, cotton, wool or linen, produces a more intense colour when organic dyes are used with sodium chloride as a mordant.

Materials/Apparatus

Materials 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 9-11-9 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 (E.g. Yellow with greater intensity of dye; Yellow will 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 coloration 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).

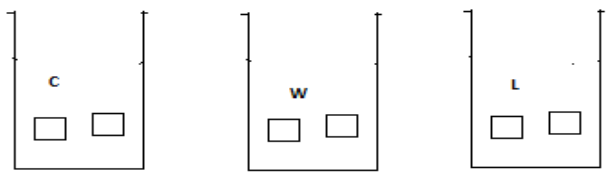
2. Weigh the fabric samples to be dyed.

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 9-11-9 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 (E.g. Yellow with greater intensity of dye; Yellow will 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 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

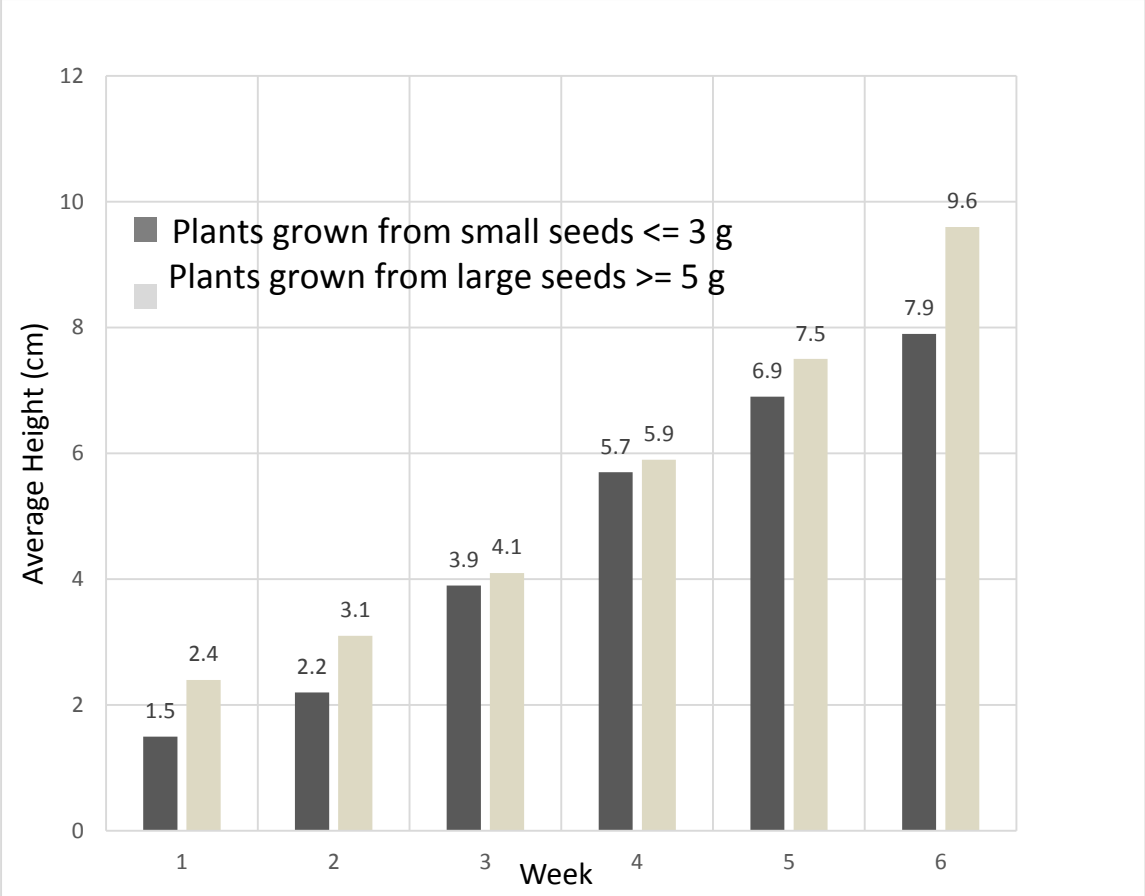


Figure 1: Average Height for Small Seeds and Large Seeds over a Six-week Period

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

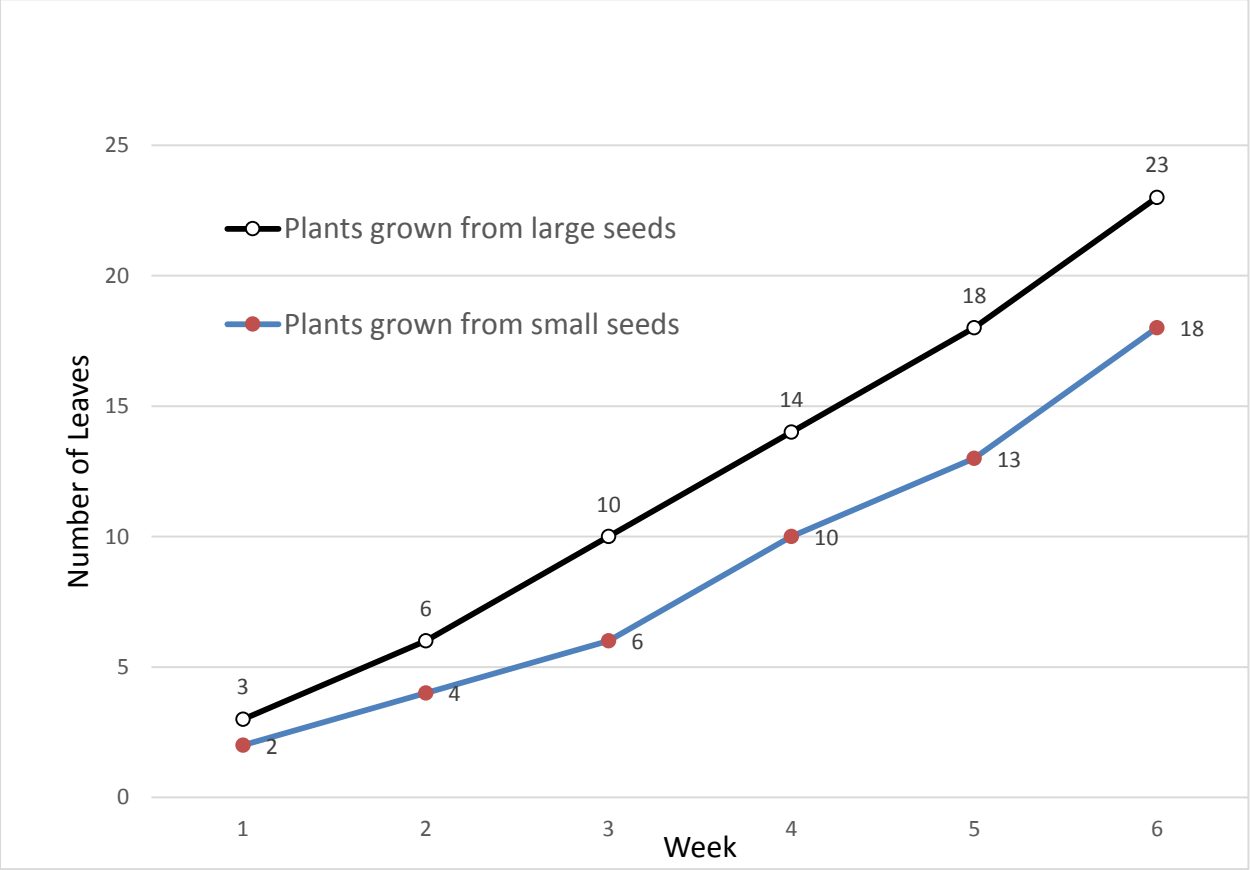


Figure 2: Average Number of Leaves Found on Plants Grown from Small Seeds and Large Seeds over a Six-Week Period

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;
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 second 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;*
   (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;
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)	2/12	23/2	Avg. (10)	15/10	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.
Chapman, S., Luttig, D., Murray, J., Ritchie, E., and Tindale, A.	*Chemistry for CSEC,* United Kingdom: Nelson Thornes Limited, 2009.
Chung-Harris, T.	*CXC Integrated Science,* Oxford: Macmillan Caribbean, 2005.
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,* United Kingdom: Nelson Thornes Limited, 2008.
Koh, A., Chang Hong, W., and Ming Jun, L.	*CSEC Integrated Science,* Trinidad and Tobago: Caribbean Educational Publishers, 2008.
Neeranjan, D. Avison, J. and Henry, D.	*Physics for CSEC,* United Kingdom: Nelson Thornes Limited, 2007.
Potter, S. and Oliver, R.	*Integrated Science for CSEC*, England: Pearson Longman Publishing, 2003.
Ragoobirsingh, D.	*Longman Human and Social Biology for CSEC,* England: Pearson Education Limited, 2007.
Taylor, M., and Chung-Harris, T.	*CXC Chemistry,* Oxford: Macmillan Education, 2006.

♦ GLOSSARY

WORD/TERM	DEFINITION/MEANING	
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	
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	
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	
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	
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)

♦ 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.

Appendix I

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: _____

♦ 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.

♦ 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)

♦ 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
- Dicot root, T.S.;

Sockets, lamp

Solar system, model of

Solder

Sonometer (commercial or improvised – a guitar can work)

Stands, retort with clamps

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^{o}C - 110^{o}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
February 2015