



CARIBBEAN EXAMINATIONS COUNCIL

**Caribbean Secondary Education Certificate
CSEC[®]**

**INTEGRATED SCIENCE
SYLLABUS**

Effective for examinations from May/June 2011

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

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



Integrated Science Syllabus

◆ RATIONALE

In our daily lives and in society at large, many of our decisions demand a knowledge of science. This knowledge is necessary for dealing satisfactorily with many of the situations that confront us daily in our home, at the workplace and in the wider environment. Science should, therefore, be an important part of our general education. The Integrated Science syllabus attempts to meet this need.

The syllabus is based on *three* themes – The Organism *and Its Environment*, The Home and Workplace, *and Energy* – chosen because, they 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. Integrated Science is a subject in its own right, encompassing topics mainly from Physics, Chemistry and Biology. Indeed, if such distinctions were made, other components such as Earth Sciences and Meteorology would also be recognized.

The CSEC Integrated Science syllabus is designed to allow students to work individually and cooperatively, utilizing theoretical concepts of the course in interactive and practical activities. Students are expected to apply, scientific principles, investigative and problem solving skills, be effective in communicating scientific knowledge and demonstrate an appreciation for all living organisms in their environment.

The Integrated Science syllabus is intended to contribute to the science education needs of Caribbean secondary level students in the following groups:

- i. those whose abilities, aptitudes and choice of courses will allow them to pursue only one science subject, or who wish to pursue a science course in the interest of a rounded general education;
- ii. those who study science-related subjects such as Home Economics, *Physical Education and Sport* and Agricultural Science, or who intend to go on to studies at the tertiary level, for careers in areas, such as, nursing and teaching.

◆ AIMS

This syllabus aims to:

1. *develop scientifically and technologically literate students;*
2. *develop the ability to apply scientific concepts and principles to everyday situations;*
3. *promote a willingness to work cooperatively with others and to persist with a task to a logical conclusion;*
4. *increase awareness of the importance of living in harmony with the environment;*
5. *encourage an appreciation of the need to preserve the natural environment;*
6. *develop experimental and critical thinking skills;*
7. *develop competencies that will enable students to make appropriate decisions regarding health, safety and some everyday life problems.*

◆ PRE-REQUISITES OF THE SYLLABUS

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 equivalent are also strongly recommended as allied subjects to be studied.

Mathematical Requirements

CSEC Mathematics provides an excellent course that will support work in *CSEC* Integrated Science. In particular, the areas below will be very useful.

- The four basic operations (+, -, x, ÷)
- Decimals
- Change of subject of simple formulae
- Substituting values into simple formulae
- Significant figures
- Means and modes
- Graphs, histograms, charts, tables

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. At least two periods per week should be devoted to practicals.

◆ ORGANIZATION OF THE SYLLABUS

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

<i>SECTION A</i>	-	<i>THE ORGANISM AND ITS ENVIRONMENT</i>
<i>SECTION B</i>	-	<i>THE HOME AND WORKPLACE</i>
<i>SECTION C</i>	-	<i>ENERGY</i>

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.

◆ 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 candidate's performance of each candidate under the following headings:

- (i) Knowledge and Comprehension;
- (ii) Use of Knowledge;
- (iii) *Practical 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.

Practical Skills (PS)

	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 recognize the limitations and assumptions of data.

Note: In addition to the *Practical skills*, candidates are expected to utilize 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)

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 03/1
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. CXC will require a sample of laboratory notebooks for external moderation. A statement of the tasks set for SBA and the corresponding Mark Schemes used should accompany these. See Guidelines for School Based Assessment on pages 36-44.

Paper 03/2
(*School Based Assessment*
For private candidates
only)
(2 hours)

Alternative to the School Based Assessment for private candidates. The paper will examine the same skills as these tested on Paper 03/1. The focus, therefore, will be on Practical skills and consist of three written questions.

TABLE 1

ALLOCATION OF MARKS ACROSS PAPERS AND PROFILE DIMENSIONS

<i>PROFILES</i>	<i>PAPER 01</i>	<i>PAPER 02</i>	<i>SBA 03</i>	<i>TOTAL</i>
<i>Knowledge and Comprehension (KC)</i>	30	17	-	47
<i>Use of Knowledge (UK)</i>	-	29	-	29
<i>Practical Skills (PS)</i>	-	4	20	24
<i>Total %</i>	30	50	20	100

◆ REGULATIONS FOR RESIT CANDIDATES

1. *Resit candidates must complete Papers 01 and 02 of the examination for the year for which they re-register. Resit candidates who have earned 50% of the MODERATED score for the SBA component may elect not to repeat this component, provided they re-write the examination no later than the year following their first attempt. The scores for the SBA can be transferred once only - that is, to the examination immediately following that for which they were obtained.*
2. *Resit candidates who have obtained less than 50% of the MODERATED scores for the SBA component must repeat the component at any subsequent sitting.*
3. *Resit candidates must be entered through a school or other approved educational institution.*

◆ REGULATIONS FOR STUDENTS FROM PRIVATE INSTITUTIONS

1. *Private candidates must be entered through institutions recognized by the Council.*
2. *Private candidates will be required to complete all aspects of the examination (Papers 01, 02 and 03).*
3. *The SBA activities of private candidates must be monitored by tutors in the institution through which they register.*
4. *Private candidates must submit their own work, which must be validated by their tutors.*

◆ SECTION A - THE ORGANISM AND ITS ENVIRONMENT

GENERAL OBJECTIVES

On completion of this Section, students should:

- 1. understand that cells are the basic unit of life;*
- 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. develop investigative and problem solving skills.*

UNIT I – THE CELL

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>draw simple diagrams to show the structure of unspecialized plant and animal cells;</i>	<i>Cell wall, cell membrane, nucleus, cytoplasm, vacuoles, mitochondria, chloroplast. Details of structures as seen in electron micrographs <u>not</u> required.</i>	<i>Construct models using plasticine or other materials found around the home or laboratory.</i>
2. <i>explain the importance of the cell wall, cell membrane, nucleus, chromosomes, cytoplasm, mitochondria, vacuoles and chloroplast;</i>	<i>Simple treatment only, for example, chromosomes carry genetic information in the form of DNA.</i>	
3. <i>explain the processes of diffusion and osmosis using an experimental approach.</i>	<i>Importance of diffusion and osmosis in transporting substances in and out of cells and from one cell to another in all living organisms. Reference to the cell membrane as a partially permeable membrane.</i>	<i>Carry out simple investigations to illustrate the movement of particles (molecules and ions)</i>

UNIT II – FOOD AND NUTRITION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>describe</i> the process of photosynthesis;	Definition, identification of substrate, conditions and products; word and chemical equations; outline of process; importance of light, chlorophyll, carbon dioxide and awareness that light energy can be converted to chemical energy.	Experiments to establish conditions for photosynthesis, <i>tests</i> for starch as a product of photosynthesis.
2. <i>describe photochemical reactions</i> ;	<i>Refer to photosynthesis and photography.</i>	
3. <i>explain</i> the importance of food;	<p><i>The Caribbean food groups, their sources and functions of their main nutrients.</i></p> <p><i>Discussion of food additives and their effect on health; balanced and unbalanced diets. Balanced diet related to age, gender, occupation; deficiency diseases (PEM) obesity.</i></p>	<p><i>Food tests.</i></p> <p><i>Collect food labels to discern nutritive content.</i></p> <p><i>Experiments to measure energy value of food.</i></p>
4. <i>discuss dietary needs for specific activities and the timing of meals prior to physical activities</i> ;		
5. <i>explain</i> the process of digestion in <i>human beings</i> ;	<i>Mechanical and chemical digestion; role of enzymes; enzymes active at different stages, substrates and products; absorption, assimilation, egestion.</i>	Draw and label the digestive system in human beings and state the function of each part; <i>identify enzymes, digestive juices and state of acidity/alkalinity at each stage</i> ; experiments to show effects of temperature and pH on enzymes.

UNIT II – FOOD AND NUTRITION (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
6. <i>explain</i> the role of teeth in digestion.	<i>Types of teeth/dental formula; relate structures to function; Effect of fluoridation.</i>	Draw and label a diagram of a vertical section of a tooth; examine models of individual teeth.

UNIT III – RESPIRATION/AIR POLLUTION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>explain the mechanism of breathing;</i>	<i>Inhalation/exhalation, pressure and volume changes, role of ribcage and diaphragm: composition of inhaled and exhaled air.</i>	<i>Bell jar experiment. Ventilator or ventilator machine - Consider the use of technology clips - video, DVD, CD's flash drives.</i>
2. <i>distinguish between gaseous exchange and breathing;</i>	<i>Structure of lungs and alveoli.</i>	<i>Diagrams.</i>
3. <i>discuss the importance of respiration to organisms;</i>	<i>Definition, substrate and products, word and chemical equation; site, types and importance of energy release; energy related to type of substrate.</i>	<i>Experiments to show release of energy and carbon dioxide by organisms.</i>
4. <i>compare and contrast aerobic and anaerobic respiration;</i>	<i>Types - compare amounts of energy produced, products and use; importance of anaerobic respiration [sports/industries].</i>	
5. <i>discuss the features common to respiratory surfaces;</i>	<i>Including how fishes obtain oxygen from water.</i>	
6. <i>identify the causes of air pollution;</i>	<i>Sulphur dioxide, carbon dioxide, methane, carbon monoxide, lead; - affinity of carbon monoxide to haemoglobin of red blood cells.</i>	
7. <i>discuss ailments that are caused by air pollution;</i>	<i>Allergies, lung cancer, other respiratory disorders.</i>	
8. <i>explain the effects of smoking on the respiratory system.</i>	<i>Importance of smoke free environments.</i>	<i>Collect newspaper clippings, make histograms.</i>

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, structure of stem – xylem/phloem.
[Refer to Unit I, Specific Objective 3].
Experiments on diffusion with agar cubes of different sizes to show how surface area/volume ratio affects total diffusion.
2. relate the structures of the circulatory system in human beings to their functions;
Composition of blood and types of blood cells and their functions; blood vessels and their functions, structure of the heart and heart beat; names of major blood vessels associated with the heart only.
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 the role of antigens and antibodies in natural and artificial control of diseases;
Vaccines; an awareness of AIDS as a disease which results from damages to the immune system.
Research on the effect of retrovirals on person's living with HIV/AIDS.
5. explain possible causes of hypertension and heart attacks;
6. discuss the physiological effects of exercise;
Effects on circulatory and respiratory systems, effects on balancing energy input and output.
7. discuss the effects and ethics of using drugs and other techniques in the performance enhancement of athletes.
Blood doping to increase the number of red blood cells; use of hormones (steroid); diet and training programs.
Research and report on use and mis-use of drugs.

UNIT V - EXCRETION

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

1. distinguish between excretion and egestion;
2. explain the mechanism of excretion by the lungs, skin and kidneys;
3. identify the waste products of flowering plants and their methods of excretion.

Definitions. [Refer to Unit II, Specific Objective 5].

Relationship to metabolism, excretory organs and products; kidney - structure of tubule related to ultra-filtration (dialysis) and re-absorption; *Osmoregulatory function of kidneys; dialysis. Relate structure of skin to its function.*

[Refer to Unit III, Specific Objective 2].

Waste products of respiration and photosynthesis only. *Osmoregulation related to environmental factors; plants - waste products, gaseous exchange and its importance, leaf fall/storage in bark.*

Examine *cross section* diagrams/models of the skin and kidneys of *human beings*.

UNIT VI – SENSE ORGANS AND COORDINATION

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. describe the structures and functions of the nervous system;	<i>Brain, sensory and motor neurone. Features (receptors, control, effects). Voluntary and involuntary actions.</i> <i>An understanding that nerves carry messages using chemical and electrical energy; identification of the effects of the malfunctioning of the system, for example, paralysis.</i>	Simplified diagrams showing structures of brain and neurones. Simple reflex arc, for example, knee jerk.
2. describe the functions of the endocrine system;	Endocrine - hormones as messengers; thyroid, pancreas, sex organs, adrenal glands and pituitary glands.	<i>Structural diagram – identify location of organs; list hormones produced and their uses/effects.</i>
3. explain how life processes are regulated by feedback control;	Ectothermic and endothermic animals; advantages of endothermy; feedback control - set range of values, detection of deviation and response.	<i>Use a flow chart to illustrate the concept of the feedback mechanism; illustrate using temperature control and osmoregulation.</i>
4. relate the structures of the mammalian eye to their functions;	<i>Accommodation and control of amount of light entering eye.</i>	Compare a model of the eye with a camera. (Pin hole)
5. explain sight defects and their corrections;	<i>Long and short sightedness; effects of bright light, ultra violet light and physical injury; function of convex and concave lenses.</i>	<i>Carry out simple investigations using convex and concave lenses.</i>
6. 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.	<i>Carry out simple investigations on pitch and loudness.</i>

UNIT VII – REPRODUCTION AND GROWTH

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- | | | |
|--|---|---|
| 1. <i>distinguish between asexual and sexual reproduction;</i> | <i>Simple cell division - Details of meiosis and mitosis not required. Comparison of asexual and sexual reproduction, advantages and disadvantages of asexual reproduction (variety, evolution, livestock and crops).</i> | <i>Examine and draw storage organs including corms, bulbs, rhizomes, runners, and cuttings. Drawing of half-flower, fruits and seeds.</i> |
| | | <i>Use models/charts of human reproductive system.</i> |
| 2. describe various methods of asexual reproduction in plants and animals; | <i>Budding, cuttings, runners, tissue culture, cloning, grafting.</i> | |
| 3. <i>describe the process of sexual reproduction in plants and in human beings;</i> | <i>Flowers: name and functions of parts; pollination: types, advantages of cross pollination, agents of; fertilization and development of seeds/fruits (outline); human reproductive system: names and function of parts.</i> | |
| 4. <i>describe the menstrual cycle;</i> | <i>Roles of estrogen and progesterone; mention menopause.</i> | |
| 5. <i>discuss ovulation, fertilization, implantation, development of the foetus and birth;</i> | | <i>Simplified diagrams to illustrate processes.</i> |
| 6. <i>discuss the advantages and disadvantages of various methods of birth control;</i> | <i>Natural, barrier, hormonal, surgical.</i> | |

UNIT VII – REPRODUCTION AND GROWTH (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. <i>discuss the importance of pre and post natal care of mothers and babies;</i>	<p><i>The effects of nutrition, drugs, x-rays and diseases; advantages of breastfeeding, and immunization.</i></p> <p><i>The implications of the Rh factor. [Refer to Unit IV, Specific Objective 3].</i></p>	Collect data from health centre or other health facilities.
8. <i>discuss the causes, symptoms, prevention and control of sexually transmitted infections [STI's];</i>	<p><i>Herpes, Gonorrhoea, Syphilis, Hepatitis, AIDS;</i></p> <p><i>Bacterial - Syphilis or Gonorrhoea;</i></p> <p><i>Viral - Herpes; Fungal - Candida.</i></p> <p><i>[Refer to Unit IV, Specific Objective 4].</i></p>	Use charts/tables compare information of STI's.
compare growth patterns in selected organisms;	<p>Seeds of annual plants - balsam, bean and corn (maize).</p> <p>Germination in plants.</p>	Plot graph of plant growth at regular intervals of one week and extrapolate to predict height at future time; construct and analyze 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.	Collect population statistics from agencies, such as, WHO and UNESCO, as well as Internet sources.

◆ SECTION B - THE HOME AND WORKPLACE

GENERAL OBJECTIVES

On completion of this Section, students should:

- 1. appreciate that the soil and the sea are the two most important outdoor working environments in the Caribbean;*
- 2. understand the relationship between human beings and the environment in which they work;*
- 3. understand the need for appropriate physical conditions, such as, ventilation and sanitation in the home and the workplace;*
- 4. understand the occurrence of accidents, hazardous situations and safety measures used in their prevention;*
- 5. 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; | <i>Conduction, convection, radiation. Mention land and sea breezes.</i> | Perform simple experiments. |
| 2. explain the principle by which thermostatically controlled household appliances operate; | <i>Electrical and gas ovens, electrical irons.</i> | Demonstration to illustrate the principle using a bimetallic strip. |
| 3. describe the features of thermometers and the principles by which they work; | <i>Types of thermometers, for example, clinical, laboratory, digital, minimum and maximum thermometers, alcohol and mercury thermometers.</i> | <i>Perform simple experiments to demonstrate use. Safe handling techniques should be encouraged.</i> |
| 4. explain the cooling effect of evaporation; | <i>Latent heat of vaporization, sweating and metabolic rate.</i> | |

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

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- | | | |
|---|--|---|
| 5. <i>explain</i> the effects of temperature and relative humidity on body functions; | <i>Physiological effects of exposure to the sun.</i> | Investigate the effects of wind, temperature and humidity of the area on evaporation and drying of materials. |
| 6. <i>explain the need for proper ventilation.</i> | <i>Effects of ventilation. Include air conditioner and humidifier.</i> | <i>Identify features of buildings which promote ventilation.</i> |

UNIT II – THE TERRESTRIAL ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>discuss the factors which influence soil formation;</i>	Physical and chemical weathering and biological action.	
2. <i>compare the types and functions of soils;</i>	Sand, loam and clay; <i>drainage, air content.</i>	<i>Sedimentation tests and drawing of soil profile observed.</i>
3. <i>relate soil fertility to the physical and chemical properties of soil;</i>		Quantitative work with humus. Make inferences about plant growth after making soil tests;
4. identify causes of soil erosion and methods of prevention;	Evaluation of the soil as an important natural resource.	Field trips.
5. <i>compare and contrast methods used in the production of crops;</i>	<i>Include strip planting, contour ploughing, terracing, crop rotation, contouring, greenhouse farming. Determination of which methods will result in maximum crop yields with the minimum depletion in soil nutrients.</i>	Visits to nearby farms; study of common agricultural practices needed to maintain crop growth; need for conservation.
6. discuss food chains and food webs found in an environment;	<i>Producers, consumers (primary and secondary) decomposers, habitat, herbivores, carnivores, omnivores, population, community, ecosystem.</i>	Observe plants and animals in a nearby area or the school grounds and classify them as producers, consumers, decomposers, herbivores, carnivores. Draw simple food chains and food webs in <i>terrestrial and aquatic environments.</i>
7. describe <i>the oxygen, carbon, nitrogen cycles;</i>	<i>The role of decomposers including nitrogen-fixing and denitrifying bacteria in soil.</i>	<i>Simple diagrams and models of cycles.</i>

UNIT II – THE TERRESTRIAL ENVIRONMENT (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
8. <i>describe the various types of air masses;</i>	<i>Air masses affecting the Caribbean; the spread of pollutants, radioactive fall-out, volcanic dust, industrial waste, Sahara dust, landfill fumes.</i>	<i>Use video clips, DVD's, power point, to illustrate.</i>
9. <i>distinguish among the four types of local fronts;</i>	<i>Include symbols. Consider how they affect weather.</i>	
10. <i>describe the characteristics of a cyclonic storm, particularly a hurricane;</i>		<i>Collect records of hurricanes in the Caribbean to trace their paths on weather maps. Research and discuss evacuation and safety procedures.</i>
11. <i>describe tidal waves and how they are formed;</i>	<i>Underwater landslides, volcanoes and earthquake; tsunami and how it is formed. [Include Kick-em-Jenny off the coast of Grenada - underwater volcano]</i>	
12. <i>explain the causes of the different types of volcanic eruptions;</i>	<i>The ecological consequences of volcanoes in the short and long term.</i>	<i>Use models to show volcanic eruptions.</i>
13. <i>discuss the relationship between earthquakes and volcanoes;</i>	<i>The function of a seismograph. Richter scale.</i>	
14. <i>describe how tides are formed.</i>	<i>The effects of tides. Include high, low, spring, neap tides.</i>	<i>Study of plant and animal life on seashores or river banks with respect to tidal patterns.</i>

UNIT III – WATER AND THE AQUATIC ENVIRONMENT

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>explain</i> the uses of water;	Role in life <i>processes</i> , uses in home (consider wastage and conservation). <i>Growing crops (hydroponics); drinking, fire fighting, generation of electricity.</i>	
2. describe methods of purifying water;	Sources of water; the treatment of seawater for domestic use.	Experiments to purify water by boiling, filtration, chlorination, distillation, and additives of alum.
3. discuss <i>the importance of the water cycle in providing</i> a continuous supply of fresh water;		<i>Simple diagram or model of the water cycle.</i>
4. discuss the chemical and physical properties of water;	<i>Sea and fresh water. Effects of sea and fresh water on aquatic life.</i>	<i>Investigate the presence of dissolved air and solids in water by heating.</i>
5. state <i>the conditions for flotation in terms of upthrust and density;</i>	<i>Archimedes principle. The Plimsoll line on boats and ships.</i>	Observe sinking and floating of similar materials in fresh and seawater. <i>Simple measurements of densities.</i>
6. discuss <i>the factors affecting the free movement of objects in air and water;</i>	<i>Resistance to (friction/viscosity), streamlining, speed and direction of wind and water currents on sailing, kite flying, running and cycling.</i>	<i>Determine the angle at which the projectile must be thrown to obtain maximum range; apply this knowledge to sports involving throwing, for example, javelin, discus.</i>
7. discuss the effects of water pollution on aquatic life;	Sources of pollution, for example, nitrates, phosphates, [eutrophication] various pesticides, oil spills.	<i>Visit sites where there is evidence of water pollution.</i>

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

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
8. describe the various methods used locally for fishing;	Compare the various methods. <i>Include -by hand; spears/harpoons; netting (trawling, purse seining, long- lining, dredging); lining; pots or traps; fish farming.</i>	Collect information from local fisherfolks and fisheries department.
9. describe the various navigational devices used at sea;	<i>Compass as a device; how the magnetic compass works; safety standards set by regional boards. Sonar, radar, GPS.</i>	Magnetic attraction and repulsion should be demonstrated; identify directions using a magnetic compass.
10. identify water safety devices;	<i>Life rafts and jackets, inflatable tubes.</i>	
11. discuss the hazards associated with scuba-diving.	<i>Respiratory problems: damage to membrane due to high pressure. The bends, nitrogen narcosis, embolism.</i>	<i>Recompression chamber.</i>

UNIT IV– PESTS AND PARASITES/SANITATION

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- | | | |
|---|---|---|
| 1. describe the conditions which promote the growth of microorganisms; | Procedures for retarding and preventing the growth of bread mould. <i>The effects of microorganisms in food.</i> | <i>Investigate growth of mould on bread under different conditions.</i> |
| 2. discuss the principles used in food preservation; | <i>Methods - salting, drying, pickling, heating, refrigeration, adding sugar and treating with other preservatives.</i> | |
| 3. discuss conditions that encourage the breeding and control of household pests and parasites; | <i>Differentiate between pests and parasites.</i>

Cockroaches, flies, rats, mosquitoes.

<i>Biological, mechanical and chemical sanitary controls.</i> | |
| 4. discuss the different types of waste; | Domestic, industrial and biological waste. <i>Uses to which waste can be put, for example, recycling, biogas production. Bio- degradable and non bio-degradable waste.</i> | |
| 5. discuss the need for personal and community hygiene. | <i>The importance of the state in the disposal of waste, adequate toilet and sewage disposal facilities, garbage collection and disposal.</i>

<i>Environmental effects, such as, pollution of potable water, food contamination, 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.</i> | |

UNIT V – SAFETY HAZARDS

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

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|---|---|---|
| 1. discuss safety in the home and workplace; | Types of accidents, causes and precautions; accidents that are likely to result from negligence in the use of household appliances, for example, overheating of electric iron, delay in lighting gas cookers; <i>hazards in any working environment - food contamination, fires, toxic gases, corrosive substances, infection by pathogens, excessive noise, electrical shock; methods used to prevent food contamination, possible hazards; maintenance of household appliances; adequate lighting; types of disabilities that can occur due to accidents and improper lighting; laboratory rules.</i> | Demonstrate the correct use of the <i>Bunsen burner</i> ; <i>Principle of combustion, Luminous and non-luminous flames.</i>

Visit Industrial Arts, Home Economics and Visual Arts department of the school.

Collect, identify and display examples of safety symbols, hazard signs. |
| 2. evaluate first aid methods for treating accidents; | Electrical shock, burns and principles of mouth to mouth resuscitation. | <i>Visit to Emergency Medical Department or invite EMS personnel for demonstration workshops.</i> |
| 3. discuss the various methods used in extinguishing fires; | <i>Electrical, chemical and bush fires.</i> | Visit to fire department or invite fire personnel for guest lecture.

<i>Design and make a simple carbon dioxide fire extinguisher.</i> |
| 4. evaluate conventional protective wear recommended for various jobs; | Protective clothing - gloves, goggles, helmets, chest masks. | |
| 5. discuss <i>the hazards caused by careless handling of radios, television sets and other equipment that operate from the mains.</i> | <i>Radiation and voltage hazards.</i> | |

UNIT VI – METALS AND NON METALS

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. relate <i>the uses of metals and non-metals to their properties</i> ;	Metals, plastics and wood; properties such as electrical conductivity, thermal conductivity, melting point, density, tensile strength. <i>Materials used in sports/sporting equipment.</i>	
2. discuss the advantages and disadvantages of using plastics;	Negative effects on the environment of using plastics.	
3. describe the reactions of metals with oxygen, acid, alkali, water and <i>steam</i> ;	<i>Aluminum (Al); Copper (Cu); Iron (Fe); Tin (Sn); Silver (Ag); Zinc (Zn).</i>	Observe which metals react 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;	<i>Consideration of toxicity and corrosion.</i>	
5. discuss methods of cleaning household appliances;	Household appliances made of aluminum, copper, iron, tin, silver and zinc.	
6. discuss the benefits of using alloys to make household items;	Alloys and examples of alloys commonly found in the home and workplace - <i>steel, brass and soft solder.</i>	
7. discuss the conditions which cause rusting;	Tarnishing as a chemical process (oxidative).	

UNIT VI – METALS AND NON METALS (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
8. identify the factors which affect the rate of rusting;	Problems of rusting metal fixtures in houses located near the sea or an industrial plant.	
9. discuss the methods used to reduce or prevent rusting of iron or steel.	Painting, covering with oil, electroplating; galvanizing; the scientific principles involved, commercial as well as household.	Controlled experiments to show that air and water are necessary for rusting.

UNIT VII – 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.	
2. <i>distinguish among acids, bases and salts;</i>	The concept of pH and neutrality. Classification of household chemicals into acids, bases and salts. <i>Principle of neutralization.</i>	Carry out 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 neutralization using droppers. <i>Experiments on stain removal - bicarbonate of soda for fruit stains; borax for fruit, wine and tea stains.</i>
3. <i>distinguish among solutions, suspensions and colloids;</i>	Classification of household chemicals in each category.	Simple preparations of solutions, suspensions and colloids.
4. <i>explain the action of a solvent in stain removal;</i>	Aqueous and non-aqueous solutions.	Experiments on stain removal - turpentine for paint; methylated spirit for glass; acetone for nail polish. <i>Demonstrate ways of removing rust marks on clothing.</i>
5. <i>discuss the safe and economic use of some common household chemicals;</i>	The action of disinfectants, antiseptics, deodorisers.	
6. <i>distinguish between hard and soft water;</i>	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.

UNIT VII – ACIDS, BASES AND MIXTURES (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
7. <i>explain the cleaning actions of scouring powders and detergents;</i>	Constituents of scouring powders and detergents.	
8. <i>discuss the effectiveness of various types of abrasive materials;</i>	<i>Corrosion and toxicity</i>	
9. <i>distinguish between soapy (soap) and soapless detergents.</i>	Their cleaning action; the effects of detergents on the environment <i>biodegradable/non biodegradable detergents.</i>	

◆ SECTION C - ENERGY

GENERAL OBJECTIVES

On completion of this Section, students should:

- 1. understand the nature of gravitational force;*
- 2. appreciate the importance of energy in every day life;*
- 3. appreciate the inter-conversion and conservation of the different forms of energy;*
- 4. understand the principles of conservation of mass energy and momentum;*
- 5. understand the methods used in transferring energy;*
- 6. appreciate the motions within our solar system;*
- 7. develop investigative and problem solving skills.*

UNIT I – 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 (<i>good, semi and poor</i>). Use of rubber and plastics in covering electrical wires and connections. | Simple experiments to detect good, <i>semi</i> 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 <i>and fuse</i> . | Calculate wattage given voltage and current; use ammeters and volt-meters to show how different resistances affect current; set up circuits to show properties; draw diagrams of series and parallel circuits. |
| 3. explain how a fuse works as a safety device; | <i>Colour</i> 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. |

UNIT I – ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
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). <i>Unit = 1 kWh</i>	Measure energy consumption (units on meter) of 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.
7. <i>discuss energy conservation measures;</i>	<i>Energy wastage in faulty electrical appliances.</i>	
8. <i>explain the magnetic effects of electrical current;</i>	<i>Types - electromagnets temporary magnets, permanent magnets.</i>	<i>Make bells, bi-relays and electromagnets; demonstrate magnetic effect.</i>
9. <i>distinguish between natural and artificial lighting;</i>	<i>Effects on colours of objects.</i>	
10. <i>compare and contrast the use of fluorescent tubes and filament lamps in providing light;</i>	<i>Shadow formation, efficiency, ease of brightness control and similarity with daylight.</i>	<i>Compare the brightness of various filament lamps of different voltage.</i>
11. <i>describe how to separate white light into its component colours;</i>		<i>Glass or water prisms can be used.</i>

UNIT I – ELECTRICITY AND LIGHTING (cont'd)

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

12. *differentiate between primary and secondary colours of light;*
13. *discuss the effects produced by mixing various combinations of primary pigments.*

Colour wheel.

Separation of different coloured inks by chromatography.

UNIT II – FOSSIL FUELS AND ALTERNATIVE SOURCES OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>identify the various types of fossil fuels;</i>	<i>Formation of fossil fuels.</i>	
2. <i>identify the energy obtained from petroleum as stored energy;</i>		Simple combustion experiments to show that energy is evolved from petroleum.
3. <i>discuss problems associated with the use of fossil fuels;</i>	Fossil fuels as a non-renewable resource; environmental effects of acid rain, global warming.	
4. <i>identify alternative sources of energy;</i>	<i>Solar, biogas, wind, wave, biofuels, geothermal, hydroelectric, biodiesel.</i>	
5. discuss the uses of solar energy;	<i>Include water heating, solar cells (photovoltaics cells), solar cookers/cooking; air heating (cold temperature), lighting, solar driers (meat, fish, fruits, crops).</i>	<i>Make simple solar cells, solar panels, solar cookers.</i>
6. discuss variables affecting solar energy transfer;	Conduction, convection and radiation. [<i>Refer to Section B, Unit 1 Specific Objective 1</i>].	
7. appraise the extent to which solar energy can be used as an alternative source of energy.	Loss of energy during conversion; Devices such as solar water heaters, <i>solar cells</i> .	

UNIT III – MACHINES AND MOVEMENT

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

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|--|--|---|
| 1. <i>explain the functions of simple machines;</i> | 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; consider simple machines used in or associated with vehicles, for example, motor cars, push carts, draglines, bicycles; identify simple levers in the mammalian skeleton. | |
| 2. demonstrate the different types of levers; | Organizing load, effort and fulcrum in three different ways. | Actual use or observation of the hammer, bottle opener, crowbar, scissors, nutcracker, wheelbarrow, fishing rod, tweezers as levers; pulleys, wheels, hydraulic press, screw. |
| 3. <i>discuss the principles of mechanical advantage and energy conversion;</i> | 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; <i>perform calculations on mechanical advantage and energy conversion with respect to simple machines.</i> |
| 4. <i>discuss factors that contribute to the inefficiencies of machines and ways of overcoming their influences.</i> | The motorcar, lawnmower, bicycle; factors such as rusting, corrosion and friction. | |

UNIT IV – CONSERVATION OF ENERGY

SPECIFIC OBJECTIVES	EXPLANATORY NOTES	SUGGESTED PRACTICAL ACTIVITIES
Students should be able to:		
1. <i>explain the concept of energy;</i>	Energy as an ability to produce a change.	Activities involving change of state (chemical composition, temperature, and motion).
2. <i>discuss the inter-conversion and conservation of mass energy;</i>	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; discuss photosynthesis; methods used to save energy supply to vehicles and measures that may be taken <i>to decrease the effects of the internal combustion engine on life and the environment</i> ; [Refer to Section C, Unit I].	<i>Consider</i> - telephones; springs; lamps; shock absorbers in vehicles; batteries; electric motor, <i>calculators, computers</i> .
3. <i>discuss the transport and transfer of energy;</i>	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. [Refer to Section A, Unit VI, Specific Objective 5].
4. <i>explain the principles of momentum conservation.</i>	Consider conservation of linear momentum (refer to vehicular collision).	Use the momentum conservation principle to predict the outcomes of collision. Use simple qualitative trolley experiments.

UNIT V – FORCES

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

- 1. discuss the basic principles of forces;*

Action-reaction principle applied in space transport; 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 and centrifugal forces; 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 simple shapes; items such as pencils, rulers and solids with regular shapes should be used to locate the center of gravity.

UNIT V – FORCES (cont'd)

SPECIFIC OBJECTIVES

EXPLANATORY NOTES

SUGGESTED PRACTICAL ACTIVITIES

Students should be able to:

4. *explain stable, unstable and neutral equilibrium;*

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.

5. *explain the term “satellite”.*

The characteristics of space and how problems affecting human life in space might be overcome.

Use of models to show how planets orbit the sun.

◆ 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 only 18 tests of practical skills 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

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 labeled 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 labeled (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, High Commissions;*
2. *Government ministries;*
3. *The media*
4. *The Internet*

Field Work

Substantial portions of this syllabus need to be taught outside the classroom. Many of the expected exercises could be carried out within the school grounds or surrounding areas.

PROCEDURE FOR CONDUCTING PRACTICALS

In preparation for SBA practical, it is recommended that the teacher should undertake the tasks below.

1. (i) *Select the practical work to be done, which should fit in with the normal work being done in the class. The task selected should be related to a given syllabus objective and may be chosen from the "Suggested Practical Activities". An exception can be made for planning and design.*
- (ii) *List the materials including quantities and equipment that will be needed for each student.*
- (iii) *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.*
- (iv) *List the steps that 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.*
- (v) *List the skills that may be assessed [example: observation/recording/reporting, analysis and interpretation]. No more than two practical skills should be assessed from any one activity.*
- (vi) *Select the skills to be assessed on each occasion. Skills other than those required for that term on the CXC mark sheet should also be included for teaching purposes.*

(vii) *Work out the criteria for assessing each skill. This will form the basis of a mark scheme and/or 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 range from 0 to 10 and no more than 4 marks should be assigned to any one criterion.

Marks should be submitted to CXC on a yearly basis on the SBA form provided. The forms should be dispatched through the Local Registrar, to reach CXC by April 30 of the year of examination. The SBA form should be completed in duplicate - the original for submission to CXC and the copy to be retained by the school.

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 realize 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. *Organization and Conciseness*
 - i. *Logical sequence of the report*
 - ii. *Sections named - Aim, Apparatus and Materials, Procedure/Method, Observation, Discussion, Conclusion - all present in correct sequence/correct content under each heading*
 - iii. *Correct terminology and expressions - few or no grammatical errors*
 - iv. *Proper use of tables*

2. *Tables (Numerical)*
 - i. *Physical quantity in heading*
 - ii. *Units stated in heading*
 - iii. *Abbreviations/symbols*
 - iv. *Decimal points*

3. *Tables (Non-Numerical)*
 - i. *Headings correct*
 - ii. *Attention to kinds of data*
 - iii. *Details of data present*

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

5. *Graphs*
 - i. *Axes labelled*
 - ii. *Appropriate scales used*
 - iii. *Accurate plotting*
 - iv. *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*
 - i. *Attention to kinds of data*
 - ii. *Attention to details of data*

Analysis and Interpretation [A/I]

1. *Summary data*
 - i. *Accurately identify trends, patterns, relationships.*
 - ii. *Include labels and annotations of structures.*
 - iii. *Make accurate calculations and draw logical conclusion.*
 - iv. *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.*
 - i. *Make large drawing.*
 - ii. *Have clear accurate line representations.*
 - iii. *State title(s) adequately.*
 - iv. *Be two dimensional.*
 - v. *Appropriate labelling and annotations.*

2. *Accuracy - faithfulness of reproduction, structures are typical of specimen.*

- i. reasonable proportions;*
- ii. magnification stated correctly;*
- iii. view stated correctly.*

3. *Labelling/ Labelling Lines*

- i. Neat, drawn with a ruler.*
- ii. Straight and do not cross.*
- iii. Title listed.*

Planning and Designing [P/D]

1. *Hypothesis*

- i. clear statement of hypothesis on basis of observation(s);*
- ii. testable/manageable.*

2. *Design*

- i. generally workable/suitable;*
- ii. inclusion of apparatus/materials to be used;*
- iii. description of procedures;*
- iv. modification(s) where necessary;*
- v. attention to details can be duplicated;*
- vi. precautions taken, repeated measurements, controls and limitations.*

Manipulation and Measurement [M/M]

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

- i. Handle selected measuring devices - balance, thermometer, measuring cylinder, burette, syringe, watch/clock or any timing device, voltmeter, ammeter, reagent bottles, Bunsen burner.*
- ii. 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. *i. Prepare biological materials for observation or investigation;*
ii. Handle living things with care.

ASSESSMENT OF SKILLS

School Based Assessment will test skills under the profile Practical Skills. Both qualitative and quantitative work should be included. 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. For the purposes of the SBA, no more than two practical skills should be assessed from any one activity.

Each skill must be tested four times over the two-year period except for the Planning and Designing skill which must be assessed twice. Students 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, involves looking at several behaviours, teachers are advised to select not more than two skills to be assessed in any activity. The practical exercises selected for assessment should make adequate demands on the candidates and the skills assessed should be appropriate for the exercises done. For the assessment of written work, the practical selected should be the one that can be completed in the time allotted 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 over the entire two year period may, at the discretion of CXC have their marks pro-rated [adjusted proportionately].

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 Tested for CXC Moderation

SKILLS	Year 1	Year 2	Total No. of Assessments
	No. of Assessments	No. of Assessments	
Observation/Recording/Reporting	2	2	4
Drawing	2	2	4
Manipulation/Measurement	2	2	4
Planning and Designing	-	2	2
Analysis and Interpretation	2	2	4
Total No. of Skills	8	10	18

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 totaled 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:

$$\frac{27}{35} \times 10 = 7.71 \text{ (approximately)}$$

= 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 penalized.
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 minimize 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
	31/11	14/4	Avg. (10)	2/12	23/2	Avg. (10)	15/10	1/5	Avg. (10)	11/3	9/5	Av g.	
NAME S													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. | <i>CXC Biology</i> , Oxford: Macmillan Publishers Limited, 2003. |
| Chapman, S., Luttig, D., Murray, J., Ritchie, E., and Tindale, A. | <i>Chemistry for CSEC</i> , United Kingdom: Nelson Thornes Limited, 2009. |
| Chung-Harris, T. | <i>CXC Integrated Science</i> , Oxford: Macmillan Caribbean, 2005. |
| Farley, A., and Trotz, C. | <i>CXC Physics</i> , Oxford: Macmillan Education, 2007. |
| Gadd, P. | <i>CXC Human and Social Biology</i> , Oxford: Macmillan Education, 2007. |
| Kirby, P., Madhosingh, L., and Morrison, K. | <i>Biology for CSEC</i> , United Kingdom: Nelson Thornes Limited, 2008 |
| Koh, A., Chang Hong, W., and Ming Jun, L. | <i>CSEC Integrated Science</i> , Trinidad and Tobago: Caribbean Educational Publishers, 2008. |
| Neeranjan, D. Avison, J. and Henry, D., | <i>Physics for CSEC</i> , United Kingdom: Nelson Thornes Limited, 2007. |
| Potter, S. and Oliver, R. | <i>Integrated Science for CSEC</i> , England: Pearson Longman Publishing, 2003 |
| Ragoobirsingh, D. | <i>Longman Human and Social Biology for CSEC</i> , England: Pearson Education Limited, 2007. |
| Taylor, M., and Chung-Harris, T. | <i>CXC Chemistry</i> , 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; (UK) consider points both for and against; explain the relative merits of a case.
draw	Make a line representation (In case of drawings from from specimens or apparatus specimens, the magnification that shows an accurate must always be stated. A relationship between the parts. diagram is a simplified representation showing the relationship between components; KC/UK).
estimate	Make an approximate quantitative judgment.
evaluate	Weigh evidence and make (The use of logical supporting judgments based on given reasons for a particular point of criteria. view is more important than the view held; usually both sides of an argument should be considered; UK).
explain	Give reasons based on recall; (KC) account for.
find	Locate a feature or obtain as (UK) from a graph.
formulate	To express in a formula or in a (UK) systematic manner.
identify	Name or point out specific (KC) components or features.
illustrate	Show clearly by using (KC/UK) appropriate examples or diagrams, sketches.
investigate	Use simple systematic (PS) procedures to observe, record data and draw logical conclusions.

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	Itemize without detail. (KC)
measure	Take accurate quantitative readings using appropriate instrument. (PS)
name	Give only the name of. (No additional information is required). (PS)
note	Write down observations. (PS)
observe	Pay attention to details which characterize 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 generalization 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, kilo, centi and milli) will also be used.

SCHOOL BASED ASSESSMENT

Preparing the Candidate

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

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

Assessing ‘Manipulation/Measurement’ and ‘Observation’

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

Sample of Teachers’ Records

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

CARIBBEAN EXAMINATIONS COUNCIL
INTEGRATED SCIENCE
SCHOOL BASED ASSESSMENT RECORD BOOK

NAME OF SCHOOL: _____ ACADEMIC YEAR: _____

CANDIDATE'S NAME	YEAR 1 TERM 2								YEAR 1 TERM 3							
	OBS/REC/REP				DRAWING				MANIP/MEAS				ANAL/INT			
	MK	MK	MK	AV/10	MK	MK	MK	AV/10	MK	MK	MK	AV/10	MK	MK	MK	AV/10

NAME OF PRINCIPAL: _____ SIGNATURE OF PRINCIPAL: _____ DATE: _____

CARIBBEAN EXAMINATIONS COUNCIL
INTEGRATED SCIENCE
SCHOOL BASED ASSESSMENT RECORD BOOK

NAME OF SCHOOL: _____ ACADEMIC YEAR: _____

CANDIDATE'S NAME	YEAR 2 TERM 4								YEAR 2 TERM 5								
	OBS/REC/REP				DRAWING				MANIP/MEAS				ANAL/ INT				P/D
	MK	MK	MK	AV/ 10	MK	MK	MK	AV/ 10	MK	MK	MK	AV/ 10	MK	MK	MK	AV/ 10	AV/ 10

NAME OF PRINCIPAL: _____ SIGNATURE OF PRINCIPAL _____ DATE: _____

CARIBBEAN EXAMINATIONS COUNCIL
INTEGRATED SCIENCE
SCHOOL BASED ASSESSMENT RECORD BOOK

NAME OF SCHOOL: _____

SCHOOL CODE NO.: _____

NAME OF TEACHER: _____

CANDIDATE'S NAME (Alphabetical Order)	YEAR I						YEAR II						REMARKS
	/10 ORR	/10 D.	/10 M/M	/10 A/I.	TOTAL 40	REMARKS	/10 ORR	/10 D.	/10 M/M.	/10 A/I.	/10 P/D	TOTAL 50	

NAME OF PRINCIPAL:-----

SIGNATURE:-----

DATE:-----



◆ 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 of 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
Aluminum foil
Ammonia solution
Benedict's solution
Bicarbonate indicator solution
Cobalt Chloride
Calcium Carbonate, precipitated
Calcium Hydroxide (solid and solution)
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

SUGGESTED CHEMICALS/MATERIALS LIST (cont'd)

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 cm³(graduated)
 Beakers, 400 cm³/500 cm³ (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
 *Dynamo (bicycle)
E - beam
 Ear, model of
 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

SUGGESTED EQUIPMENT LIST (Cont'd)

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
 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)
 Potometers
 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
 Scapels/razor blades/knives/scissors
 Shelves, beehive
 Skeleton, mammalian, complete
 Slides, microscope (plain)
 Slides, prepared

- Leaf, T.S.; human Nerve cells
- Root tip, L.S.; human Blood smear
- Dicot root, T.S.; human vein, T.S. muscular artery

SUGGESTED EQUIPMENT LIST (Cont'd)

Sockets, lamp
Solar system, model of
Solder
Sonometer (commercial or improvised – a guitar can work)
Stands, retort with clamps
Stands, tripod (heights must be suitable for use with Bunsen burners)
Switches
Telephone, earpiece and mouthpiece
Thermometers -10°C - 110°C
Tongs, crucible
Trays, sorting
Trolleys
Test Tubes (assorted sizes)
Tubes, Y-piece connectors
Capillary Tubing
Glass Tubing (assorted lengths)
Rubber Tubing
Vertebrae (different types)
Voltmeter (d.c. dual range 0 - 5v, 0 - 15v)
White metal
Electrical Wire (flex) colour coded, connecting
Wire gauzes with insulated centres
Nichrome Wire (assorted) 1056 ohm m⁻¹ - 156 ohm m⁻¹

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