C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MAY/JUNE 2013

BIOLOGY
GENERAL PROFICIENCY EXAMINATION

GENERAL COMMENTS

The June 2013 examination in Biology at the General Proficiency level was the 44 sitting of this subject conducted by CXC. Biology continues to be offered in both January and June sittings of CSEC examinations. The examination consists of four papers: Paper 01 – Multiple Choice; Paper 02 – Structured/Extended Essay; Paper 03 – School-Based Assessment (SBA) and Paper 032 Alternative to SBA, offered only to private candidates.

This year, the performance of more than 17,000 candidates was assessed. Performance in 2013 was similar to that of 2012 with candidates scoring across the full range of marks in most questions. Topics related to the functions of the eye, variation among species, plant response to stimuli and the endocrine system were problematic for several candidates. It was also observed that candidates' knowledge of ecological investigations was mostly theoretical and several private candidates seemed to lack practical experience in planning and designing experiments and producing accurate, representative biological drawings.

Teachers and private candidates should try as much as possible to cover all aspects of the syllabus, particularly sections C – Continuity and Variation, and D – Disease and its Impact on Humans. Biological jargon should be used where appropriate and the spelling of biological terms needs special attention as candidates sometimes were unable to gain marks because examiners were unclear if they knew what they were talking about.

Candidates should be encouraged to read questions carefully, underline key terms and review answers before submitting papers at the end of the examination.

Candidates and teachers are being encouraged to make use of the online resources available on the CXC's website: http://www.cxc.org such as Biology subject reports for previous CSEC biology examinations, exemplars and online tutorials via Notesmaster. It is also suggested that teachers adopt a constructivist approach to planning and teaching the subject and try to creatively tap into the digital literacy skills of their students by posting lectures on social media pages and including videos where practical activities are being demonstrated (especially if laboratory resources are unavailable). These strategies are likely to deepen students' appreciation for the subject as these resources support their ability to learn by catering to their different learning styles and serve to improve communication with teachers who can provide feedback in a more timely fashion – in ways that textbook resources, classroom-based lectures and lecture notes would not be able to.

DETAILED COMMENTS

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. Performance on this paper was quite similar to that of 2012. The items on this paper which were most challenging for candidates were those that tested knowledge of aspects of plant biology. These included those items which related to plant storage organs, transpiration and excretion in plants.

Paper 02 – Structured/Extended Essays

Paper 02 consisted of six questions arranged into two sections. The first section consisted of three questions written in the structured response format and the second section consisted of three extended essay questions. Candidates' performance on this paper was similar to that 2012 and most of them were able to gain marks across the range for almost all questions.

Question 1

This question assessed candidates' practical skills in constructing suitable tables for recording data and planning and designing experiments to carry out investigations. It also tested candidates' knowledge of the types and causes of variation and aspects of the transport systems of both humans and plants. The mean was approximately 10 out of the 25 marks and the mode was 8.

In Part (a), candidates were given a line graph showing the heights of a sample of men in a population and asked to construct a table using the data presented in the graph. Only a few candidates scored all three marks allotted to this part of the question for writing a title, column headings (Height (cm) in the first column and Frequency/Number of men in the second column) and recording data in the correct columns. Candidates were expected to record height measurements (instead of intervals) read from the graph provided. Candidates should be reminded to include the unit of measurement for example, *cm* beside the name of the variable in the column heading.

In Part (b), candidates were asked to suggest two causes of variation among members of the same species. Most candidates were able to score the two marks allotted for mentioning genetic factors such as crossing over during meiosis, random assortment of genes, mutations and environmental factors (such as lack of nutrients) as causes of variation. Some candidates incorrectly identified artificial and natural selection as causes of variation. These candidates did not understand these concepts. Natural selection is a process by which organisms with favourable characteristics survive and reproduce more successfully than those organisms which do not have these traits. Artificial selection is a process whereby humans select and breed plants and animals that have desirable traits. These species already have variable characteristics caused by the factors mentioned earlier but the selection process does not **cause** them to be different.

Part (c) required that candidates explain the difference in the type of variation shown in the data recorded in the table they constructed in Part (a), that is, heights of the men and variation in blood type among a class of 30 students. This was especially challenging for several candidates who were unfamiliar with the terms *continuous* and *discontinuous* variation. Candidates were expected to recognize that the height of the men varies continuously but blood groups vary discontinuously (exist in distinct categories), as well as explain that variation in height is influenced by the environment while variations in blood groups are not influenced by the environment.

Part (d) tested candidates' knowledge of the blood as the transport medium of humans. In Part (d) (i), most candidates were able to correctly name two substances (such as *oxygen*, *nutrients*, *hormones* and *antibodies*) that are transported by the blood. Candidates who named components of blood such as water, blood cells and haemoglobin were not awarded marks for those responses.

Part (d) (ii) required that candidates explain how a lower than normal amount of haemoglobin in the blood of three students would affect their ability to perform well in sports. Most candidates were able to score at least three of the four marks allotted for stating that *haemoglobin transports oxygen and oxygen is needed for (aerobic) respiration to provide energy for muscles to work*. Candidates who further explained that *exercise/sports increases the need for oxygen so low levels of haemoglobin would limit the ability of the students to perform well in sports or that these students would get tired more easily/feel pain due to lactic acid build up/experience oxygen debt due to low levels of oxygen uptake were able to score all four marks.* Two candidates' responses which scored full marks were:

> *These students will not be able to perform in endurance types of sports as due to lack of haemoglobin, enough oxygen will not be transported in the blood and this oxygen is a necessity for muscles to respire and produce energy aerobically and they will have cramps as the body tries to respire anaerobically with lactic acid as a product and fatigue of muscles will result.*

Haemoglobin is the substance that combines with and transports oxygen to sites of respiration. If the level is low it lowers the rate and efficiency of respiration as there is insufficient amounts of oxygen to provide the muscles during sports. Therefore the student will slow down quicker hence short of breath and have greater risks of muscle cramps due to lactic acid build up from anaerobic respiration.

Responses that made reference to sickle cell anaemia, blood clotting and haemophilia were awarded no marks.

Part (e) tested candidates' planning and designing practical skills and was the most challenging part of the question. Several candidates scored less than half of the six marks allotted to this question. In Part (e) (i), candidates were required to draw and annotate a diagram to show how a list of materials given could be set up to investigate the rate at which water moves through xylem vessels under two different conditions. Most candidates were able to gain two of the four marks allotted to this part of the question for drawing two beakers with water poured to the same height and one plant with a transparent stem in each. Candidates were also able to gain marks if they indicated that the water in each beaker contained a dye and drew a fan directed at only one of the beakers. Marks were also gained by those whose drawings and annotations indicated that the ruler was used to measure the height of the coloured liquid in the transparent stem at regular time intervals.

In Part (e) (ii), candidates were asked to write a suitable hypothesis for this investigation. Several candidates were not awarded marks in this section of the question. The most common error made by candidates was writing expected results instead of a hypothesis. The poor performance on this question is an indication of the lack of experience candidates have in doing planning and designing practical activities such as writing a hypothesis as has been observed in the moderation of School-Based Assessments over many years. A hypothesis is an explanation based on a particular observation about how things work or why something happens. Expected candidate responses which would have gained full marks were:

Transpiration is faster in moving air.
Wind increases the rate at which water moves up xylem vessels.

Part (f) asked candidates to relate the structure of xylem vessels to their role in the transport of water through plant stems. Candidates' were usually able to score at least two of the four marks for naming two features of xylem such as *hollow, 'thin' narrow tubes, cells joined end to end with no end walls or having lignin in the walls*. They were only able to gain full marks if they also stated how each feature named was related to the transport of water via xylem. A candidate's response that scored full marks was:

Xylem is narrow so water can move up by capillary action quickly and the walls are made of lignin which prevents the xylem from bursting from the water pressure inside.

A common misconception stated was that xylem is thin (instead of narrow) and this allows for fast diffusion and osmosis.

<u>Question 2</u>

This question tested candidates' knowledge of the structure and functions of parts of the human eye, movement and response by both plants and soil invertebrates as well as their ability to distinguish between the nervous and endocrine systems in humans. The mean and mode were 6 out of 15 marks.

Candidates were given a diagram of the human eye in Part (a) and asked to name and use a label line to indicate the part of the eye which carries out the functions stated in Parts (a) (i) to (iv). Most candidates were able to score at least two of the four marks for correctly naming and labelling the retina as the light sensitive layer and the optic nerve as carrying nerve impulses to the brain. The vitreous humor — which is the jelly-like substance that keeps the eye in shape — and the ciliary muscles which control the shape of the lens were less well known. Many candidates spelt the labels incorrectly and could not be awarded marks. A common misconception was that the jelly-like substance that 'keeps the eye in shape' is the sclera.

Candidates who did not name the parts of the eye, as required, were not able to gain all four marks allotted even if the label lines were drawn correctly.

In Part (b), candidates were given two examples of plant movement shown by seedlings during growth. For Part (b) (i), they were asked to name the stimulus to which each set of seedlings was responding. This section was well done by most candidates. They were able to correctly identify *that the roots of seedlings growing downwards in the soil was in response to gravity or water while the shoots of the cucumber seedlings growing towards light coming through an open window was in response to light*. They were also able to state that auxins were the hormones responsible for the response of the cucumber seedlings in response to Part (b) (ii) but the spelling of *auxin* was sometimes incorrect. Most candidates also scored full marks for Part (b) (iii) for stating that the roots growing downwards was useful for anchorage in soil or to obtain water while plant shoots growing towards light allowed them to get optimum light for photosynthesis.

Part (c) required that candidates describe one similarity and one difference between the response of soil invertebrates to moisture and the response of the cucumber seedlings to light. It was observed that although many candidates were able to get two of the four marks allocated for stating that both cases were similar because their response or movement was directed towards a stimulus, few candidates were able to distinguish the type of movement shown by the invertebrates as *being whole movement* in contrast to the plant response as *part or growth movement*.

Part (d) asked candidates to outline two ways in which the nervous and endocrine systems function differently in humans. Most candidates scored full marks for giving correct responses to this section of the question. Correct responses frequently mentioned were that *the messages were in the form of electrical impulses/neurotransmitters in the nervous system but hormones carried messages in the endocrine system; impulses travelled via neurons in the nervous system but hormones travel via blood; messages sent via the nervous system were sent quickly but slowly in the case of the endocrine system; the effect of messages sent via the nervous system were usually short lasting but long lasting in the case of the endocrine system*.

<u>Question 3</u>

This question examined candidates' knowledge of plants' excretory products, the structure and function of the human male reproductive system, contraception methods and the difference between asexual and sexual reproduction. The mean was 8 out of a possible 15 marks and the mode was 9.

In Part (a), candidates were required to name two metabolic waste products excreted by plants. Most candidates correctly named oxygen produced from photosynthesis, carbon dioxide produced from respiration, calcium oxalate or tannins, to score full marks. A common misconception was that leaves and blossoms are metabolic waste products.

Candidates were given a diagram of the human male reproductive system in Part (b) and asked to name the parts labelled A to C in the diagram in Part (b) (i). Several candidates were awarded full marks for naming the prostate gland (A), the testis (B) and the vas deferens/sperm duct (C). It was observed that many of them did not spell the names correctly. Some candidates lost marks for incorrectly identifying the part labelled B as the scrotum. Most candidates were also able to gain full marks for correctly using arrows to show the pathway taken by urine on its way out of the male's body. Those who did not include an arrow to show the pathway from the ureter (connected to the kidney) to the bladder were only able to gain one of the two marks allotted to this question.

In Part (c) (i), candidates were asked to explain how one of the structures shown in the diagram of the human male reproductive system could be manipulated to achieve permanent sterility in males. This was well done as most candidates explained that doing a vasectomy would involve cutting the sperm duct and would prevent sperm made in the testes getting into semen so eggs could not be fertilized during sexual intercourse. A good candidate response was:

> *To achieve permanent sterility a vasectomy can be carried out in which the vas deferens can be cut preventing sperm from exiting through the urethra.*

Part (c) (ii) required that candidates explain how tubal ligation results in sterility in females. Most candidates were able to state that this involved tying off/cutting the oviducts but only a few candidates correctly explained that this would prevent mature eggs being fertilized in the oviducts leading to female sterility. Several candidates had the misconception that ovulation would not occur. A good candidate response was:

> *In tubal ligation the oviduct is cut and tied. Ovulation still occurs but sperm and egg cannot meet so fertilization cannot occur.*

Candidates were asked to explain two ways in which the method of reproduction by which new potato shoots are produced from the buds/eyes of a potato tuber was different from reproduction in humans in Part (d). Most candidates were awarded full marks for correctly stating at least two ways in which asexual reproduction in potatoes differs from sexual reproduction in humans. A candidate response that was awarded full marks was:

> *This method of reproduction is asexual, only one parent is needed to reproduce whereas in human needs male and female for sexual reproduction. The offspring of this type of reproduction in those plants are genetically identical to parent (no variation) whereas human offspring genetically vary.*

<u>Question 4</u>

This question tested candidates' knowledge of pathogenic diseases, insect vectors and immunity. The mean was 6 as was the mode.

In Part (a), candidates were asked to name two ways by which the human body prevents itself from becoming infected. Few candidates were awarded the full two marks for their responses. The expected responses included *the skin, blood clots, tears to protect the eyes, cilia and mucus in the respiratory passageways* and *hydrochloric acid in the stomach*. A good candidate response was:

> *The skin prevents the body from disease by acting as a wall of protection from viruses and bacteria. Also the hairs and mucus in the nose trap bacteria from entering the body.*

In Part (b) (i), candidates were required to describe the life cycle of a named insect vector then explain how knowledge of the life cycle of the named vector could be used to prevent transmission of a named pathogenic disease in response to Part (b) (ii). Most candidates were able to gain at least three of the six marks allotted for naming the insect vector and describing at least two stages of the insect's life cycle accurately and in the correct sequence. The words *pupa* and *mosquito* were frequently misspelled. Some candidates lost marks because they did not put the stages in correct sequence or name a suitable pathogenic disease in Part (b) (ii). Two good candidates' responses awarded full marks for Parts (b) (i) and (ii) were:

> *The life cycle of a mosquito consists of the egg, larva, pupa and adult. Knowing the life cycle of a mosquito can help prevent the spread of malaria because each stage of the life cycle needs certain conditions to survive. One example is that eggs are laid in water catchments. Eliminating water catchments can decrease the number of eggs laid in the area, therefore decreasing the mosquito population.*

Candidates who wrote on vectors of disease such as rats, snakes were not awarded marks.

In Part (c), candidates were told that a student was about to travel to a country where yellow fever is rampant and asked to explain how a vaccine could provide the student with active acquired immunity against the disease. Several candidates gained only two of the four marks allotted to this part of the question for stating that antibodies are produced to destroy the pathogen which causes yellow fever and if the student is affected again, antibodies would be produced more quickly to prevent the person getting the disease again. Only a few candidates gave a full explanation about what the vaccine contains and how it works. A good candidate response was:

> *When the student is vaccinated, a weakened version of the yellow fever virus is injected into their system. The body reacts to the disease, its white blood cells and begin producing antibodies against the virus. The antibodies kill the virus and the body reproduces the antibodies and stores them. Anytime the virus shows up again, the body will have the antibodies for the virus and will be able to kill the virus quickly, making the student immune.*

Candidates who stated that the 'body' rather than *lymphocytes* produced antibodies did not get marks. Part (c) (ii) asked candidates to discuss why a vaccine that provides passive acquired immunity would not be suitable for the student. Only a few candidates understood the term passive acquired immunity and recognized that the student would be given antibodies. A good candidate response was:

> *A vaccine that provides passive acquired immunity is not suitable since this vaccine contains readymade antibodies that are injected to help the body fight disease and some of these antibodies are destroyed when they kill the virus. The major drawback of this is that memory lymphocytes were not created for that virus since the person was injected with antibodies and the person does not actively acquire immunity if infected again so it would take it weeks for memory lymphocytes to be created to fight and destroy the virus.*

<u>Question 5</u>

This question examined candidates understanding of selected ecological terms as well as the carbon cycle. It also tested candidates' ability to apply their knowledge about mangrove ecosystems to justify constructing houses on mangrove land. The mean and mode were 8 out of 15 marks.

Part (a) asked candidates to define three ecological terms: *population*, *physical (*abiotic) factors and *habitat*, making reference to the mangrove ecosystem. Several candidates were able to gain two of the six marks allotted to this section for giving the correct definition of the term *population* as *the members of the same species living within a particular area and habitat as the place where an organism lives*. They were also expected to cite an example from the mangrove ecosystem to be awarded the full two marks for each definition and relevant example given. An example of a candidate's response that was awarded full marks was:

> *A population is a group of organisms all of the same species, living in the same habitat with the ability to interbreed and produce fertile offspring. E.g. a population of tree snakes living in the mangrove.*
>
> *Abiotic factors are all physical non-living factors that influence the activities of many organisms e.g. light intensity and salinity of water. Abiotic factors in the mangrove swamp would be water-logged brackish soil and the temperature.*
>
> *A habitat is the natural home of an organism where it lives and reproduces. The habitat in the mangrove ecosystem would be the mangrove vegetation (or trees) and the swamp area.*

Several candidates lost marks because they did not know the difference between the terms *population* and *community*.

In Part (b), candidates were asked to propose one argument to support and two arguments against supporting the plans of some investors who want to remove the mangrove swamp and develop the land for housing. Most candidates gave reasonable arguments for and against the proposal. An example of a good candidate response was:

> *One argument to support this plan is that the development of these houses would provide a place for people to live who don't already own a house. The development project would provide houses for people in a country where space is limited. Two arguments against the housing development project are 1) The construction of houses would destroy the mangrove*

> *plants which are essential in the holding of the soil together in the area where they are located and 2) the housing development programme would displace numerous populations of organisms living in the swamps and they would now have to find a new habitat to live in and most of the organisms may be killed during construction of the houses.*

Part (c) asked candidates to explain the effect on the carbon cycle of cutting and burning large areas of mangrove trees across the Caribbean. Most candidates were able to give good responses that were awarded at least two of the three marks allotted to this part of the question. Candidates' responses that were awarded marks explained that *cutting and burning large areas of mangrove trees would lead to increased amounts of carbon dioxide in the air since these trees would have used the carbon dioxide in the process of photosynthesis to make their food*. A candidate's response that was awarded full marks was:

> *Cutting down of the mangrove vegetation (trees) would increase the level of carbon dioxide gas in the atmosphere since there would not be any of these trees to take in carbon dioxide for photosynthesis. Burning large areas of mangrove trees also causes a build up of carbon dioxide gas in the atmosphere since burning (combustion) releases carbon dioxide. When trees are cut down, they are decomposed by bacteria and fungi that take the complex carbohydrates, lipids and proteins and incorporate them in their bodies and when they respire they would release carbon back into the atmosphere as well.*

A common misconception among several candidates was that global warming was caused by depletion of the ozone layer.

<u>Question 6</u>

This question examined candidates' knowledge of the endocrine functions of the pancreas and pituitary gland, properties of enzymes and the homoeostatic function of insulin, glucagon and the anti-diuretic hormone (ADH). The mean was 6 and the mode 2.

Candidates were required to sketch an outline of the human body and show the location of the pancreas and pituitary gland on the sketch in Part (a) (i). Most candidates were able to gain at least one mark for showing the correct position of the pancreas but many did not know where the pituitary gland was. Those candidates who were able to answer Part (a) (i) correctly were usually able to name hormones secreted from each of the glands in responding to Part (a) (ii) and give two factors, such as *pH* and *temperature*, that could affect enzyme activity in Part (a) (iii).

In Part (b), candidates were asked to explain how pancreatic hormones worked together with the liver to regulate blood sugar levels. This was usually well done by candidates. A good response awarded full marks was:

> *When the blood sugar level in the body is too low or too high, the body is made aware of this by a feedback mechanism which restores the blood sugar level back to its normal levels. When the blood sugar level is too high, the pancreas secretes the hormone insulin into the blood stream and this causes the cells of the liver to convert excess glucose into glycogen to be stored by the liver. When the blood sugar level is too low, the pancreas the hormone glucagon, which will cause the glycogen stored in the liver to be broken down into glucose and restored to the blood stream to be used by the body.*

In Part (c), candidates were asked to describe how a pituitary gland hormone would work to prevent complete dehydration if they were lost on a desert island for two days. Many candidates seemed not to be familiar with the role of the antidiuretic hormone (ADH) in osmoregulation. A good candidate response was:

> *When the body is dehydrates or lacks sufficient water for body processes, the hypothalamus in the brain detects this and it stimulates the pituitary gland to secrete the hormone ADH or the antidiuretic hormone. More of this hormone will be secreted so that more water is reabsorbed*

from the urine being formed in the kidney by acting on the kidney tubule. So when more water is absorbed from the urine, the water is returned to the body for necessary processes and less water will be excreted from the body as urine and the urine will be less in quantity and not as dilute.

Paper 032 – Alternative to School Based Assessment (SBA)

This paper consisted of three questions designed to examine the experimental skills of private candidates. Candidates' ability to conduct ecological investigations, plan and design an experiment or investigation to determine the dry mass of seedlings, analyse and interpret data, as well as make drawings of specimens were assessed. Performance on this paper was similar to that of 2012. Although this paper is done by private candidates, preparation must include exposure to practical investigations.

Question 1

This question tested candidates' practical skills in relation to carrying out ecological investigations, analysing and interpreting data and classifying living organisms based on visible features. Candidates did not perform well on this question as the mean was 10 out of 27 marks and the mode was 9.

In Part (a), candidates were asked to describe how a line transect could be used to investigate the changing distribution of organisms two miles inland from a river bank on either side of a river. Candidates were awarded marks for stating that they would *peg a rope/string/tape measure at a point on the river bank and extend it in a straight line 2 miles inland at right angles to the river; then observe/record all the species of organisms seen at regular intervals.* A candidate's response that was awarded full marks was:

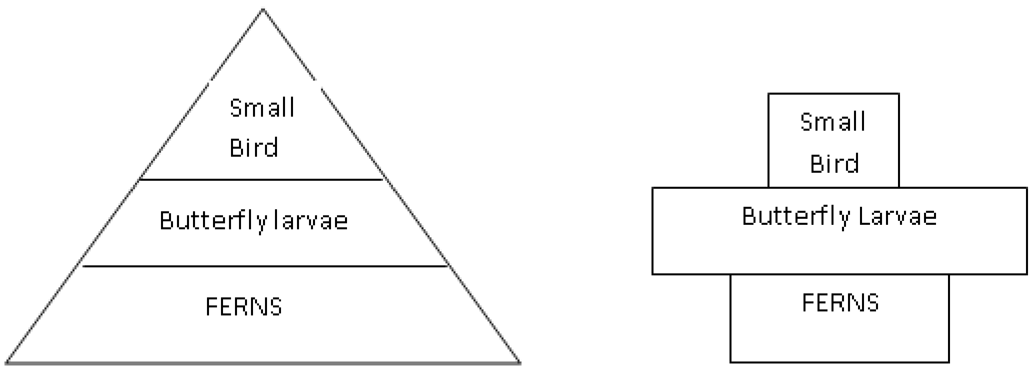
> *One pole is placed on the river bank and another is placed 2 miles inland from the river. A long string is then tied to the poles and a measurement and count of the various organisms at different distances between the poles are collected and recorded.*

Candidates were given a table with results obtained from quadrat throws from an investigation of the distribution of three different plant species found within 100 m on either side of the river bank in Part (b). They were then asked to show how they would calculate the species density of each of the three plant species in Part (b) (i). Candidates who did not show how they arrived at their results were not awarded full marks if they had the correct result. Only candidates who showed their calculations as instructed were able to gain full marks. Several candidates only found the sum of all the organisms in each quadrat throw and were not awarded any marks. They were awarded marks for dividing the total number of each plant species by 10 and getting the correct result for the species density (number of plant species per m^2).

In Part (b) (ii), candidates were asked to suggest two reasons why the number of ferns counted on the third quadrat throw was so low. Candidates were usually able to give good suggestions and were awarded marks if they mentioned that the quadrat was thrown randomly into an area were ferns were not suitably adapted to survive or the ferns in that particular area were removed by humans or eaten by herbivores. They were then asked to predict which of the plant species would be furthest from the river bank in Part (b) (iii). Candidates were expected to use their knowledge of xerophytes such as the cactus species to predict that these plants would be found furthest away since they are adapted to survive in dry areas. Candidates who analysed the data and predicted that the flowering shrubs were furthest away because they had the lowest species density also were able to gain full marks.

In Part (c), candidates were given six drawings of organisms found in the area of the forest and asked to name one visible feature other than wings to classify the organisms into two groups in Part (c) (i) and then describe how they would investigate the distribution of the flying organisms in Part (c) (ii) and state one precaution that should be taken when using the procedure described in Part (c) (iii). Several candidates were able to gain at least one of the five marks allotted to Part (c) (i) for naming a visible feature such as antennae, number of legs or segmented bodies. Only a few candidates were able to name the two groups for classifying the organism appropriately. Expected groupings were: *antennae present* vs *antennae absent*; *3* *pairs of legs* vs *4 pairs of legs*; *2 segments* vs *3 segments*. Very few candidates were awarded marks for their procedure in Part (c) (ii). Candidates were expected to describe that they would use a *sweep net/jars to capture the animals that fly, then count the number of the organism caught and record the numbers*. Some candidates described the *capture-recapture* method and were awarded full marks. Only a few candidates were able to state suitable precautions such as *mark or tag the animals so they are not counted more than once or hold the wings/body with care so as not to kill them*.

Part (d) was the easiest part of the question as most candidates were able to score at least two of the three marks for putting the ferns at the base of the pyramid, or in some cases the beginning of a food chain, and the small bird at the top. Only candidates who illustrated the feeding relationships by drawing a pyramid similar to any of those shown below were able to gain full marks.



Most candidates were able to gain full marks for Part (e) which required that candidates give a reason why biologists should or should not encourage developers to build houses in that particular area. Candidates were expected to indicate whether they were in support of building the houses or not then give their reason. Reasons for supporting the building of houses that were awarded marks included *population is increasing and people need adequate housing or that the area did not seem to be densely populated with a wide variety of species*. While arguments proposed for not supporting housing construction were *reduce biodiversity by destroying the plant and animal species; destruction of trees which are a habitat for some organism and encourage rainfall*; *destruction of the ecosystem by disrupting important feeding relationships* and *development close to the river would encourage pollution*.

<u>Question 2</u>

This question assessed candidates ability to plan and design investigations, calculate averages, analyse and interpret data as well as their knowledge of the growth and development of dicotyledon seedlings. The question was poorly done as indicated by a mean of 9 out of 23 marks and a mode of 3.

In Part (a), candidates were asked to suggest why the seeds taken from the same dicotyledonous plant did not have exactly the same weight. Very few candidates were able to explain that this was due to variations in the water and nutrient content of the seeds, genetic variations among the seeds that occurred during meiosis or even human error during the weighing of the seeds. The most common answer was difference in size. The term *dicotyledonous plant* was interpreted to mean ‘plant species’ by some students.

Part (b) (i) required that candidates describe how they would investigate the dry mass of a batch of the seedlings by listing the apparatus they would use and the procedure. This was also well done by very few candidates. The list of apparatus should include a scale and an oven or similar apparatus for drying the seedlings. The procedure should include the drying of the seedlings in the oven for a set time then weighing the dried seedlings at regular intervals until a constant mass is obtained. In Part (b) (ii), candidates were asked to suggest a suitable aim relating to treating one batch of the seedlings with varying amounts of organic fertilizer. An example of a well stated aim was:

To investigate the effect of organic fertilizer on the growth rate of a batch of seedlings

Part (b) (ii) required that candidates identify which batch of seedlings would be considered the control in this investigation and those who stated that batch A would be the control because they have been exposed to all the conditions except fertilizer gained marks.

Part (c) required that candidates show how they would calculate the average dry mass of three seedlings taken from each of the batches and record their results in a table provided. Several candidates only found the sum of the masses and were not awarded any marks as they could only earn marks if they divided the sum by 3 and recorded the correct answer. In Part (c) (ii), candidates were required to plot a graph of the data in table 3. Several candidates were only able to score three of the five marks allotted because the axes were not correctly labelled, the scale used was inappropriate and some points were not plotted correctly. Candidates who included a key, labelled both axes correctly, used an appropriate scale and plotted all the points correctly were able to gain the full five marks. Candidates who gained at least three marks in Part (c) (ii) were usually able to gain the two marks for Part (c) (iii) which required that candidates determine the average dry mass of the seedlings on Day 8 using the graph they plotted. Candidates were expected to identify Day 8 on the x-axis and find the corresponding dry mass at the point where each line crossed day 8. Batch A was 4.6 $\pm$ 0.2 mg and Batch B was 5.8 $\pm$ 0.2mg. Part (c) (iv) was not well done as many candidates described the shape of the graph instead of explaining the difference in the shape of the graphs. The difference in shape is due to the fact that organic fertilizer supplies nutrients to the seedlings in B so they grow faster.

<u>Question 3</u>

This question tested candidates' drawing and measurement skills as well as their knowledge of the respiratory surface of bony fish. The question was very poorly done with a mean and mode of 2 out of 10 marks.

In Part (a) (i), candidates were given a drawing of the head of a bony fish with its gills exposed and asked to make a labelled drawing of the gills in the space provided. Two marks were allocated for clarity, representation and labels. An average of two marks was gained for this section as most candidates were able to correctly identify the gill from the diagram and attempted to draw without shading. This was very poorly done by most candidates who had difficulty drawing an accurate, proportionate drawing with clean continuous lines and many were not familiar with the names of the gill structures. Part (a) (ii) was also poorly done as many candidates appeared to have little or no knowledge about how to calculate the magnification of the drawing. Candidates were expected to measure the longest section of the drawing and specimen and divide the size of the drawing by the size of the specimen to get the correct magnification.

In Part (b), a few candidates gained one of the two marks for identifying *thin gill filaments* but the large surface area was rarely mentioned.

Paper 03 – School-Based Assessment (SBA)

Performance on the school-based assessment was commendable at some centres. Favourable trends that continue to be observed include: *good syllabus coverage (that is, a minimum of nine syllabus topics covered) by most of the centres that were moderated; an increase in the number of centres where both quantitative and qualitative fieldwork were done; general compliance with syllabus guidelines regarding the number of times practical skills were assessed*. This suggests that most teachers recognize the value of providing sufficient opportunity for students to develop and master all the specific practical skills. However, while the skill of Observation, Recording, Reporting (ORR) was generally well done, Drawing (Dr), Analysis and Interpretation (AI), and Planning and Designing (PD) continue to present candidates with the most difficulty.

While the level of organization and presentation of books submitted from most centres was good, there were still some centres that submitted books without the requisite information. The CSEC Biology syllabus (page 44) provides guidelines for candidates' preparation of practical books for submission. Some important requirements often not met include: a Table of Contents which provides a list of the aims of practical activities, page numbers, dates, as well as *clear* and *specific* indications of the activities used for the SBA together with the skills being assessed for each activity. In addition, the marks awarded for each practical activity must be placed alongside the practical and not simply listed at the front or back of the books.

The lack of comments in the lab books, especially for skills performed poorly, suggests that students are not being given adequate feedback on their progress throughout the period of study. Frequently, only ticks are observed, along with the final score awarded for the skills but students appear unaware of their strengths or deficiencies.

The moderation exercise was often hampered by poor mark schemes. Teachers are being reminded that mark schemes must be legible and preferably bound together instead of on loose sheets of paper. There must be a *clear* and *direct* relationship between the marks awarded to the appropriate activities in the practical books and the marks on the tally sheets. It should also be noted that no more than two skills should be assessed in a single practical activity. New teachers in particular should consult pages 38–44 of the Biology syllabus for guidance in preparing and presenting mark schemes.

The following is a list of criteria which teachers should follow in marking SBA activities.

- Marks should be awarded for each skill separately. It is noted that in some cases, marks were given for the each skill then tallied to give a composite score. This is unacceptable.

- Marks awarded to students should be a fair indication of the quality of their work. Too many students received high marks for work that fell short of the CXC standard. This was particularly noticeable for Planning and Designing, Analysis and Interpretation, and Drawing. When the CXC standard is not observed there is great disparity between the teacher's score and that of the moderator. This circumstance is usually *disadvantageous* to students.

- Marks submitted on the moderation sheet should reflect students' marks in each of the samples. Consistency of marking and submission of marks relate to the reliability of the process and thus acceptability of marks submitted.

- Teachers are once again reminded that body fluids such as saliva, blood and urine are not to be used for practical work. These can be sources of infection and may have serious legal implications should a student become infected while conducting practical work. Plant materials must be removed from books before they are submitted to CXC, since these are also potential agents of infection when moved from place to place.

The examining committee would also like to recommend that there be greater cooperation among teachers of similar subjects at the same centre and mentoring of new teachers, to ensure that standards are consistently maintained.

A review of previous schools reports will provide additional suggestions for developing practical skills. Further suggestions are reiterated in this report and each teacher is alerted to the specific strengths and weaknesses displayed by their students in the Moderation Feedback Report sent to schools after moderation. The Moderation Feedback Report, which is sent to each centre, provides constructive and useful information relevant to the particular teacher(s). This report offers specific recommendations and is intended to assist teachers in the planning, conducting and assessing of practical work — in the laboratory and field. Improvement of students' practical skills will have a direct influence on the overall performance of candidates in the Biology examination, since certain questions, notably Question 1 on Paper 02, and where applicable questions on Paper 032, are based on knowledge and application of these practical skills.

Specific Comments on the Assessment of Skills

The following information is to assist teachers, especially new ones in interpreting the information given on the CXC Moderation Feedback Report. *It should first be noted, however, that the number of times a skill is assessed is considered sufficient if assessed a minimum of four times, except for the Planning and Designing skill which is assessed twice.*

Observation, Recording, Reporting (ORR)

This skill appears to be the one best mastered at most centres. Generally candidates presented reports in which the method was clearly described with a logical sequence of activities. Usually past tense was correctly used as required. Careful attention should be given to grammar, quality of expression and detailed description since science students need to appreciate the importance of clarity in explaining their results. During the conduct of the lab exercises, whenever possible, students should also be encouraged to repeat procedures to improve the reliability of their results.

The tables and graphs were usually clear and provided adequate details which allowed for a clear description and discussion of the experiment. The examining committee recommends that teachers provide more activities where students construct their own tables and graphs using their results. This will allow them the opportunity to develop these skills.

Guidelines for Drawing Tables and Graphs

Tables

The title should be written in *capital letters*, and appropriate column headings used. (See example below.)

TABLE 1: BREATHING RATE AFTER EXERCISE

Time (mins)	Number of Breaths
1	15
3	12
5	9

Graphs

The title should be *written below the graph* and *underlined*; *axes should be labelled* with *units* stated and a *key* should be given if necessary.

If calculations are required, all necessary calculations should be presented neatly and in an organized fashion. Units should also be included where necessary.

When drawings are used in reporting observations, they should meet standard SBA drawing criteria.

Drawing (Dr)

Most teachers selected drawing exercises from those indicated in the syllabus. These included bones, flowers, seeds, fruits and storage organs.

While a range of drawing exercises can be given to students, there are some that should not be selected. Since most schools in the region only provide light microscopes, it is not a good practice to assign students microscope drawings of cells and then give full marks to a reproduction of an electron microscope diagram showing structures which would be impossible to see with a light microscope. Marking drawings of dissections is also problematic since structures in a dissected specimen are usually difficult to discern and students resort to textbook drawings for presentation in their lab books.

Many of the mark schemes used by teachers did not reflect the CSEC standard for drawing and this resulted in a large discrepancy between the marks awarded for drawings by teachers and moderators.

An example of an appropriate mark scheme submitted by one centre is given below.

Activity: To examine different storage organs and make annotated drawings

Criteria for Assessment of Drawing

Clarity – clear continuous of even thickness – 1

Drawings large in size – 1

Accuracy – faithful representation of specimen/correct proportions – 2

Label lines drawn with ruler and pencil touching structure, no arrowheads, not crossing, writing in script – 2

Title must be written below each drawing and underlined with appropriate storage organ mentioned – 1

At least of the drawings annotated – 2

Presence of magnification – 1

Total = 10 marks

Table 1 is a list of Do's and 'Don'ts' applicable to SBA biological drawings at the CSEC level.

TABLE 1: DO'S AND DON'TS OF BIOLOGICAL DRAWINGS

Do's	Don't s
• Use pencils for all drawing activities – drawing, label lines, labels. • Use drawings of actual biological specimen (not diagrams, models or textbook drawings); ensure that there are drawings of flowers, fruits, seeds and bones for assessment. • Ensure that the size of drawings are at least half page. • As far as possible, have label lines and labels positioned to the right of drawings. • Ensure that all label lines end at the same vertical plane. • Ensure that label lines are drawn parallel to the top/ bottom of the page. • Ensure label lines end on part being made. • In the title, use the word '*drawing*' and not '*diagram*'. • Position title under the drawing and indicate the actual name of the specimen (for example, cervical vertebrae of a goat, mango leaf, hibiscus flower) *and* the view drawn. • Underline the title. • Include the magnification and state where appropriate, actual length and width of specimen as well as place 'x' in front of the magnification. • Write magnification to one decimal place. • Use a key to explain symbols where appropriate, for example, stippling/cross hatching.	• No arrow heads • No crossing of label lines • No dots or dashes • No joining of letters or words for labels or titles.

The examining committee also encourages teachers to ensure that standard drawing criteria are applied whenever drawings are required in lab activities, especially when reporting observations and/or illustrating biological processes, for example, germination, regardless of whether DR skills are to be assessed. This should help students appreciate the importance of the skill.

Teachers should also ensure that students draw on plain paper and then neatly insert drawings into lab books, if the books are not designed with plain sheets of paper for drawing. Distinguishing features and label lines are oftentimes unclear when drawings are done on ruled sheets of paper.

Analysis and Interpretation (AI)

This skill is still problematic for the majority of candidates. Many students simply recorded the relevant theory/background information but made no attempt to use this information to provide an explanation for their results. Most neglected to state a logical conclusion or suggest limitations which may have affected their experiments/investigations.

While questions given by the teacher may be used to stimulate discussion, the students' reports should not consist only of answers to these questions. Such questions must guide students to provide the required background information, give explanations for the results, draw conclusions and show an awareness of possible limitations. The information provided in this way should then be written up as a paragraph of continuous prose as is normally done for the discussion/conclusion. In many cases, candidates seem to have learnt a formula for writing up the discussion but showed no real understanding of how to interpret their own results. As a learning strategy, teachers may ask students to orally explain the results to obtain a clearer view of their understanding and to help them develop their analytical skills.

The marking criteria used by some teachers did not include *limitations*. It was sometimes observed that precautions/control/sources of error were often accepted as limitations by the teacher.

The use of controls should also be emphasized in discussions as they are a point of comparison for the experimental set-up in which a particular variable has been omitted. This comparison should be included in the discussion as it is the key to drawing the conclusion. Conclusions should relate directly to the aim of the investigation. Students should also be reminded to discuss at least one limitation of the investigation. It is important for them to recognize that the conditions present in a school laboratory are rarely ideal.

The processes involved in demonstrating the AI skill are reiterated here.

- Background information may be written in the *discussion,* or *introduction* section.
- Background information for the experiment must relate to the theory.
- The discussion should be an analysis or interpretation of the recorded experimental results. It must not simply answer posed questions for AI:
  - Questions may be used to guide students but answers must be written in paragraph format (without the questions, or written comprehension style).
  - Questions should not to be included in the lab report.
- The conclusion must be based on the aim. (It is a brief answer to the aim.)
- Limitation(s) should be included among the AI marking criteria as very important to lab(s).
- Identifying source(s) of error and precaution(s) are necessary as is knowing that these are both different from each other and from limitation(s).
- All components of AI (background knowledge, explanation of results, limitations and conclusion) should be included in the mark scheme for the skill.

The examining committee is again reminding teachers that food tests *on their own* are not appropriate for assessing AI. Simple investigations can be designed in which food tests are used. For example, students can be given unknown mixtures and asked to find out which food would be most suitable for an infant. Food tests can also be used to determine the presence of a particular food before and after digestion by an enzyme. These types of exercises will allow students to develop the necessary skills. Knowledge of the food tests and the nutritional requirements can then provide the background information on which they will base their conclusions.

Most of the mark schemes submitted this year for marking the AI skill did not meet the CSEC standard. This resulted in large discrepancies between the teachers' and moderators' marks.

An example of an appropriate mark scheme submitted by one centre is given below.

Aim: To investigate transport in plants using celery stalks.

Skill marked AI:

Background information – 3

Explanation/interpretations of results – 4

Conclusions based on observations/data related to aim – 2

Limitations – 1

Total = 10 marks

Manipulation and Measurement (MM)

Most of the exercises scanned for this skill were appropriately selected from those activities which asked the students to use simple laboratory equipment. However, not all samples seen were accompanied by relevant mark schemes. Teachers should indicate which criteria were met in students' lab books and also provide written feedback.

As has been the trend in previous years, this skill continues to be the one that most candidates appear to have achieved mastery of, based on the observation that most are awarded full marks. However, evidence such as the generally poor performance on the practical aspects of Question 1 on Paper 02 of the final examination, suggests that the SBA marks for the MM skill may not be the result of rigorous marking. Also, if virtually all students in a class gain full marks on an activity, this suggests that the task may not be demanding enough or the criteria not detailed enough to allow the necessary discrimination between different levels of performance.

The examining committee recommends that teachers expose students to as wide a range of apparatus and their use in collecting data as is possible. This would aid in the development of students' manipulation skills and allow for a more fair assessment of their competence in MM.

Planning and Design (PD)

Performance on this skill has shown some improvement relative to former years, and teachers should be commended for demonstrating more creativity in the types of observations/problem statements provided to students on which to base their hypotheses and design their experiments. The examining committee continues to emphasize the importance of using examples from students' local environment as this will help them better appreciate how they can apply their biological knowledge and practical skills to solve problems they frequently encounter. Teachers are reminded that it is *inappropriate* to have students copy procedures from textbooks and reproduce them verbatim for assessment of PD skills.

An example of a good planning and design activity submitted by one centre is given below.

Assignment

It was observed that when cows were given a certain brand of feed, they produced a larger quantity of milk than those that feed on other brands. Plan and design an experiment to investigate the above observations.

Suggested Teacher's Mark Scheme

Hypothesis acceptable and based on observations – 2

Aim relevant to hypothesis – 1

Materials and apparatus appropriate – 1

Method feasible/attempt to control conditions – 1

Control included – 1

Repetition/large sample used – 1

Expected results stated – 1

Limitations noted – 1

Format suitable for planning and design activity – 1

Total = 10 marks