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

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION

MAY/JUNE 2011

BIOLOGY
GENERAL PROFIENCY EXAMINATION

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GENERAL COMMENTS

The June 2011 examination in Biology at the General Proficiency level was the 37th sitting of this subject conducted by CXC. Biology continues to be offered in both January and June. The biology examination is one of the more popular of the single sciences offered at the CSEC level and in 2011 assessed the performance of approximately 16,000 candidates. The examination comprises four papers: Paper 01 – Multiple Choice; Paper 02 – Structured/Extended Essay paper; Paper 03 – School-Based Assessment (SBA); and Paper 032 – Alternative to the SBA (offered only to private candidates).

Overall performance in 2011 was similar to that of 2010 with candidates scoring across the full range of marks in almost every question. However, candidates were challenged by their lack of knowledge of the specifics of biological concepts, their inability to analyse data and account for trends, and most importantly to make drawings that adequately represent biological specimens. Many candidates also had difficulty recalling and spelling the names of biological processes and events. Candidates are still unable to adequately display the skills they are supposed to acquire in pursuing practical work, for example, data representation and methods of investigation. These comments relate to teaching of the subject matter and calls for students having more opportunity to express for themselves the concepts, principles and processes — writing these down and checking for accuracy as well as for engaging in practical activity, including field/laboratory work, and not merely writing up experiments in notebooks. Further, there is insufficient attention paid to several suggestions, which the Biology examiners have repeatedly made over the past years.

DETAILED COMMENTS

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. Performance on this paper was quite similar to that of 2010. The mean for the paper was 60 per cent compared to 61 per cent in 2010. Most questions had acceptable p and r values. The items on this paper which were most challenging for candidates were those that tested their knowledge of plant biology. These topics included sexual and asexual reproduction in plants, the role of auxins in plant growth with particular reference to the unilateral growth of plant seedlings towards light, as well as the role of various types of plant tissues.

Teachers should stress that seed formation results from sexual reproduction, which involves fertilization. The location of the male and female gametes in flowering plants should be made clear. The distinction between fertilization and pollination as well as between self and cross-pollination should also be clarified.

The role of auxin and the way it is distributed in the stem should be outlined in explaining why stems of plants grow towards the light.

Greater attention should be paid to the structure and function of various plant cells and tissues, for example, cambium, parenchyma, meristems, epidermal cells.

Paper 02 – Structured and Extended Essays

Paper 02 consisted of six questions, three of which were in the structured response format and three in the extended essay format. This paper tested all profile skill areas identified in the Biology syllabus. All questions were compulsory. Candidate performance on this paper was slightly better than performance on the June 2010 paper. Candidates were able to gain marks across the range for almost all questions and the mean for most questions was relatively close to the mid-point of the range.

Since candidates were able to generally attain marks across the allotted range for the questions, with the exception of Question 5. It is evident that most of the marks on the paper were available and attainable.

<u>Question 1</u>

This question tested candidates' data analysis skills and their knowledge of transport in plants. The mean mark scored was 12 and the median was 11.

Part (a) (i) required candidates to illustrate, by means of a graph, data for transpiration rates of celery stalks at different temperatures. This was generally well done, with a fair number of candidates scoring full marks. Commendably, data points were accurately plotted, scales for the axes were recorded and the dependent variable was represented on the y-axis. Candidates need to be reminded of the need to choose axes scales that allow maximum use of the graph page, quote units in the labels for the axes and include a self-explanatory title. A self-explanatory title mentions the subject of the experiment, the manipulated variable and the observations made. An example of such a title is *Distance moved by dye up celery stalks at varying temperatures.* It should be emphasized to candidates that the title format *name of independent variable vs. name of dependent variable*, for instance, *time vs. distance* is not acceptable in Biology, although it may be used in the other areas of science.

Part (a) (ii) required candidates to account for the observed trends in the data. Candidates who did not score full marks here seemed to misinterpret the word 'account'. A biological reason for the observations should have been offered and not a description of the data. Candidates' attention should be drawn to the Glossary of Terms used in Science Papers, located at the end of the current CSEC syllabus.

Part (b) tested candidates' ability to formulate a suitable aim for an experiment, given the experimental procedure. Although candidates seemed knowledgeable of the content of the Aim statement, a large number of them were unable to offer a well-written one. An acceptable Aim includes a verb, the manipulated variable, observations to be made and the subject of the experiment. An example of such an Aim is *To investigate the transpiration rates of celery stalks at different temperatures* or *To determine the effect of heat on the transpiration rates of celery stalks.*

In Part (c), identification of Flask A as the control seemed easy for most candidates. A pleasing number of them appeared to know that a control is an arrangement of apparatus, identical to the experimental arrangement, except the manipulated variable.

A conclusion, drawn from the data, was required in Part (d). A well-written conclusion is a one-sentence response to the Aim, often describing the effect of the manipulated variable on the results. An example of a well-written conclusion is *Temperature increases the rate of transpiration in celery stalks.* A number of candidates included reasoning and explanation in the conclusion statement.

Part (e) asked for a description of the physical processes involved in the movement of water through specified routes. A number of candidates were able to score full marks. Responses which were not awarded full marks often had incomplete descriptions of the processes, often merely identifying them. This underscores the need for candidates' familiarity with the Glossary of Terms used in Science Papers. The word 'describe' should have guided candidates to name the process and state how it is done. As an example, an appropriate description of 'capillarity' is *adhesion of water molecules to the sides of xylem vessels and cohesion of these molecules to water molecules in the centre of the vessels results in the rise of water up the xylem tissue*.

No marks were awarded for descriptions involving routes which were not mentioned in the question. A common misconception is that water is drawn up the xylem vessels solely by capillarity. While this contributes to the upward water movement, it cannot account for the long distances over which water is transported. The negative pressure at the upper areas of the xylem, generated by transpiration, results in an upward suction effect in the xylem and so allows upward water movement over large distances. Another common error found was the synonymous use of the terms 'transpiration stream' and 'transpiration pull.' A third area of concern is the number of responses citing root pressure as the only force responsible for upward water movement in the xylem. Root pressure may be high in the lower areas of the xylem but is not high enough to send water to the leaves. Thus, it may cause guttation but is insufficient to cause transpiration. It was also commonly thought that osmosis is responsible for the upward movement of water up the xylem.

Part (f) was well answered, with correct responses including the small diameter of xylem vessels to facilitate capillarity, degeneration of end-walls to allow formation of a continuous tube, lignification of vessels to withstand the negative pressures of the transpiration pull and degeneration of cytoplasm to allow uninterrupted water flow. An extremely common misconception was the idea that lignification is necessary to withstand the high pressures generated in the xylem. Too many candidates seemed unaware that the pressure in the upper xylem is so low that it becomes negative, that is, a 'pull' instead of a 'push'.

The benefits of transpiration, required in Part (g), provided relatively easy marks for a number of candidates. Marks were awarded for benefits such as the provision of water for photosynthesis and other metabolic reactions, the maintenance of turgidity, loss of heat by the evaporation of water and the uptake of dissolved minerals from the soil. A number of responses described transpiration as a means of removal of excess water, which would otherwise cause lysis of cells and 'drowning' of plants. This highlights inadequate knowledge of concepts as fundamental as the role of cell walls in plants.

The identification of phloem tissue as the means of transport of the products of photosynthesis in the form of sucrose, in Part (h), was well done. More than half of the responses had, however, incorrect spellings of the word *phloem*. A large number of candidates seemed unaware that the glucose produced in photosynthesis is converted to sucrose in order to be transported in the phloem. Too many of them stated that glucose is transported in the phloem. A number of them cited starch as the material transported, despite the insolubility of starch.

Part (i) required candidates to compare the transport systems of flowering plants and the transport system of mammals. Most responses were unable to score full marks in this part. Acceptable differences include the presence of a pump and valves in the mammalian system but not the plant's transport system. Similarities include the use of water as a solvent and the network of vessels found throughout the organisms.

Question 2

This question tested candidates' knowledge and understanding of the processes of aerobic and anaerobic respiration. Candidates were able to score across the full range of marks with the average mark being six.

Part (a) (i) was fairly well done. Candidates were expected to suggest one reason why humans need oxygen to stay alive. The role of oxygen in the oxidation of glucose to release energy during aerobic respiration or any variation of expression was the expected answer. Many candidates were able to give a reasonable suggestion.

In Part (a) (ii), candidates were expected to write the following chemical equation which summarizes the process for which oxygen is required in living cells:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

Many candidates were unable to write this chemical equation. Those candidates who did not balance the equation gained one of the two possible marks. Part (a) (iii) required candidates to name aerobic respiration as the process occurring in the previous section. Most of them simply wrote 'respiration'. This indicates that there is a need for a distinction to be made between the cellular processes of aerobic and anaerobic respiration.

Part (b) (i) was poorly done. Few candidates were able to explain why Usain Bolt's muscles became starved of oxygen during his spectacular sprint in the Olympic games. Acceptable answers included:

- His breathing could not keep pace with respiration taking place in his muscles.
- Exercising muscles need more oxygen than normal.
- Time taken for enough oxygen from lungs to be delivered to cells.
- His heart cannot pump blood fast enough.

Most candidates were able to identify lactic acid as the substance produced in Bolt's muscles, which were starved of oxygen.

Part (b) (iii) was fairly well done. Candidates were expected to explain how lactic acid could affect Bolt's performance if he continued running for another 10 minutes. Accepted explanations included the fact that Bolt's muscle would ache, cramp or become fatigued. As a result, Bolt would slow down or suffer a decrease in performance. Most candidates scored at least one mark.

Few candidates were able to score the mark for Part (c) (i) which required them to name anaerobic respiration as the process by which plants obtain energy in the absence of oxygen. Too many candidates indicated photosynthesis, which suggests that there remains the misconception that "plants photosynthesize during the day and respire only at night".

Another possible conclusion is that some candidates ignored (or did not read/understand) the first sentence and zeroed in on the key words 'plants' and 'energy', and hence answered *'photosynthesis'* instead of *anaerobic respiration* (incomplete oxidation of glucose in the absence of oxygen to produce ethanol, carbon dioxide and some energy). Very few candidates were able to describe anaerobic respiration, although they were generally able to identify products of anaerobic respiration such as lactic acid and ethanol.

Some common misconceptions were:

- Alveoli or lungs described as the organelle for the site of respiration

- Yeast is a product of anaerobic respiration

Question 3

This question tested candidates' comprehension of basic aspects of energy transfer in a food chain and the nitrogen cycle. Candidates' scores ranged between 0 and 15 marks, with a modal score of 7 and a mean score of 7. A few candidates did not provide a response to the question.

Part (a) required candidates to explain the unique role of the producers in the ecosystem. This part of the question was well done. Candidates were able to indicate that the role of producers in an ecosystem is to ensure that energy entered the ecosystem for the survival of the organisms further along the food chain.

Part (b) gave stimulus information in the form of a concept map showing transfer of energy from the sun through producers and consumers in a food chain. This section was well done. Most candidates were able to distinguish primary consumers and secondary consumers clearly. However, some candidates used the term omnivore to describe organism B. This term could be applied to organisms at A as well. Based on the given concept map, omnivore was not accepted.

In Part (b) (ii), an explanation of the role of B in the ecosystem was required. Most candidates were able to suggest a named carnivore and describe its role in the ecosystem. Other responses which included a named organism that exhibits omnivore-feeding patterns such as 'bird, human, fish, etc' were accepted. Some candidates' responses included named herbivores. These were not awarded marks.

Part (b) (iii) asked candidates to give one example of a decomposer and explain how a decomposer releases carbon to the atmosphere. The correct response to this question was fungi, bacteria, saprophytes or actinomycetes. Many candidates named detritivores or scavengers instead of decomposers. This indicates that the role of the various types of organisms which feed on dead and waste matter needs to be clarified.

In Part (b) (iv), the concept of the food cycle and the food chain were examined. This section presented the greatest challenge for candidates which indicates that the concept of the one-way flow of energy through the ecosystem is not well understood. Most candidates did not score a mark in this section. The suggested answers were:

- As energy flows through the trophic levels energy is lost as heat to the environment while materials transported to each organism can be recycled.

- Some energy is used up at each trophic level while materials (water, carbon, nitrogen etc.) can be reused/ recycled.

- The sun's energy is infinite while materials are finite and therefore must be recycled.

- There is no known mechanism for returning the energy to the sun while organisms aid in the recycling of materials.

Part (c) asked candidates to draw a diagram of the nitrogen cycle showing the links between four named processes. Many candidates knew the names of four processes in the nitrogen cycle, but could not correctly identify them in the cycle. Most candidates were able to name an organism responsible for one of the processes in the nitrogen cycle, for example, Rhizobium, Azobacter, leguminous plants.

Question 4

This question was designed to test candidates' theoretical as well as practical knowledge of the structure/function relationship of a leaf for the process of photosynthesis. It was fairly well answered and was able to discriminate those who had a good grasp of this process and those who did not.

For Part (a), most candidates were able to state two ways in which the leaf is adapted for photosynthesis. These include *flat, thin surface to capture light; held at an angle to capture sunlight; presence of chloroplast in palisade layer; chlorophyll to trap the solar energy; network of veins (xylem vessels) to supply water needed in photosynthesis and phloem cells to transport manufactured food; presence of stomata for entry of carbon dioxide.*

In Part (b) (i), most candidates were able to score the allocated four marks. Some candidates lost marks for not putting a title and others for inaccurate labels. The use of a key and stippling is to be discouraged for a diagram of this nature. Simple lines and labels would suffice to represent a variegated leaf.

For Part (b) (ii), very few candidates chose the non-green areas as the part of the leaf that would change colour. There appeared to be some confusion with the colour change due to the 'destarching' with alcohol and the formation of the starch-iodide complex. In Part (b) (iii), while most candidates stated 'blue-black' as the colour change, many of them did not indicate the original colour of the iodine. There were many candidates who indicated that the leaf changed colour rather than the iodine, which reacted with starch molecules to produce the blue-black iodide-starch complex. Some candidates stated that the colour change was purple.

For Part (c), most candidates were able to state the role of chlorophyll in photosynthesis. They were also able to explain the formation of starch (from carbon dioxide and water) with glucose as the intermediate. However, candidates were less able to clearly relate this theory to the practical investigation using the variegated leaf, which demonstrated the need for chlorophyll in photosynthesis.

In Part (d), most candidates knew that 'food' manufactured in leaves was transported in the phloem to other parts of the plant for storage. If they indicated the material was used for respiration/growth processes, they were not penalized. Several candidates thought the material transported was either glucose or starch. Some candidates interpreted *parts of the plant that do not contain chlorophyll* as the non-green areas in the leaf.

Question 5

This question was poorly done as illustrated by the mode of 0 and mean of 3. Although most candidates were able to score the two marks allocated to Part (a), many of them were too general in stating urine or nitrogenous waste instead of specifying the components of urine.

The answers to Part (b) indicated that candidates had many misconceptions with regard to the formation of urine. Some of them apparently confused the process of egestion with excretion, for example, 'after digestion excess or unwanted substances go from the intestines to the kidney for excretion'. Candidates did not seem to understand clearly how urine is formed from blood by the processes of ultra-filtration, re-absorption and secretion. Too many of them referred to blood passing through the kidney tubule (nephron) rather than the filtrate. Many candidates did not do an annotated diagram. Candidates should be reminded to pay attention to the meaning of this term. The glossary in Appendix 5 of the syllabus indicates that the term *annotate* means to *add a brief note to a label; simple phrase or a few words only*.

Part (c) asked candidates to account for the presence of blood cells and glucose in the urine. Most candidates were able to score two out of the four available marks for mention of malfunction, disease, damage, hypertension and diabetes. Far too many candidates referred to hypertension as 'suffering from pressure' and diabetes as 'having sugar'. Attention should therefore be paid to the use of accurate terminology for commonly known conditions.

<u>Question 6</u>

This question was attempted by the majority of candidates. The overall performance of candidates was average. The marks obtained by candidates showed a normal distribution with a mean mark of 7 and a mode of 6.

Part (a) (i) tested candidates' knowledge of the four categories of disease: pathogenic, nutritional deficiency, hereditary and physiological. This part was generally well done with candidates being able to score most of the four marks for identifying a named example of each of the categories of diseases. Candidates knew the names of many diseases and gave a wide range of correct responses. Some candidates used common names of diseases such as 'sugar', iron deficiency and deformation of bones rather than the biological, which were not accepted. Other candidates gave names of psychological diseases for physiological diseases indicating a misunderstanding of the two terms.

Part (a) (ii) required candidates to compare the methods of treating and controlling the pathogenic and physiological diseases named in (a) (i). Most candidates scored a maximum of three marks for identifying the differences but lost one mark since they did not identify the similarity. Some accepted responses for differences include: lifestyle choices; education; medication/drugs; vaccination; surgery; hygiene for pathogenic disease; diet and exercise for physiological disease. Candidates focused on the prevention of the diseases. In addition, they did not use appropriate linking words to compare, rather they wrote the response for each separately. Some candidates gave general answers comparing the categories of disease without specifying the two diseases, which they named in Part (a) of the question.

For Part (b) (i), candidates were required to state the meaning of *genetic engineering*. Most candidates only scored one out of the two available marks since it was evident that they did not clearly understand the definition. They confused genetic engineering with cloning, grafting, artificial selection and crossing-over. Acceptable responses included the idea of inserting genes from one organism into another so that the genotype of the genetically engineered organism is altered.

Candidates were able to score marks in Part (b) (ii) for discussing the social, ethical and ecological implications of genetic engineering. While many candidates discussed each, most of them were not clear about the meaning of the terms social, ethical, ecological and implication. As such, they spoke of ethnicity rather than ethical; and they discussed socialization of plants.

Paper 032 – Alternative to SBA

This paper assessed most of the practical skills required of biology students. Candidates continue to display weak practical skills especially in aspects of Planning and Designing, including the assembling of apparatus, describing methods of experiments and in drawing conclusions from data. These observations indicate that candidates should be exposed to actual experimenting and investigating scientific phenomena, discussions, explanations and rationalizing of procedures and outcomes so that they can develop experimental skills.

Candidates continue to display weak drawing skills and lack of knowledge of the conventions of biological drawings, such as the inclusion of magnification and titles of the drawings. In addition, far too many candidates presented untidy drawings with crooked labelling lines.

<u>Question 1</u>

This question tested candidates' drawing skills, their knowledge of the parts of a fruit and their understanding of food tests. The responses were generally poor.

The performance in Part (a) was the better of the two sections. Most candidates were able to gain at least four of the 11 marks available in this section. Many candidates failed to provide a title to the drawing and the accuracy of the representation of the cut orange was often very poor. Candidates also lost marks for lack of clarity due to shading and the absence of clean, clear, smooth lines. Several candidates had difficulty depicting a transverse section and instead gave a 3-D representation. In Part (a) (ii), the majority of candidates were unable to either correctly calculate the magnification or write the correct notation with the times (x) in front of the calculated value.

Part (b) was poorly done. In (b) (i), though most candidates were familiar with the test reagent, iodine and the colour change from brown to blue-black associated with starch, they appeared less knowledgeable about the protein test which used KOH + CuSO4 (Biuret test) with a colour change from blue to purple, and reducing sugar test which used Benedict's with a colour change from blue to red-brown. Candidates must be reminded of the importance of reading questions carefully. Many of them gave the colour of the food substance before the test and not the colour of the reagent as required.

Many candidates misinterpreted what was required for Part (b) (ii), often giving properties of the pulp, rind and seed cotyledon. Few candidates were able to relate the presence of the food substance to its role in dispersal or to the survival of the plant itself. Acceptable answers included:

- Pulp – to attract agents of dispersal/as a food source
- Rind – gives a scent to attract agents of dispersal/prevent evaporation
- Cotyledon – food for germinating seed

<u>Question 2</u>

This question posed great difficulty for candidates. In Part (a) (i), many of them failed to correctly read the volumes in the measuring cylinder, often reading the top of the meniscus recording values of 72 cm^3 instead of 71 cm^3, and 62 cm^3 instead of 61 cm^3. Candidates were often unable to correctly state the aim required in Part (a) (ii), although many of them were able to use the indicative terms *to find out/to investigate*. Expected answers included:

- To find out/investigate/compare the water-holding capacity of two types of soil: soil X and Y.

In Part (a) (iii), many candidates were unable to differentiate between a precaution and good basic experimental technique. Acceptable responses included:

- Soil sample should be dried thoroughly to avoid different water content at the start of the experiment.

- No errors in reading measurement: to avoid inaccurate readings — read at eye level, use a flat surface, read the bottom of the meniscus.

In Part (a) (iv), the answers provided were often vague, lacking in the scientific terminology/jargon required at this level. Words like 'soaked up, absorbed' were loosely used and most were unable to make the connection between the change in volume and airspaces. Answers were expected to relate the change in volume seen in each cylinder to the properties of Soil X and Y. Candidates should also be encouraged to use the number of marks awarded to get an idea of the depth of the answer required.

Cylinder A:
Soil X particles smaller than Soil Y
Less air spaces in soil X
Soil X is clay

Cylinder B:
Soil X particles larger than Soil X
More air spaces in Soil Y
Soil Y is sandy soil

Parts (b) (i) and (ii) were the best answered in this question, with candidates scoring at least two out of three marks.

Question 3

Performance on this question was fair. In Part (a) (i), most candidates were able to plot values. However many of them did not include a title, and/or the axes with units. Candidates often used scales that were too small. As a result, they utilized less than half the graph paper provided. Candidates often confused the position of the two axes, placing the dependent where the independent variable should be and vice versa. However, several candidates were unable to correctly place incremental numerical values on the x and y-axes.

Many candidates were unfamiliar with the way in which a hypothesis statement should be made often providing an aim statement instead. They were also often unable to differentiate between a precaution and a limitation. Acceptable answers included:

Hypothesis
The closer the light gets to the eye, the smaller the pupil.

Limitations
Eyes could get tired.
Fluctuations in electricity.
Eye defects.

In Part (b), many candidates did not recognize that there are two muscles in the iris — the radial and circular muscles that control the size of the pupil. In addition, many candidates who attempted this question explained accommodation instead of the antagonistic movement of the muscles in controlling the size of the pupil. Acceptable answers included:

- Contraction of circular muscles decreases the diameter of the pupil, while contraction of the radial muscles increases the size of the pupil.

Most candidates were able to pick up at least one mark for concave or diverging lens, or laser surgery.

Paper 03 – School Based Assessment

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 and the number of times practical skills were assessed generally complied with syllabus guidelines. 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 and Reporting (ORR) was generally well done, Drawing (Dr), Analysis and Interpretation (AI) and Planning and Design (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 CXC Biology syllabus (page 44) provides guidelines for students' preparation of practical books for submission. Some important requirements often not met include: presence of a Table of Contents providing a list of the aims of practical activities, page numbers, dates, as well as clear and specific indication 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 activity and not simply listed at the front or back of the books.

The lack of comments in the 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 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 to 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' work should be a fair indication of its quality. Too many candidates received high marks for work that fell short of the CXC standard. This was particularly noticeable for Planning and Design, 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 the students.

- Marks submitted on the moderation sheet should reflect the 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 subject 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 candidates in the Moderation Feedback Report sent to schools from CXC, 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 their overall performance in the Biology examination, since certain questions, notably Question 1 on Paper 02, and 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 especially new teachers of Biology 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 Design skill which is assessed twice* (see page 37 of the Biology syllabus).

Observation, Recording, Reporting (ORR)

These skills appear to have been mastered at most centres. For most of the work observed, the method was clearly described with logical sequence of activities. It was also observed that generally, the past tense was correctly used in the presentation of the report on the practical activity as required. Candidates should be encouraged to give careful attention to grammar, quality of expression and giving as much details as possible when reporting their procedures and observations, as science students need to appreciate the importance of clarity in explaining their results. Where possible, students should also be encouraged to repeat procedures and give average results to improve the reliability of their results.

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

When using tables, teachers should remind candidates that the title should be written in capital letters, and appropriate column headings should be given. See example below.

Example:

TABLE 1: FROG POPULATION OBSERVED FROM OCTOBER 1997 TO OCTOBER 2004

Year	Number of frogs
2004	5
2001	110
1997	125

When presenting 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.

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

Drawing (Dr)

There has been a general improvement in the clarity of drawings done by students at most centres. Some teachers continue to reward high marks to drawings that do not meet the CSEC standard. The examining committee does not expect drawings to be works of art, but they should meet the criteria for accuracy, clarity, labelling and magnification. Teachers should ensure that students are given several opportunities to practise and develop drawing skills.

It is a requirement that drawings must be practised from actual specimens and not from textbooks. Specimens must include drawings of *flowers, fruits*, *storage organs and bones*. Additional examples may be included in practical books. However, *microscope drawings, models and apparatus should not be used for SBA assessment*. Drawings of cells while useful for teaching should not be assessed at this level. Similarly, dissections may help students to understand structures such as the digestive system but they are too complex to be drawn accurately at this level. These difficult drawings do not provide a fair test of ability at the CSEC level.

Accuracy and labelling continue to be problem skills and there appears to be some degree of inconsistency — even among teachers at the same school — in how they are assessed. Label lines should be drawn with a ruler and as far as possible, labels should be written in script so that they can be easily read. Annotations that accompany drawings should be as brief as possible and clearly and neatly written.

Table 1 is a list of DOs and DON'Ts applicable to SBA biological drawings at the CSEC level.

TABLE 1. DOs AND DON'Ts OF BIOLOGICAL DRAWINGS

DOs	DON'Ts
• Use pencils for all drawing activities – drawing, label lines, labels • Use drawings of actual biological specimen (not diagrams, models or textbook drawings); ensure for assessment there are drawings of flowers, fruit, seeds and bones • Let the size of drawings be at least half page • As far as possible, have label lines and labels positioned at right side of drawing • Let all label lines end at the same vertical plane • Let label lines be drawn parallel to the page top/bottom • 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	• Do not use arrow heads • Do not cross label lines • Do not use dots or dashes • Do not join letters of words for label or title

The examining committee also encourages teachers to ensure that standard drawing criteria are applied whenever drawings are required in laboratory activities, especially when reporting observations and/or illustrating biological processes, for example, germination, regardless of whether DR skills are to be assessed or not. 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 labelling lines are oftentimes unclear when drawings are done on ruled sheets of paper.

Analysis and Interpretation (AI)

This skill continues to present problems for the majority of candidates. Many teachers continue to use questions to stimulate discussion. This device is good for helping students to develop their AI skills. However, they should not be used excessively, nor should they be the only means of assessment. These 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 their 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’ as one of the criteria. 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 in the introduction section
- Background information for the experiment must be related to the theory
- Discussion should be an analysis or interpretation of the recorded experimental results. Discussion 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
- 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 this is very important to laboratory exercises.
- 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 be used also 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.

Manipulation and Measurement (MM)

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 of them are awarded full marks. However, evidence such as the generally poor performance on the practical aspects of Question 1 in 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 help to ensure students' manipulation skills develop and allow for a more fair assessment of students' 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 students 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 assessing students' PD skill.

The experiments designed by students from some of the centres moderated indicated that there was some understanding of the procedures involved in planning and conducting an experiment but in some instances, there were no replicates in the investigations. There are still a few areas of difficulty where students were unable to state their hypotheses clearly and relate the aim to the hypothesis. A hypothesis is a testable explanation based on particular observations, about how things work or why something happens.

It is also important that development of the skill start with the commencement of the teaching of the syllabus. In many cases, it was obvious that practical activities targeting the development of the PD skill was among the last set of activities in which candidates engaged prior to the examinations. Figure 1 is an example of how a planning and designing activity might be effectively developed. Students should be encouraged to ask 'why', in other words, to think of an explanation for their observation rather than simply describing the observations.

An example of description of an observation stated as a hypothesis is as follows:

OBSERVATION GIVEN*: Someone observed that when bananas are wrapped in paper and placed in a dark cupboard, they ripen faster than those left in the light*.

STUDENT'S HYPOTHESIS: *Bananas wrapped in paper and placed in a cupboard ripen faster than those left in the light.*

SUGGESTED HYPOTHESIS: *Exposure to light slows the ripening process in bananas*.

The PD activity shown in Figure 1 generated different experimental designs from students at a particular centre, which underscores the point that if students are given clear instructions and guidance, they can become proficient in this skill.

Example:

This Planning and Design activity submitted by a centre was based on the following observation:

Whilst digging his garden, a gardener noticed that there were a lot of earthworms in one area but few in another.

The teacher's instructions to the students were:
Suggest one possible hypothesis for the gardener's observation. Design an experiment which you could carry out to test your hypothesis. Your design must include:

- Your hypothesis, which clearly relates to the observation given.
- Your aim which clearly relates to your hypothesis.
- A list of the apparatus and materials you would use.
- A clear method, written in instruction format, stating the steps you would use and including a suitable control.
- At the end of your method, clearly identify the manipulated variable, the responding variable and the controlled variable.
- A summary of the expected results – if your hypothesis is correct and – if your hypothesis is not correct.
- An explanation of the limitations of your method.

Figure 1. Example of a Good Planning and Design Activity

Two hypotheses related to the example in Figure 1 are:

- Earthworms live only in shaded areas.
- Earthworms are found only in moist habitats.

Relevant aims to the proposed hypotheses include:

- To investigate the distribution of earthworms in well-lit and shaded areas
- To investigate the distribution of earthworms in moist and dry areas