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 SECONDARY EDUCATION CERTIFICATE EXAMINATION

MAY/JUNE 2009

BIOLOGY

CARIBBEAN EXAMINATIONS COUNCIL

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GENERAL COMMENTS

The June 2009 examination in Biology at the General Proficiency level was the 34th sitting of this subject conducted by CXC. Biology continues to be offered at both the January and June sittings of the examinations. The Biology examination is one of the more popular of the single sciences offered by the CXC at the CSEC level and assessed the performance of approximately 14 000 candidates this year. The examination comprises three papers: **Paper 01 – Multiple Choice; Paper 02 – Structured/Extended Essay paper; and Paper 03, the School Based Assessment (SBA).**

The overall performance of candidates this year declined slightly over 2008. Seventy-four percent of the candidates achieved grades I – III as compared with 77 percent in 2008. Candidates were challenged by their lack of knowledge of the specifics of biological concepts, their inability to analyse data and account for trends, and to make drawings that adequately represent biological specimens. Some candidates also found difficulty recalling 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 work, and not merely writing up experiments in note books. Further, there is insufficient attention paid to several suggestions which the Biology examiners have repeatedly made over the past years. These comments take on more meaning with the new format of the Biology examination that has eliminated choice. Particular attention must be paid to the comments reiterated below in preparing candidates, *if the desired improvement in performance is to be realized and sustained*. These comments relate both to test-taking techniques and means of addressing the content of questions:

- Teachers should remind their students that there is more to taking an examination than memorizing the content. When preparing students for an examination, time should be spent practicing *how to interpret* and answer questions clearly, concisely, and to the point.
- Candidates also waste time providing information that is irrelevant to the question. This gains them no marks. This is particularly important for the extended essay component of the paper. Candidates ought to make better use of the time allotted for reading through the paper and planning their responses *before* starting to write.
- Candidates are advised to take special note of the cues given in the questions and underline key words to draw attention to what the question requires. When the question asks for two items, many candidates give one, and lose marks unnecessarily through apparent carelessness.
- Candidates should not re-write the questions in the spaces allocated for the answers.
- Candidates should also use the question numbering as a guide to link the different parts of the question. They should note that the numbering changes when there is a change in concept or context. They should also make every attempt to use the information given in the various parts of a question to help focus the context and content of their responses.

- Biological jargon should be used where appropriate and **spelling** of biological terms **must** be correct. Spelling of common biological terms continues to be atrocious. Even when the biological term is used in the question candidates will introduce their own incorrect spelling of the term. It is not possible to award marks for incorrectly spelt terms where they actually mean something different. Candidates far too often seemed unfamiliar with the meaning of common terms used in Biology, for example, "annotate", "adaptation", "structural features", "distinguish", "precaution", "limitations", "factor", "implications" or "types". Teachers should direct their students to the glossary of terms available in the CSEC Biology syllabus.

It should be noted that candidates at this level are expected to demonstrate understanding of fundamental principles and concepts including *the relationship of structure to function in living organisms; the relationship of living organisms to their environment; the cell as the fundamental unit of living organisms; genetics and variation and their role in perpetuating species; the impact of disease on living organisms, including social and economic effects on humans, and the impact of human activity on the environment.* The Biology Team suggests that teachers should use more constructivist approaches in the teaching of Biology. This requires students to be more involved in explaining their notions, clarifying the content, and fully engaged in problem-solving activities.

It is repeated here that every effort must be made to encourage and facilitate the use of appropriate biological jargon, including the correct spelling of terms. Candidates can lose marks for incorrect spelling as the badly spelt term may take on new meaning.

The Biology Examining Committee also believes that there is very limited or no sharing of best practice in the subject area. Sharing best practices among science educators cannot be over-emphasised. In addition, advanced technology is at our disposal and the timely introduction of e-learning programmes across the region is viewed as a potentially enabling opportunity. This innovation must be embraced by all as far as possible.

DETAILED COMMENTS

Paper 01 – Multiple Choice

Paper 01 consisted of 60 multiple-choice items. Performance on this paper was quite similar to that of last year's. The mean for the paper was 61 per cent, the same as for 2008.

Some of the topics that were most problematic for candidates were:

- Role of bacteria in the nitrogen cycle
- Role of ATP
- Water conservation in plants
- Identifying variables in an investigation
- Reflex arc and reflex action
- Surface area to volume ratio
- Function of the skin in humans
- Functioning of the uriniferous (kidney) tubule
- Role of hormones in the menstrual cycle
- Monohybrid inheritance
- Sex linkage
- Sampling, using a quadrat
- Soil properties

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 the three profile skill areas identified in the Biology syllabus. All questions were compulsory. Candidate performance on this paper declined over June 2008. Candidates were able to gain marks across the range for almost all questions and the mean for almost every question 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, it is evident that all the marks on the paper were available and attainable. However, in order for more candidates to give their best performance, attention must be paid to the observations and suggestions the Biology examiners have repeatedly made. Observations and suggestions relate primarily to examination techniques which candidates should follow when writing this paper. In particular, candidate attention is drawn to the use of the stimulus material in responding to the questions and the guidance provided by the spaces allotted to each question where necessary.

Candidates must note that they are not required to repeat the questions to begin their responses for the first three questions on the paper. Candidates also continue to display weak practical skills especially in describing methods of experiments and in drawing conclusions from data. These observations suggest that teaching for developing practical skills *must include discussions, explanations and rationalization of procedures and outcomes on the* part of students, so that they become capable of developing and manipulating experiments and experimental data on their own.

Simply having students write up experiments without orally communicating what they are doing and, providing appropriate explanations for occurrences, squanders the opportunity practical activities provide for teaching and learning. In addition, too many candidates are unable to produce accurate diagrams of common biological structures and they do not observe the conventions of drawing, including giving the diagram or drawing a title, labelling neatly, using straight parallel lines, using sharpened pencils and providing the magnification.

Question 1

This question dealt with an investigation of a small coastal ecosystem along a busy highway which was studied by a biology class. Candidates were required to demonstrate knowledge of methods used in undertaking field work, as well as of data collection and representation procedures; and their ability to interpret data and account for trends observed in historical data.

Candidate performance on this question was disappointing. The mean was approximately **9** out of **25**.

Part (a) examined candidates' knowledge of investigative methods in ecology. Candidates were required in Part (a) (i) to identify pieces of apparatus other than the quadrat that could be used to investigate the changing distribution of plant and animal species in the area under study, and in Part (a) (ii) to describe how the apparatus they identified could be used for the stated purpose. These parts of the question were fairly well done by the candidates. The majority were able to identify an appropriate piece of apparatus and to a large extent describe how it could have been used in an investigation of species distribution in the area. Candidates were generally expected to include in their responses: *rope/string; tape measure; bottles; traps and other relevant materials.*

Part (b) examined candidates' knowledge of data collection methods, data representation and analysis. In Part (b) (i) candidates were asked to give a precaution that should be taken when using a quadrat to determine species distribution. In Part (b) (ii), they were to calculate the density of one species given data presented in a table, and in Part (b) (iii) they were to give a reason why the succulent plants were found in the large numbers recorded in the table. These parts of the question were fairly well done, although many candidates omitted the units in providing their answers to the calculation. Many candidates knew that in using the quadrat they would have to make the throws randomly and repeat throws as precautionary measures. Candidates found Part (b) (iii) to be the most challenging. Candidates were expected to know that succulent plants store water which makes it readily available in a habitat that is deficient in water supply, or in which water becomes unavailable to the plant because of environmental conditions. Candidates were thus expected to indicate in their responses: *water in short supply; water availability limited; water available to their growth not suitable; succulent plants store water; they are better adapted to habitat with limited availability of water.*

Candidate responses that gained full marks were:

> There may not be a high source of water in the area and so the plants have to adapt to store water to cope with the water shortage, hence their succulence.
>
> Succulent plants are present since they receive little water near the busy highway, which accounts for their need to conserve water.

Candidates performed reasonably well on Part (c) of the question, which assessed knowledge of feeding relationships amongst a range of organisms in a pond. In Part (c) (i), candidates were asked to construct a food web guided by the feeding relationships of numerous organisms in the pond that were presented in tabular form. In Part (c) (ii), they were asked to explain why a food web usually has no more than four trophic levels and in (c) (iii), they were to identify physical factors that might affect the population of the organisms that live in the pond. Candidates were generally able to earn the marks allocated to Part (c) (i), although many candidates still placed the arrows in the wrong directions, and others did not capture the interconnectedness of food chains, characteristic in a food web. While candidates were able to earn at least one of the marks allotted to Part (c) (iii), many of them were not able to distinguish physical from biotic factors. Candidates were expected to identify factors such as*: temperature, turbidity and rainfall.*

Part (d) of the question examined candidates' knowledge and understanding of the importance and impact of studying population trends. Candidates were given data in a table on the population size of frogs over a seven-year period. Candidates were to first plot a graph of the data using the grid provided. The data provided indicated that no data was collected in one year in which there was a hurricane. Candidates read the data as though there was thus no frog population. Many candidates left a gap in the graph or put the frog population at zero. Candidates must be aware that the fact that data was not collected at a particular time does not mean that the data does not exist. The graph should be continued as normal with a straight line drawn between the data collection points. What is critical though, is that the scale should not be changed, but should reflect that there is no data collection point where none is collected. In addition, many candidates produced a bar graph, when the line graph is more appropriate for showing the continuous variation characteristic of a population size. In Part (c) (ii), candidates were to account for the trend in the frog population before and after the hurricane.

This part of the question was not at all well done. Many candidates proceeded to describe the graph rather than offer an explanation of the decline in the frog population before the hurricane and the increase and decline after the hurricane. Candidates were expected to include in their responses: (1) decline before the hurricane may be due to – *limited availability of food; killed by vehicles/humans; use of pesticides/insecticides* (2) increase after hurricane – *pond expands due to rainfall; more tadpoles/increase fertility;* (3) decline after hurricane – *competition; limited availability of food; killed by vehicles; use of pesticides/insecticides; destruction of habitat.* A good response was:

> Before the hurricane the frog population was in decline because of the dry, heated and inhospitable conditions. After the hurricane wet conditions provided adequate breeding grounds/habitat for the frogs accounting for the sharp increase in the frog population. Conditions eventually grew drier after 2000, hence the population decreased from 2001 to 2004.

In Part (d) (iii), candidates were to suggest why it is useful to study the distribution of frogs. This part of the question was not very well done. At best, some candidates focused on the importance of such studies to the frog species only, and did not relate to the role of the frog population in the food web, so that monitoring of the frog population was also a means of monitoring other populations of importance to humans. Candidates were expected to include in their responses ideas such as: *good indicator species; numbers give an indication of how well the ecosystem is doing; population changes in frogs indicate changes in the environment* and that the frog population will change due to - *amount of food available; number of predators in the ecosystem; suitability of the habitat for the survival of the organisms.* Responses that earned full marks were:

> It is useful because frogs are amphibians and they live in both aquatic and terrestrial environments. Therefore the migrating pattern of frogs will give us an indication of the problems affecting the environment.
>
> Frog populations would reflect on the availability of insects as a food source, suggesting insect population distribution.

<u>Misconceptions</u>

- Quadrats or nets could be used to determine the population of organisms in a pond.
- 'Succulent' plants can be sucked, rather than the plants are adapted for storage of water.

Question 2

This question tested candidates' knowledge of the structure and functioning of the human eye. Candidate performance on this question was as anticipated with those who knew the material obtaining full or near to full marks, while those with only a passing familiarity with the subject scored low. Once more it is stated that candidates often seem to perform worse than expected on questions that require specific knowledge of familiar biological content – concepts, principles and processes. However, candidates were able to access marks across the range with their performance showing a mean of **7** out of **15**. Several candidates indicated that they 'know' the material, but cannot recall correctly the names of structures and definitions. This relates to teaching of the subject matter and calls for students having more opportunity to express for themselves various aspects of the content – concepts, principles and processes – writing these and checking for accuracy.

Part (a) of the question required candidates to label certain structures identified in a diagram of a longitudinal structure of the human eye. This part of the question was only fairly well done even though this is a common part of the Biology syllabus. Candidates too often failed to correctly name the parts of the eye, referring to the *iris* as the *cornea* and the *fovea* as the *blind spot*, and other similar errors. Candidates also tended to be loose in distinguishing the *ciliary muscles* and *suspensory ligaments* referring to them as the 'ligaments' or 'muscles', which could not earn them marks. In Part (d) (i), some candidates named the corrective lenses, but did not note the label to which they referred, and thus lost marks that they otherwise might have gained.

Part (b) asked candidates to give the biological term for rods and cones given that they are specialized cells stimulated by light. This part of question was not very well done. The expected response was *receptors /sense cells*.

In Part (c), candidates were asked to explain how a severe lack of Vitamin A might affect a person's ability to see. This part of the question was not very well done. Candidates were expected to focus their responses on: *passage of light through cornea becomes blocked; cornea needs to be transparent; could cause blindness/impaired vision.* A good response to this part of the question was:

> The cornea is responsible for the refraction of light. When it is dry and thickened refraction becomes more difficult and the object observed cannot be focused on the retina to cast the image resulting in the person's inability to see.
>
> If the cornea is dry and thickened, light would not be able to refract correctly on the lens and would not be able to focus on the retina

In Part (d), candidates were given some diagrams illustrating common eye defects and corrective lenses. In (d) (i), candidates were to identify the illustrated eye defects and match the corrective lens with the defect. This part of the question was reasonably well done. Candidates were expected to: *distinguish between long-sightedness and short-sightedness* and *link the diagram of the convex lens with the correction of long-sightedness and the concave lens with correcting short-sightedness.* Many candidates knew the names of the lens that corrected each defect, but failed to identify which of the three lenses in the diagram should be used to correct the defect, and thus failed to earn the allotted marks. In Part (d) (ii), candidates were asked for precautions to be taken when using contact lenses. This part of the question was quite well done. Candidates were generally able to make reasonable and accurate suggestions including: *washing of hands before applying; washing lenses in antiseptic lotion.*

Question 3

This question required knowledge of the structure and functions of a green plant, in particular, the internal structure of a dicotyledonous leaf, transport within the plant, and aspects of conservation of water. This is another popular component of the Biology syllabus and was generally familiar to candidates. However, as for questions about specific topics in Biology, their knowledge of specific details was often lacking. The mean was **6** out of **15**.

Part (a) of the question asked candidates to give a function for which the leaf is suited and indicate how it is in fact suited to the named function. This part of the question was well done. Candidates appropriately referred to a number of functions including, photosynthesis, respiration and transpiration. They also appropriately referred to the leaf being broad, thin and flat, to trap sunlight,

the possession of chloroplasts for light absorption, stomata and sub-cellular air spaces for gaseous exchange.

Part (b) of the question focused on candidates' knowledge of the leaf structure and function. In Part (b) (i), candidates were to show, using three arrows only, the path of water diffusing from the leaf on the diagram provided. This part of the question was not well done. Far too many candidates had little idea of the diffusion pathway of water molecules in the leaf which should have shown movement from: *spongy or palisade mesophyll to the sub-stomatal air spaces through the stoma.* In Part (b) (ii), candidates were to identify the two structures labeled on the diagram. These structures were the *vascular bundle/xylem* and *stoma*. This part of the question was well done. However, candidates need to know that stomata refer to more than one 'stoma'. In Part (b) (iii), candidates were to give one consequence to a herbaceous plant if there is a temporary unavailability of water to replace that given off in transpiration. This part of the question was not at all well done. Candidates were expected to refer to the fact that under this condition of stress, *stoma closes; wilting occurs.* Many candidates stated that the plants become flaccid. Note that this term describes the condition of plant cells that have lost water and not the entire plant, which in fact shows 'wilting'. A well-stated response was:

> The plant will stop photosynthesising and wilt and could eventually die.

Part (c) of the question examined candidates on their knowledge of transport in plants. In Part (c) (i), they were asked to explain how water from the soil gets to the leaf in a plant. This part of the question was fairly well done. Candidates were expected to indicate that *water is absorbed by the root hairs; diffuse across cells of root cortex; xylem takes water from the root cortex/water diffuses into the central xylem; forces act to move water upwards in xylem/capillarity/root pressure/transpiration pull; diffusion from xylem to leaf cells*. A response that gained full marks was:

> Water from the soil diffuses into root hairs along a concentration gradient, and travels in the transpiration stream due to transpiration pull and capillary action. Water travels up the xylem in xylem sap and thus diffuses into cells in the leaf of the plant, where it is used in photosynthesis and metabolism.

In Part (c) (ii), candidates were to explain how any named structural feature of plant cells helps in transport within plants. This question proved challenging, especially for less able candidates. Candidates were expected to refer to structures such as: cell wall - *thin walls that allowed diffusion of materials; narrow*, conducting vessels, for example xylem - *hollow tubes for capillarity to allow water to move upwards; hollow tubes/ continuous columns/no end walls to facilitate transpiration pull*. Responses that gained full marks were:

> The xylem vessels are long and elongated. Also, they are dead, without contents and walls are made of lignin. Because they are dead and hollow there are no obstructions, thus, there is free movement of water from the root to the leaves.

> Plant cells have partially permeable cell membranes, which allow certain substances to enter and leave the cells. This aids in the transport of nutrients and water to the different parts of the plant and in transport of waste materials out of the plant.

Part (d) asked candidates to explain why all the water taken up by the roots of a plant is not lost by evaporation from the leaves. This part of the question was very poorly done. Candidates' responses were expected to develop on ideas such as: *use of water in photosynthesis; use in other metabolic processes; constituent of protoplasm/vacuoles.* A response that earned full marks was:

> Some of the water taken up by the roots is used in photosynthesis (in the light dependent stage) and some is used in the activation of enzymes for metabolic reactions. Thus, only some water evaporates.

Misconceptions

- Plants become flaccid – the correct concept is that plant cells become flaccid.
- Water diffuses through the waxy cuticle.
- The processes of osmosis and diffusion are the same.
- The term 'semi-permeable membrane' is no longer used. The correct term is 'selectively permeable' membrane.
- Gaseous exchange and transport in plants are different.

Question 4

This question assessed the depth of candidates' understanding of the structure of the kidney tubule and the ways in which its functions are affected under specific conditions. The question also assessed candidates' knowledge of xerophytic conditions and the ways in which plant functions may be adapted to suit those conditions. The performance was weak. The mean was **5** out of **15.** Candidate weaknesses were observed to be: inability to provide accurate drawings; to recall the structure and function of a common biological organ; as well as applying their knowledge of biological events to a particular context or situation.

Part (a) of the question dealt with the structure and functioning of the kidney tubule. In Part (a) (i), candidates were asked to draw a diagram of the kidney (uriniferous) tubule, and explain how urine is produced and gets to the bladder. This part of the question was fairly well done, although several candidates produced poor diagrams in which the major structures were not accurately represented, or they drew a diagram of the gross structure of the kidney. Some candidates drew the gross structure and included a minute diagram of the uriniferous tubule. Candidates need to follow the instructions of the question and do only what is asked. They are not credited for providing irrelevant information. Too many candidates seem unfamiliar with the common biological practice of annotating diagrams and drawings. Annotations are notes on the drawings themselves which are neatly placed to support the labels and usually give the function of the labeled parts. In Part (a) (ii), candidates were required to suggest why urine production is important in humans. This part of the question was fairly well done. Many candidates did not obtain all the marks allotted to the question as they did not provide a comprehensive enough response, citing only one of the functions of urine production. The following is an example of a response that earned full marks:

> Urine production is important in humans because it filters the blood and allows excess water, salts and urea to be excreted from the body. If there is too much water in the blood, cells would take in excessive amounts of water and if it is not secreted the cells will swell and burst. If there is too little water in the blood, the cells can become plasmolysed and die. The kidneys help in osmoregulation.

Part (b) of the question assessed candidates' knowledge of how the body deals with an excess of water presented in the context of the activities of a Boy Scouts troop going on a hike. Candidates who recognized the immediate homeostatic response of the body to maintaining water balance in the blood were able to describe the response to excess water in the blood, including the role of the hypothalamus. Too many candidates believe that when one takes in water, the body simply sweats to reduce the excess. Candidates were expected to refer to the: *role of the hypothalamus, reduced production of anti-diuretic hormone; reduction of re-absorption of water by the kidneys; increased production of watery urine and elimination from bladder*. Good candidate responses to this part of the question were:

> The hypothalamus senses that blood is too dilute when the blood is passing through it so it sends a message to the pituitary gland to secrete less anti-diuretic hormone, thus lowering the permeability of the walls of the distal convoluted tubule and the collecting ducts, lowering the amount of water reabsorbed. Large amounts of dilute urine is produced and the blood returns to normal concentration.
>
> … his hypothalamus gland will control the release of anti-diuretic hormone (ADH) in such a way to allow less water to be reabsorbed into his bloodstream via the kidney so that the excess water is passed out with his urine.

In Part (c), candidates were to give reasons why plants growing along a hiking trail had mechanisms to reduce water loss. A good candidate response to Part (c) was:

> (1) Given the inclination of the mountain there will be a lot of water runoff and plants will have to adapt to the lack of water available. (2) There will be a lot of wind blowing up the mountain which will increase the rate of transpiration (water loss) from the plants.
>
> For the trail to exist, it had to be cut which removes overhead foliage. The direct sunlight increases temperature which would increase transpiration rates.
>
> The trail has the tendency to be very hot during the day. The hot air above the trail rises and the cool air rushes in causing breezes made by convection currents. These winds move saturated air from around the leaf bringing drier air. This could increase the transpiration rates and more water could be lost.
>
> The plants were in an ecosystem where water was sometimes scarce and unavailable and thus needed to conserve any available water for later use. The plants were in a very hot, windy environment which favours transpiration and so to prevent too much water from being lost, they had mechanisms for conservation.
>
> This may be due to the absence of a constant water supply. This area may also be very windy and hot which encourages very rapid transpiration rates. To avoid these conditions plants adapt to conserve the little water they receive from time to time.
>
> The plants on the trail have mechanisms for reducing water loss because:
> (1) The plants are growing on a hillside which means that when it rains, water quickly runs down the hill. With necessary adaptations (long and wide growing roots), the plant will be unable to acquire sufficient water for sustenance and photosynthesis.

(2) Also, the plant on the trail may not receive a sufficient amount of water each day, for example, those at the summit of mountains (water flows faster down from the top.)

They need special mechanisms to trap water … the hill may be very windy which will increase transpiration of the small amount of water contained in the plant. The plant is adapted to such circumstances.

Misconceptions

- Animal cells become turgid. It should be known that 'turgidity' is a plant concept.
- Sweating is part of the mechanism for controlling the water concentration in the blood.
- 'Ureter' and 'urethra' mean the same.
- Urine comes out of the uterus.
- Excess water is released through respiration or sweating.
- ADP/ATP/ADH are interchangeable terms.
- The function of urine is for pregnancy testing.

Question 5

This question required knowledge of the carbon cycle and the impact of human activity on changes in the levels of atmospheric carbon dioxide, consequences of such changes, and ways of controlling carbon dioxide levels in the atmosphere. Candidate performance on this question reflected a mean of **7** out of **15**.

Part (a) of the question required candidates to show how named processes are involved in the recycling of carbon in nature. This part of the question was not particularly well done. While many candidates were able to either name relevant processes or describe aspects of the processes, far too many failed to address the issue of the *recycling* of carbon. Candidates were expected to show in their responses how the processes that they identified contributed to the recycling process relevant to carbon. The question asked for an illustration using a diagram. Just stating the processes was inadequate. Many candidates failed to make a link between the process that fixed carbon dioxide into organic compounds (photosynthesis), and those processes that either released carbon dioxide back into the atmosphere (respiration, combustion, decomposition), or further integrated them within living organisms (feeding).

Part (b) of the question examined candidates' knowledge of the impact of human activity on natural cycles and the consequences of these activities. In Part (b) (i), candidates were required to suggest ways in which human activity contributes to an abnormal rise in the level of atmospheric carbon dioxide. This part of the question was fairly well done. Candidates were expected to include in their responses reference to: *deforestation, overuse of fossil fuels, industrialization and or agricultural practices*. A good response was:

Burning of fossil fuels: Car exhaust from the burning of fossil fuels increases the carbon dioxide content in air. Also, factories and industries increase the amount of carbon dioxide.
Deforestation: Humans deforest for lumbering purposes, development, housing or cultivation/agriculture. Trees reduce the amount of carbon dioxide in the atmosphere, therefore, cutting the trees down decreases the amount of carbon dioxide being absorbed by the trees thereby increasing the carbon dioxide concentration in the air.

Part (b) (ii) followed on from the first part of the question by asking about the consequences of an abnormal rise in carbon dioxide levels on ecosystems. Candidates were mostly familiar with the range of possible consequences of increased carbon dioxide levels in the atmosphere and performed well on this part of the question. Candidates correctly included in their responses*: warming of the atmosphere/climate change; melting ice caps/rising sea levels; organisms adapted to cool climates may die; some areas become drier and infertile; plants that thrive on extra carbon dioxide will flourish.* Good candidate responses were:

> One likely consequence of abnormally high carbon dioxide levels on ecosystems is that plants would thrive if they also had a supply of water and sunlight, but the animals would suffer from oxygen deprivation leading to weaker young from breeding … lower chances of survival. The producers in the ecosystem would thrive but the consumers would suffer, especially carnivores, which depend on other animals being plentiful in numbers for food.

> One likely consequence of abnormally high carbon dioxide levels on the ecosystem is the removal of certain species of animals and plants from the ecosystem due to global warming. Global warming is the increase in temperature of the earth's atmosphere due to absorption of heat by the increased concentration of greenhouse gases such as carbon dioxide. This rise in temperature can cause changes in the habitats of some animals (for example, glaciers melting, polar bear population decreasing). This can cause the extinction of species. Also, some populations of plants and animals cannot cope with the slightest change in temperature, therefore, through global warming these organisms can die out and be removed from the ecosystem. Hence, organisms which feed on these organisms are affected and so the entire ecosystem is affected. Biodiversity decreases.

Part (b) (iii) asked candidates to suggest ways in which the levels of atmospheric carbon dioxide can be controlled. This part of the question was also well done, with most candidates gaining the marks allotted. Good responses were:

> Carbon levels can be controlled by (1) the use of alternative sources of energy which are efficient, cleaner and safer for the environment. One such form of energy is … ethanol to power vehicles in Brazil. The vehicle emissions from the ethanol do not pollute the atmosphere or the environment. Other alternative sources of energy include solar, wind, wave and geothermal energy, geothermal being … earth's volcanic energy. (2) when areas are deforested for development, trees and other plants should be re-planted in another area. When trees are cut down for lumber the area should be reafforested. Policies and laws should be introduced that control the number of acres of land being deforested per year and governments should reserve portions of land devoted to preserving the ecosystems there. This would help ensure that the carbon dioxide levels …

> Reafforestation/Afforestation reduces the high levels of carbon dioxide in the atmosphere by the absorption of carbon dioxide by plants for their life processes (photosynthesis). Reduce burning of fossil fuels. More organic fuels can be used like biogas and ethanol.

Misconceptions

- Global warming cause depletion of the ozone layer.
- The term 'carbon dioxide' is interchangeable with carbon.
- Carbon dioxide destroys the ozone layer.
- Perfumes and sprays destroy the ozone layer and increase the amount of carbon dioxide in the atmosphere.

Question 6

This question assessed the depth of candidates' knowledge of the structure and function of the human female reproductive system. The mean was **7** out of 15.

Part (a) addressed candidates' ability to draw an outline of the human female reproductive system and provide the functions of selected components. In Part (a) (i), candidates were asked to show on a diagram the relative positions of specific, given parts of the female reproductive system. While most candidates earned the marks allotted to this part of the question, several lost marks because they misrepresented various components, for example, they presented the ovary as continuing from the fallopian tube including a cavity, or the uterus and cervix as one continuous indistinguishable walled cavity. Candidates are to be reminded that their diagrams must accurately represent the biological structures. In Part (a) (ii), candidates were asked to annotate the diagram to identify the functions of the labelled parts. This part of the question was only fairly well done. A very large number of candidates did not appear to know the meaning of the term "annotate", and as for Question 4, provided extensive notations in prose after the diagram instead of labelling the parts and giving their functions on the diagram itself. There were, also, problems in labeling, in that the convention of labelling to one side then the other of the diagram with adequate space for the annotations were often not done. The result was very untidy and unclear diagrams. Candidates were expected to include in their labels the following functions: *ovaries for ova production/ production of hormones – oestrogen and progesterone; oviduct for passage of ovum/site of fertilisation; uterus for implantation of the embryo/development of the embryo and cervix – ring of muscles that closes lower end of uterus/dilates for passage of baby during birth.*

Part (b) examined candidates' knowledge of the female reproductive cycle and the impact of certain factors on the developing foetus. In Part (b) (i), candidates were to pose likely consequences of limited production of oestrogen and progesterone. This part of the question was generally well done, as candidates associated limited production of these hormones with lack of development of secondary sexual characteristics, the inability of the female to have a regular menstrual cycle and to properly prepare for pregnancy. Candidates' responses in a variety of ways reflected anticipated concepts: *no development of secondary sexual characteristics; irregular menstrual cycle; inability to become pregnant* or *unsuccessful pregnancy.* A good response was:

> With limited production of oestrogen, there would be no ovulation since the peak in oestrogen during the menstrual cycle stimulates the release of an ovum from the ovaries. Also, the uterus lining would not be able to thicken properly since these are the two hormones responsible for this and, thus, the girl would not be able to conceive and have a baby.

In Part (b) (ii), candidates were asked to identify ways in which smoking might harm the developing foetus. This part of the question was well done. Candidates often cited the role of carbon monoxide in reducing the oxygen-carrying capacity of the blood, thus reducing availability to the foetus. They suggested that this could result in *underdeveloped babies/low birth weight/increased chances of still births*. They also made claims to the role of nicotine as being able to cross the [placenta resulting in addicted babies that could show withdrawal symptoms at birth. A good response was:

> … Cigarette smoke contains many harmful chemicals such as nicotine and carbon monoxide. These chemicals are able to pass over into the foetus' blood system via the placenta. Nicotine causes the narrowing of arteries and thus the foetus' arteries would constrict increasing the blood pressure inside the foetus. Since the foetus has very delicate tissues, high blood pressure can lead to the rupturing of these tissues and thus death of the foetus. … [c]onstriction of arteries also reduces the oxygen-carrying capacity of the blood. Carbon monoxide, too, reduces the oxygen-carrying capacity since it combines irreversibly with haemoglobin to form carboxyhaemoglobin. This would lead to the foetus' tissue not getting enough oxygen to respire to get energy to develop and the baby can be born physically or mentally retarded and is usually premature.

Part (c) of the question assessed candidates' knowledge of reproductive health. In Part (c) (i), candidates were to give one disadvantage of using condoms. This part of the question was very well done. Candidates indicated that *condoms were not 100 percent effective; were not used correctly* or that *users required psychological adjustment/preparation*. Part (c) (ii) asked candidates to offer reasons why choosing a birth control method can be more difficult for the female partner in a marriage. This part of the question was also very well done. Candidates cited a range of reasons that were anticipated in their responses, including: *the female is the only one who gets pregnant; they are more susceptible to contracting STDs; their fertility might be affected/side effects from methods; discomfort with certain methods.* A good response to this part of the question was as follows:

> This is because (a) the birth control methods for a female's use often deal with the insertion of some foreign object into the vagina or even an injection. These methods are uncomfortable and sometimes painful, and (b) one birth control method is tubal ligation. This process is irreversible … and she may not want to make this final decision … when men can easily just put on a condom which is painless.

Paper 03 – School-Based Assessment

GENERAL COMMENTS

Performance on the School-Based Assessment was commendable. Favourable trends that continue to be observed include: good syllabus coverage (that is, a minimum of nine syllabus topics covered) by most centres; 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 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 CXC 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 with aims of the practical activities, page numbers, dates, and a clear and specific indication of the activities used for SBA and the skills being assessed. In addition, the marks awarded for each practical activity must be placed along with the practical, and not simply listed at the front or back of the books.

The lack of comments in the practical books, especially for skills performed poorly, suggests that students are not being given adequate feedback on their progress throughout the period of study. Often times, only ticks are observed, and 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 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 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 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 the candidates.
- Marks submitted on the moderation sheet should reflect the candidates' marks in each of the samples. Consistency of marking and submission of marks relate to the reliability of the process and thus the 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 consistency in standards is 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 candidates in the Moderation Feedback Form sent to schools from CXC, after moderation. The moderation feedback form, which is sent to each centre, provides constructive and useful information relevant to the particular teacher(s). This form offers specific recommendations and is intended to assist teachers in planning, conducting and assessing practical work – in the laboratory and field. Improvement of students' practical skills will have a direct influence on candidate overall performance in the Biology examination, since certain questions, notable Question 1 on Paper 02, 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.
The number of times a skill is assessed is considered sufficient if assessed a minimum of 4 times (see page 37 of the Biology syllabus).

Observation, Recording, Reporting (ORR)
This skill appears to have been mastered. For most centres sampled, the method was clearly described with logical sequence of activities. It was also observed that except for a few centres, the past tense was correctly used in the presentation of the report on the practical activity (except for Planning and Designing, 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 above the table using CAPITAL LETTERS, the table must be enclosed and appropriate row and column headings should be given.

Example:

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

Year	Number of frogs
2004	5
2001	110
1997	125

When using graphs the TITLE should be written below the graph and underlined; axes should be labelled, with units stated and a key should be presented if necessary.

If calculations are required, all necessary calculations should be shown and these should be done and 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, although the skill is not being assessed.

Drawing (Dr)

The quality of drawings of candidates from most centres has shown some improvement, especially in relation to clarity of drawings. However, at too many centres poor drawings were awarded high marks. 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, but if taught, the calculation of magnification should also be emphasized. 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 this level.

Table 2 is a list of 'Do's' and 'Don't's' applicable to SBA biological drawings:

TABLE 2: DO'S AND DON'T'S 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 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 • Write TITLE using CAPITAL LETTERS • In 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 1 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 • Do not join letters of words for label or title

Accuracy and labelling continue to be problematic for candidates 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 much as possible, labels should be written in script (not capitals) so that they can be easily read. Annotations should give the functions and descriptions of the structure where appropriate. Annotations that accompany drawings should be as brief as possible and clearly and neatly written.

The Examining Committee also encourages teachers to ensure that standard drawing criteria are applied whenever drawings are required in practical 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 practical 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:
    a. questions may be used to guide students but answers must be written in paragraph format (without the questions or written comprehension style)
    b. 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 they are very important to practical activity.
- Identifying source(s) of error and precaution(s) is 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 are awarded full marks. However, evidence such as performance on the practical question in the final examination suggests that these marks 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 a wide range of apparatus and their use in collecting data. This would help to ensure candidates' manipulation skills develop and allow for a more fair assessment of students' competence in MM.

Planning and Designing (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 the 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 were still a few areas of difficulty where candidates were unable to state their hypotheses clearly and relate the aim to the hypothesis. A hypothesis is a theory 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 Planning and Designing skill was among the last set of activities in which the candidates engaged

prior to the examinations. Figure 1 is an example of how a planning and designing activity might be effectively developed.

Example:

This Planning and Designing activity submitted by one centre was based on the observation that "*A boy notices that all the trees around his yard except the grapefruit tree were infested with 'duck' ants".* The students were required to plan and design an experiment to determine what was responsible for the difference in infestation. An example of an appropriate hypothesis and a relevant aim for investigating the hypothesis was:

> ***Hypothesis****: 'Duck' ants do not feed on grapefruit trees because the leaves contain a chemical that repels the ants.*
>
> ***Aim****: To find out which plant leaves 'duck' ants feed on*
> (The aim of the subsequent investigation could be: *To determine the presence of chemical X in different leaves.)*

There was a clear description of the materials and method. Students planned to use different leaves to see if the duck ants would respond as they do the grapefruit leaves. The 'duck' ants would then be placed in labeled containers containing the same number, sizes of leaves taken from a particular tree. A container with no leaves was an appropriate control. The measurable variable would be the number of 'duck' ants that leave or remain in each dish. Results would then be tabulated and subsequently discussed.

As stated by the candidates, one limitation may be that 'the chemical in the leaves that cause the effect on the 'duck' ants may be affected by the extraction'. Appropriate marks were awarded for the various aspects of the experiment.

Figure 1. Example of a good Planning and Designing activity