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

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

MAY/JUNE 2014

BIOLOGY
GENERAL PROFICIENCY EXAMINATION

GENERAL COMMENTS

The June 2014 examination in Biology at the General Proficiency level was the 46th sitting of this subject conducted by CXC and the first to be marked electronically by a team of competent professionals internationally and across the Caribbean. 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 18,000 candidates this year. The examination comprises four papers: Paper 01 – Multiple Choice; Paper 02 – Structured/Extended Essay paper; Paper 03, the School Based Assessment (SBA); and Paper 032 Alternative to the SBA (offered only to private candidates)**.**

The overall performance of candidates this year was similar to that of last year's with candidates scoring across the full range of marks in almost every question. Several candidates demonstrated above average knowledge of fundamental biological concepts and principles relating to feeding relationships, the heart and the carbon cycle. Topics such as genetics, sexual reproduction in flowering plants, accommodation by the human eye as well as practical based questions which require that candidates plan and design experiments or make drawings, still present major challenges for many candidates.

Some improvement was seen in candidates' test-taking techniques as more candidates were able to give concise responses in the spaces provided without repeating the question and it was evident from the quality of many responses that candidates are being encouraged and guided by teachers in practicing how to interpret and answer questions clearly and to the point. This suggests that some attention is being paid to the recommendations being given in the reports by the Biology examining team over the years. To ensure that these improvements are sustained however, attention must be paid to the comments reiterated below in preparing the candidates.

- Teachers should try as much as possible to dedicate adequate time to the teaching and formative assessment of all specific objectives (S.O.) covered by the syllabus. It appeared that several candidates were not familiar with important topics in Section C of the syllabus and consequently were unable to respond to the genetics and natural selection questions.

- Biological jargon should be used where appropriate and the spelling of biological terms must be correct in order to be awarded marks.

- Teachers should ensure that candidates are familiar with the meaning of terms listed in the glossary of the biology syllabus, especially those frequently used in writing questions such as 'annotate', 'compare', 'describe', 'design' and 'explain'.

- A constructivist approach to the teaching and preparation of biology students will enhance their ability to explain their ideas, clarify content and get them more engaged in problem solving activities. It was evident that some candidates were learning content by rote as these candidates were usually unable to adequately respond to questions that required that they apply their knowledge.

- Practical activities should be used to support the teaching of theoretical content and not treated as a separate activity. Practical skills such as drawing, analysis and interpretation, and planning and design in particular, should be developed as part of regular class proceedings and not just given attention in a 'laboratory' type setting. The consistently poor performance in practical skills observed in the review of SBA and inability to score full marks for most practical -based questions suggest that candidates were not given sufficient opportunity to develop their practical skills.

DETAILED COMMENTS

PAPER 01 – Multiple Choice

Paper 01 consisted of 60 multiple choice items. Performance on this paper was satisfactory and quite similar to that of last year's.

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

- oxygen debt
- transport in plants
- the structures of the skin involved in temperature regulation
- immunity

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. Candidates' performance on this paper was similar to that on the June 2013 paper. Candidates were able to gain marks across the range of marks allotted for all questions.

SECTION A

Question 1

This question examined some important practical skills including candidates' ability to construct tables to record data, label a drawing of a gill and analyse graphical data. It also tested candidates' knowledge and understanding of feeding relationships within a marine ecosystem (S.O. A1.1, 2.4, 2.5, E3.1). Most candidates attempted this question and a few were able to gain full marks but performance was below expectation. The mean was approximately 14 out of 25 marks.

Candidates were given drawings of eight different types of fish collected from a marine ecosystem in Part (a). Part (i) required that they construct a table to classify the fishes into groups using two visible features other than size. Several candidates were able to use a ruler to construct a neat table with appropriate row/column headings relating to visible features which allowed for accurately placing the fishes into groups. A few candidates also, as required, included a title for the table. Some candidates were not awarded full marks because they failed to describe two visible features and only named one feature being present or absent. Visible features that were correctly used for grouping the organisms included: Scales – present or absent; Shape of the tail – curved inwards or outwards; Spikes/Spines – present or absent; Number of dorsal fins – one or two. Candidates were also expected to use the numbers I to VIII to identify which fish was to be placed in each group. This was sometimes not done and those candidates were unable to earn the mark for classifying the fishes into groups.

Candidates were asked to annotate a drawing of the gill of a fish to illustrate two characteristics that make the gill suitable for gaseous exchange in Part (a) (ii). Very few candidates were able to annotate the lamellae as being thin or having a large surface area as required. Some candidates could not be awarded marks even though they wrote the correct annotations because they incorrectly positioned the label lines by the gill bar. A few candidates had the misconception that the gills are able to carry out inhalation and exhalation under water. Only those whose annotation indicated that the diffusion of gases takes place quickly through the thin walls and across the large surface area of the lamellae were awarded marks.

Most candidates were able to correctly state two reasons why gaseous exchange is important in living organisms in response to Part (a) (iii). Responses that were awarded marks included the following:

- T*o obtain oxygen for respiration/energy production to take place;*
- *To excrete or remove carbon dioxide which can be poisonous to the organisms;*
- *Homeostasis - plants require carbon dioxide from the atmosphere for photosynthesis/make their food*;

were awarded marks.

Part (b) was well done by most candidates. A diagram of a food web in the marine ecosystem was given and several candidates were able to correctly identify sea grass, phytoplankton and corals with zooxanthellae as the producers in the food web in responding to part (b) (i). They were generally also able to state two characteristics of producers in a food web in responding to part (ii). Characteristics of producers named by most candidates were that the producers: have the ability to make their own food, contain chloroplast/chlorophyll, trap sunlight for photosynthesis, are found at the beginning of a food chain/web and/or make food by chemosynthesis. A common misconception was that all producers are plants.

In Part (iii), candidates were required to identify the type of feeding relationship described between a coral and zooxanthellae and give the reason for the type identified. Although most candidates were able to correctly identify the feeding relationship as mutualism since both organisms benefit from the association, some candidates incorrectly said commensalism. It was also observed that the term ‘mutualism’ was frequently misspelt.

Candidates were given a table showing data of the estimated number of parrot fish and a predatory fish over a three year period in Part (c). In Part (c) (i) candidates were asked to represent the data on a suitable graph. Only a few candidates were awarded full marks for the graphs plotted. Marks could not be awarded if: an inappropriate scale was used in constructing the axes; both axes were not completely labelled, or a title or a key was not provided.

Candidates were asked in Part (c) (ii) to suggest an explanation for the differences in the shape of the graphs. Marks were awarded if candidates explained that the predatory fish did not have predators to feed on them or that the parrot fish were being fed on by the predatory fish. Marks were not awarded for describing the trends in the numbers of fish observed.

Part (c) (iii) asked them to name two features that the predatory fish may have that allow it to carry out its role as a predator. Most candidates were able to state features such as having sharp teeth, strong jaws, fast swimmers, very good eye sight or producing poisonous secretions to immobilize prey.

In Part (c) (iv), candidates were usually able to suggest that the size of the population of prey of the predatory fish would decline drastically or there would be an increase in the population of the organisms consumed by the parrot fish/prey as the likely consequences of the uncontrolled increase in the population size of the predatory fish. Other responses that were accepted mentioned that there would be a reduction in biodiversity or there would be increased competition for food, space or mates. A common misconception was that the species of prey would go extinct.

<u>Question 2</u>

This question tested candidates’ knowledge of the structure and function of select parts of the human circulatory system as well as the transport system of plants (S.O. B4.3, 4.5, 4.6, 4.7, 4.9; D1.2). Candidate performance on this question was good. While candidates were able to access marks across the full range of the question, their performance showed a mean of **7** out of 15.

Candidates were given a diagram of an external view of the human heart in Part (a) and asked to identify the structures labelled A, B and C in Part (i). This was well done by most candidates. The terms vena cava, aorta and ventricle were often misspelt.

In Part (a) (ii), they were asked to explain how the function of the heart may be affected by a blockage of a blood vessel labelled X on the diagram. A few candidates were able to identify that the blood vessel labelled X was the coronary artery that supplies the heart muscles with blood so if it was blocked, the heart would stop pumping blood and the individual would have a cardiac arrest/heart attack.

In Part (b), candidates were given a diagram of blood vessels labelled A and B, used to transport fluids around the body of a mammal. Arrows were used in the diagram to show the direction of flow of the blood. In Part (i) most candidates were able to correctly identify blood vessel B as the vein. Part (ii) however asked them to identify one structure visible in the diagram which helps a vein to carry out its function. Part (iii) then required them to explain how that structure allows the vein to fulfill its function. Candidate responses to these parts of the question were usually awarded full marks as most candidates were able to identify the valve and knew that the valve helps the blood which is flowing at a lower pressure to flow in one direction by preventing backflow.

In Part (b) (iv), candidates were told that diets high in saturated fats may lead to the formation of plaques in blood vessels. They were then asked to explain how such deposits may lead to hypertension. Most candidates got at least one of the two marks for mentioning that the formation of plaque would cause the diameter of the blood vessels to get smaller. Only a few candidates also mentioned that this would result in an increase in the pressure on blood flowing through the arteries or cause the heart to have to pump harder increasing the pressure to keep blood flowing to the organs and tissues throughout the body.

In Part (c), candidates were given a diagram of the transport vessels in a flowering plant and asked to identify the vessels at positions labelled P and Q. Several candidates were able to correctly identify P as xylem and Q and phloem but some candidates were unable to spell the terms correctly.

Part (d) required candidates to explain why plants do not need an organ like a heart in their transport system and outline a mechanism by which plants move fluids through their transport vessels. Only a few candidates were able to suggest that plants do not need a heart because they have a lower metabolic rate or that substances do not need to be delivered to plant tissues at a fast rate. A common misconception was that plants are all small organisms so they do not need a heart. Candidates also had a difficulty describing a mechanism by which plants move fluids. They were expected to mention that plants have a pumping mechanism to move water across the root into the xylem or that they have a pulling mechanism, transpiration pull, as a result of evaporation from leaves. A few also correctly mentioned cohesive or adhesive forces, or capillarity helping water to move up the xylem against gravity.

Question 3

This question tested candidates' knowledge of the structure and function of the kidney tubule (nephron), osmoregulation and diabetes (S.O. B5.4, 5.5; D1.2). Candidates' performance on this question was poor with few obtaining full marks. The mean was **6** out of a possible 15 marks.

In Part (a), candidates were provided with a diagram of a nephron found in a human kidney then asked to identify the structures labelled A, B and C and describe the process that takes place in each of the structures in Part (i). This was done correctly by many candidates but the terms Bowman's capsule and Loop of Henlé were often spelt incorrectly.

Part (ii) required candidates to name the hormone secreted by the pituitary gland when there is not enough water in body cells. Most candidates were able to name the antidiuretic hormone or ADH.

In Part (iii), candidates were asked to explain why the composition of urine produced by the nephron of someone who drank a lot of water would differ from that of someone who had no water to drink for over 24 hours. Most candidates were awarded at least two marks for stating that the urine of the person who drank a lot of water would be dilute or pale in colour while that of the person who drank no water would be concentrated or yellow due to the kidney reabsorbing some of the water. Very few candidates also mentioned that the changes in blood concentration of water is detected by the hypothatlmus which causes the pituitary gland to stop secreting antidiuretic hormone (ADH) when blood concentration falls/when a lot of water is consumed and this causes the kidneys to reabsorb only a little water; while the pituitary of the one

who drank no water would secrete more ADH to cause the kidney to reabsorb more water if none was consumed.

In Part (b), candidates were given a table showing the amount of select substances (glucose, protein, urea, sodium chloride and water) found in the urine of a healthy person and a diabetic. Part (i) required them to explain why there is glucose in the urine of the diabetic person assuming that the kidneys are functioning properly. Many candidates were awarded one mark for mentioning that the blood glucose levels are higher than the levels the kidney is normally able to reabsorb but only a few were able to explain that this was because diabetics are unable to use or store the excess glucose with the help of insulin because insulin is not being produced or the cells are not responding to the insulin. A common misconception was that diabetics have higher than normal blood sugar because they are unable to break down glucose. Students should be reminded that glucose is the end product of digestion so it is broken down inside the cells to produce energy during respiration. In the case of diabetics, they are unable to absorb the glucose into the cells to use it up during respiration or store excess amounts as glycogen in the muscles and liver, due to a lack of insulin or because their cells are unable to respond to the insulin produced.

In Part (ii), they were asked to describe two ways of managing diabetes mellitus. Most candidates correctly mentioned reducing sugar consumption, regular exercise or using medications to regulate blood sugar such as injecting insulin. A common misconception was that diabetes can be managed by drinking a lot of water. Students should be taught that this may increase the frequency of urination but not help in the management of diabetes.

SECTION B

Question 4

This question examined candidates' knowledge of the carbon cycle (S.O. A4.1; E4.2, 5.1, 5.2, 5.3). Performance on this question was good as illustrated by a mean of 7 out of 15 marks.

Part (a) required candidates to use a diagram to outline three processes which return carbon to the atmosphere and one which removes it from the atmosphere. They were also instructed to include the form in which carbon is found in the atmosphere. This was generally well done as most candidates were able to illustrate that plants take in carbon dioxide and use it for photosynthesis, then release it back to the atmosphere following respiration. Respiration by animals and decomposers as well as the burning or combustion of fossil fuels to release carbon back to the atmosphere were also shown.

In Part (b) candidates were asked to describe the impact of cutting down or burning large areas of forest on the recycling of carbon. This was not very well done as most candidates misinterpreted the question and spoke about the impact on global warming, climate change and even the ozone layer. They were expected to explain that cutting down trees may contribute to an increase in the amount of carbon dioxide in the atmosphere to be recycled because they would not carry out photosynthesis to use it up and burning would result in carbon compounds also being released into the atmosphere. Fewer trees may also lead to a reduction in the number of organisms in that particular area because the trees provide food and a habitat for them; so less respiration would be carried out which results in less carbon dioxide production and release into the atmosphere.

Many candidates were able to give good responses to Part (c) which required that candidates suggest three ways in which humans can make changes in their day to day activities to reduce the amount of carbon in the atmosphere. An example of a candidates' response that was awarded full marks was:

> *Three ways in which humans can make changes in their day to day activities to reduce the amount of carbon in the atmosphere are: carpooling so that there are less vehicles to produce carbon monoxide; dispose of garbage properly or otherwise recycle rather than burning it so that burning is kept down to a minimum; and walk or use bicycles when going short distances to minimize the burning of fossil fuels.*

A common misconception was that aerosol sprays and chloroflurocarbon compounds (CFCs) release carbon dioxide into the atmosphere.

Question 5

This question tested candidates' knowledge of genetic terms, continuous and discontinuous variation and the theory of natural selection as well as their ability to use genetic diagrams to illustrate the pattern of inheritance of albinism (S.O. C2.6, 3.2, 3.3, 4.4). The performance on the question was poor with the mean mark obtained being 5 out of 15 marks.

Part (a) of this question examined candidates' ability to define the terms: genotype, phenotype, recessive and dominant. This was very poorly done as most candidates seemed unfamiliar with the terms. The genotype can be described as the alleles or genes that an individual possesses while the phenotype is the physical expression of those genes/alleles. Recessive is the term used to describe the allele that this not expressed in the phenotype of the individual who is heterozygous. Dominant is the term used to describe the allele expressed in the heterozygous state. Some misconceptions that were repeatedly observed in several candidates' responses to this part of the question were that dominant genes are strong or superior while recessive alleles are weak.

In Part (b) (i), candidates were asked to give two examples of continuous variation. Most candidates correctly identified height, weight and length as characteristics which show continuous variation but Part (b) (ii) which required candidates to use appropriate symbols to draw a genetics diagram to show the genotypes of the parents and expected phenotypes of the offspring of a man with normal pigmentation and an albino woman was poorly done. Many candidates were awarded at least two marks for using appropriate symbols to represent the alleles for normal pigmentation or albinism and correctly identifying either the mother's or father's genotype. Very few were able to correctly illustrate how the alleles from each parent would pair up during fertilization using a punnett square. Some candidates did not state the phenotype of the offspring produced or used sex linked alleles and were not awarded any marks. A candidate response that was awarded full marks was:

*Let **A** represent Normal pigmentation*

*Let **a** represent Albino*

Parent phenotype	*Father with normal pigmentation*			*X*	*Albino mother*	
Parent genotype		*Aa*		*X*	*aa*	
Gametes	*A*	*a*		*X*	*a*	*a*

Fertilisation

	A	*a*
a	*Aa*	*aa*
a	*Aa*	*aa*

Offspring genotype	*Aa*		*aa*
Offspring Phenotype	*Normal pigmentation :*	*Albino*	
Phenotype Ratio	*1*	*:*	*1*

Part (c) required candidates to use the theory of natural selection to account for the fact that many antibiotics used to control tuberculosis are no longer effective. This part was poorly done as several candidates were unfamiliar with the role of antibiotics, the disease tuberculosis as well as with the theory of natural selection. Candidates were expected to explain that variation exists among bacteria that cause disease and some of

these bacteria were naturally resistant to the antibiotics. These bacteria would survive when persons take these antibiotics and be able to reproduce and produce offspring that are also resistant because they would inherit the genes. Eventually more surviving bacteria will be resistant to the antibiotics.

Question 6

This question assessed candidates' knowledge of coordination and movement in animals, as well as accommodation by the eye (S.O. B6.6, 7.2(i), 7.5, 7.9). Performance on this question was also poor with a mean of **5** out of 15 marks.

In Part (a) (i), candidates were asked to name three types of tissue which coordinate to bring about movement in animals, then state three reasons why it is important for animals to be able to move. This was very well done as most candidates were able to name bones, muscle, connective tissue or nerve tissue. Finding food, a mate, escaping predators, finding favourable habitats were correctly identified as reasons animals need to move.

In Part (a) (ii), they were required to explain why plants are able to survive without moving from place to place unlike animals. This was also well done as candidates explained that plants use the raw material in their environment to make their food or their mates are selected by pollinators such as wind, water or animals.

In Part (b), candidates were asked to describe the changes that occurred in the eyes of a father to keep the face of his son in focus as his son stepped down onto a tarmac and ran towards him. This was poorly done by most candidates. Many candidates only described the pupil reflex which controls the amount of light entering the eye. They were expected to describe how accommodation occurs to allow the eye to adjust to see an object at different distances from the eye. In this case, candidates were to explain that when the son was far away from the father, light from the son's face entered his eyes through the pupils then fall on the retina. Light rays from the son's face are coming from a distance so they are almost parallel, hence they do not need to be bent or refracted too much. The ciliary muscles would be relaxed and increase the tension or pull on the suspensory ligaments. These ligaments pull on the lens in the eye causing the lens to become flat/thin. As the son approaches the father (gets closer), the light rays from his face become more divergent and need to be bent (refracted) more. The ciliary muscles in father's eye contract releasing the tension on the suspensory ligaments attached to the lens. The lens become more convex/bulge in order to bend the light rays unto the retina.

It was observed that many candidates did not spell the names of the eye structures such as ciliary muscle and fovea correctly.

PAPER 032 – Alternative to the SBA

This paper assessed all of the practical skills required of biology students. Candidates continue to display weak practical skills especially in aspects of doing drawings, planning and designing including manipulating apparatus, describing methods of experiments, identifying limitations and in drawing conclusions from data. These observations suggest that many candidates *were not exposed to actual experimenting and investigation of scientific phenomena, discussing observations and giving explanations* so that students become capable of developing and manipulating experiments and experimental data on their own.

Question 1

This question tested candidates' knowledge of the structure of a fruit, germination, asexual reproduction, (S.O. B2.5, 4.10, 4.11, 9.10, 9.11 and C2.1) as well as a range of their experimental skills. Performance was generally poor. Candidates were able to score a maximum of **29** marks of the 35 marks available. The mean for this question was approximately **11**.

In Part (a), candidates were provided with a drawing of a longitudinal section through a tomato fruit. Their ability to draw and label the longitudinal section through a tomato fruit at a magnification of X2 was tested. Although some drawings were accurate in their representation of the fruit, many were disproportionate in

representing the distance between the outer and inner wall of fruit, as well as the size and distribution of the seeds. Many candidates were also not awarded full marks because they did not use clean continuous lines or shaded structures such as the sepals. A few candidates were not familiar with how to calculate the magnification of their drawing nor did they use a ruler to check the magnification of their drawing to ensure it was in the range of two times the size of the original drawing as required. Many were unfamiliar with the parts of the fruit. The sepals were often labelled stem and the fruit wall was called a cell wall or cell membrane. Candidates are being reminded that label lines should be drawn with a ruler and should touch the structure being identified.

Part (b) required candidates to describe the procedure that was carried out to test the presence of food nutrients in a sample of tomato juice and based on the observed results stated, tell the conclusion for each test. Performance on this part of the question was very disappointing. Very few candidates described the sequence of each procedure for each food test correctly. In testing for reducing sugar using Benedicts solution, some candidates did not mention that the mixture should be heated. In describing the protein and starch tests, some candidates incorrectly said that after copper sulpate was added in the case of the protein test or after iodine was added in the case of the starch test, the mixture should be heated. In some instances, candidates did not test a sample of tomato juice as instructed but described reagents they used in class to do food tests such as glucose solution, egg white, vegetable oil and starch solution. Some candidates described the emulsion test using ethanol instead of the grease spot test, to test the juice for the presence of fat even though the observation mentioned that there was a water mark on the filter paper.

In Part (c), candidates were given a diagram of apparatus set up to investigate one of the conditions necessary for the germination of tomato seeds. One set of apparatus was set up in a transparent box at 29°C while the other was set up in a black box at 29°C. Part (i) asked candidates to write a suitable aim for this investigation. A few candidates did this part of the question well and only included one condition to be investigated but some candidates wrote the title of the figure provided in the question. A suitable aim that was awarded full marks was: *To investigate if tomato seeds need light to germinate.*

In Part (ii), they were asked to suggest two precautions that need to be taken to ensure that the results of this investigation are valid. This was also well done by most candidates. Precautions that were awarded marks included ensuring that the temperature for each apparatus is maintained at 29^{0}C; ensuring that the cotton wool remains moist, ensuring the same number of seeds are used in each apparatus.

Part (iii) required that they explain the importance of moisture in the cotton wool. This part was not well known. Candidates had several misconceptions about the role of moisture in germination including that moisture was to allow for cooling or maintaining a constant temperature/environment for germination to take place or to provide oxygen. The moisture is needed for activation of the enzymes in the cotyledon of the seeds to breakdown food stores to provide nutrients for the developing embryo.

Part (iv) asked candidates to describe how the investigation could be modified to determine if oxygen is necessary for germination. Most candidates were awarded at least one of the two marks for mentioning that oxygen would be excluded from one of the tubes but only a few candidates were able to explain that this could be done by using pyrogallol to absorb oxygen or by using a rubber stopper/bung or paraffin to cover the test tube.

Only a few candidates were able to suggest that some seeds that were planted deep in the soil germinated but did not come up above ground because their food stores were limited or used up before the plumule was able to reach light to photosynthesize as was required in Part (v).

In Part (d), candidates were given drawings of six germinated tomato seedlings collected at different times after the experiment was set up. They were also told that the magnification of each drawing is x3. They were asked to measure the length of the radicle of each of the tomato seedlings and record the measurements in a suitable table in the space provided. Many candidates were able to construct tables with appropriate row and column headings to record their measurements. It was however evident that some did not measure only the length of the radicle as instructed but included the seed in their measurement. No mark was awarded if the measurement was incorrect. Candidates are being reminded that they should write the unit of measurement in the column or row heading and avoid cluttering the table by writing the unit beside each measurement.

Part (e) tested candidates' knowledge of asexual reproduction in plants. In Part (i) most candidates were able to name the type of reproduction carried out by the plant in the diagram provided as asexual reproduction. Candidates that referred to the process as self-reproduction were not awarded the mark. Very few however were able to suggest two advantages of asexual reproduction compared to the production of seeds for reproduction as required in Part (ii). Advantages that candidates were expected to suggest included:

- *Reproduction is faster because plants reproducing asexually do not have a dormancy period like seeds;*
- *Offspring will have favourable characteristics of the parents as they are genetically identical to them*
- *Asexual reproduction is likely to successfully result in the production of offspring unlike some seeds which may not germinate even if conditions are ideal because they are not viable.*

Question 2

This question tested the candidates' knowledge of the structure of human vertebrae (S.O. B 6.5) and their ability to construct a table to represent data as well as to plot a suitable graph to represent data presented in a table. Candidate performance on this question was satisfactory with the mean score being **6** out of a possible 15 marks but the range of marks awarded to candidates was 0 to 14.

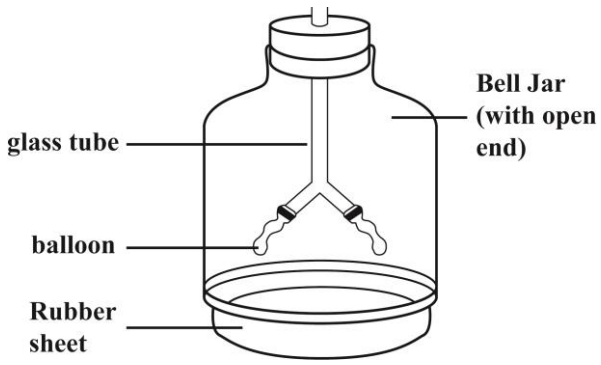
In Part (a), candidates were given drawings of two human vertebrae labelled A and B and asked to construct a table to compare any three characteristics of the two vertebrae. Performance on this part of the question was disappointing as most candidates were unable to correctly name and compare at least two of the three characteristics required. Candidates were expected to compare the shape and appearance of the neural spine, neural arch, centrum, transverse process, neural canal and or facets.

Performance on Part (b) was good. Candidates were given a table showing the average bone density of males and females between the ages of 25 and 85 years and asked to plot a suitable graph to represent the data in response to Part (i), then write a conclusion that could be drawn from the data represented by the graph drawn in Part (ii). Most candidates used an appropriate scale and used fully labelled axes (which included units) to draw their graphs. Some did not include a key to distinguish the female from the male data plots but most candidates plotted all the points correctly. A few candidates described trends observed instead of writing a conclusion as required in part (ii). Candidates were expected to conclude that bone density decreases with age or that the rate of bone density decline is greater among women than among men.

Question 3

This question tested candidates' knowledge of the breathing process (S.O. B3.6) as well as their ability to draw a model of the human respiratory system using suitable apparatus. Performance in this question was disappointing. The mean mark was **3** out of **10** marks.

In Part (a) candidates were provided with a diagram of apparatus used to construct a model of the human respiratory system, namely two balloons, a bell jar, rubber sheet and a rubber stopper with Y-tube inserted. Very few candidates were able to draw an accurate representation of a model of the human respiratory system using the material provided. Clean continuous lines were rarely used to produce the drawings and many candidates were unable to get full marks because they shaded the rubber sheet or did not draw label lines using a ruler. Candidates were expected to draw a model similar to the one below:



Most candidates were able to name the structure in the human respiratory system represented by the rubber sheet as the diaphragm in responding to Part (b).

Part (c) examined candidates' understanding of how the model could be used to demonstrate breathing in humans. This too was very poorly done by most candidates. Candidates were expected to mention that they would pull the rubber sheet downwards (to represent contracting of the diaphragm) in order to reduce the air pressure/increase the volume within the bell jar so the balloons would inflate to demonstrate inhalation of air; and that the rubber sheet could be pushed upwards (representing relaxation of the diaphragm) to increase the air pressure/decrease the volume within the bell jar so air is forced out of the balloons to demonstrate exhalation.

Teachers are again being encouraged to use models to demonstrate important biological processes such as breathing to help students clarify and understand important biological concepts.

PAPER 03 – School-Based Assessment

GENERAL COMMENTS

Performance on the school-based assessment was commendable. Favourable trends which continue to be observed included: good syllabus coverage (i.e. 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 lab books, especially for skills performed poorly suggests that students are not being given adequate feedback on their progress throughout the period of study. Oftentimes only ticks or the word 'Seen' 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 being 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 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 students received high marks for work that fell short of the CXC standard. This was particularly noticeable for Planning and Designing and 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 candidates' 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 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 at most centres. 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 ones 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 before 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, proportions; clarity, labelling and magnification. Teachers should ensure that students are given several opportunities to practice and develop drawing skills.

It is a requirement that drawings must be practiced 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 1 is a list of ‘Do’s and ‘Don’ts applicable to SBA biological drawings:

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

Do's	Don't s
• Use pencils for all Drawing activities – drawing, label lines, labels • Use drawings of actual biological specimen (not diagrams, models or textbook drawings); ensure 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 word "drawing" and not "diagram" • Position title under the drawing and indicate the actual name of the specimen (e.g. 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 e.g. 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 lab activities, especially when reporting observations and/or illustrating biological processes e.g. 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:
    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 very important to labs
- 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 as wide a range of apparatus and their use in collecting data as is possible. 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 are 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 an 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 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.

Figure 1. Example of a Good Planning and Designing Activity

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.