

**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**

**JUNE 2004**

**BIOLOGY**

**Copyright © 2004 Caribbean Examinations Council  
St Michael, Barbados  
All rights reserved.**

## BIOLOGY

JUNE 2004

### GENERAL COMMENTS

The June 2004 examination in Biology at the General Proficiency level was the 24<sup>th</sup> 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 the most popular of the single sciences offered by the CXC at the CSEC level and assesses the performance of approximately 13 000 candidates annually. The examination comprised four papers: **Paper 01 – Multiple Choice; Paper 02 – Structured questions; Paper 03 – Extended essays; Paper 04 – the School Based Assessment (SBA)**. The mean score across all papers for this sitting fell below the mean for the June 2003 examination.

The overall performance of candidates in June 2004 was lower than expected, and lower than the performance in June 2003. Apart from the effects of examining a new syllabus this year, the lower performance of candidates is in part also due to a lack of attention to several suggestions which the Biology examiners have repeatedly made over the past years, and candidates' inability to display skills they are supposed to acquire in pursuing practical work. *Particular attention should be paid to these comments in preparing candidates for the examination, 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, and are as follows:

- In papers where limited spaces are provided for short answers, candidates should NOT **repeat the questions asked**. This leaves insufficient room and leads to the writing of responses in the margins which wastes valuable writing time.
- Candidates wasted time providing information that was irrelevant to the question, gaining no marks. This was particularly notable in Paper 3. Candidates should make better use of the time allotted for reading through the paper by selecting their questions and **planning** their responses BEFORE starting to write.
- Teachers should remind candidates that in preparing for the examination, they should do more than memorize the content. When preparing candidates for an examination, time should be spent practicing how to interpret questions and how to answer questions clearly, concisely and to the point.
- Too many candidates did **not read** the questions carefully. They should be advised to take special note of the cues given in the questions and to underline key words to focus attention on what the question requires. For example, when the question asked for TWO items many candidates gave ONE and lost marks unnecessarily through apparent carelessness.
- The manner in which a question is numbered may be used as a guide to how parts of a question are linked. Candidates 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.

### PAPER 01 – Multiple Choice

Paper 1, as is customary, consisted of 60 multiple-choice items. Performance on this paper was surprisingly lower than that of June 2003. The mean for the paper was **34.32** (57 per cent) compared with 37.20 (62 per cent) in 2003.

Topics that were *most* problematic for candidates were:

- General knowledge of common chemical reactions in the body e.g. hydrolysis, oxidation, glycolysis
- Aspects of nutrition
- Aspects of respiration and excretion
- Bones and their functions
- The eye as a receptor and effector organ
- Metabolic rate and effect on the body temperature
- Distinction between meiosis and mitosis

### PAPER 02 – Structured Questions

Paper 2 consisted of five short-answer structured questions of which the first was the data analysis question worth 30 marks. This paper tested all skill areas identified in the biology syllabus. Performance on this paper was much lower than anticipated and fell below the performance in 2003.

Reports over the last few years have highlighted the need for candidates to pay attention to examination techniques when writing this paper. In particular, attention is drawn to the use of the stimulus material in responding to the questions and the guidance provided by the space allotted to each question. Candidates also continue to display weak practical skills especially in planning and designing, describing experimental methods and in drawing conclusions from data. These observations suggest that **teaching for developing practical skills** *must include discussions, explanations and rationalizing 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 thinking squanders the opportunity practicals provide for **teaching and learning**.

#### Question 1

Question 1 tested a range of experimental skills associated with investigating the properties of visking tubing and movement of particles across this membrane. Among the skills candidates were expected to demonstrate in their responses were means of eliciting information from an experimental procedure, interpreting data, drawing conclusions and modifying/ manipulating an experimental design using the same apparatus but different reactants. The question also required candidates to consider the components of a balanced diet presented in a chart and work out the relationships between the components. Candidate performance on this question was poor. Candidates displayed particular weaknesses in describing the method of the experiment illustrated; explaining the events of the experiment that the apparatus illustrated; and were unable to modify the procedure for a similar type of investigation. *Teachers are thus advised that their students should not only be required to write up experiments in the conventional scientific format, but must also be able to explore the experimental procedures and outcomes to ensure understanding and to determine outcomes of adjusting the experimental procedure. Further, students must be encouraged to express themselves more fully so that they also develop skill in communicating experimental procedures; analyzing data and drawing conclusions **independently**.* Further suggestions for teaching practical work are contained in SBA Biology modules, 1996, in previous schools' reports as well as in the notes contained in the syllabus.

Part (a) tested the candidates' ability to interpret data. In Part (a) (i) many candidates recognized that the substance in the visking tubing was starch but they provided no evidence for arriving at their conclusion. Far too many candidates do not seem to know that the change of iodine to a blue-black colour is a defining test for starch. Their responses included substances such as water, iodine, alcohol, green

pigment and black pepper. Part (a) (ii) asked candidates to account for the difference between the volume of liquid in the visking tubing before and after the experiment. Few candidates gained the mark here. They were expected to say that water moved into the visking tubing by osmosis. In Part (a) (iii) candidates were required to identify the process by which the **iodine** moved into the visking tubing. Few candidates correctly identified the process as diffusion. The majority of candidates made no distinction between osmosis and diffusion which is an important conceptual distinction in Biology. In Part (a) (iv) candidates were required to draw a conclusion based on the experiment. It is clear from their responses that candidates are still struggling with the term – ‘conclusion’. A conclusion is a statement that is based on the results/ data and is related to the aim of the investigation. It should also be noted that the preferred term currently used to describe the cell membrane is **partially permeable membrane** (Institute of Biology on Biological Nomenclature 2000) rather than semi- permeable/selectively permeable membrane. In Part (a) (v) candidates were asked to give a precaution that should have been taken in setting up the investigation. Many candidates were unable to state appropriate precautions such as: *ensure the tubing is not leaking; or carefully wash the outside of the membrane.*

Part (b) of the question asked about changes to the experiment if an amylase enzyme solution were added to the tubing. In Part (b) (i) candidates were required to describe the test suggested to be carried out on the contents of the cylinder after addition of the enzyme, and to state the results expected. This question was fairly well done, but too often the wrong reagents and sequence were used in the test. Part (b) (ii) asked candidates to draw a conclusion based on the expected results in (b) (i). Few candidates seemed to realise that digestion of the starch would produce a reducing sugar and failed to make a clear statement in this regard. Similarly, Part (b) (iii) which asked candidates to explain the results they expected in Part (b) (i), was poorly done. Candidates were expected to explain that amylase converts starch to maltose, which can diffuse through the membrane. In Part (b) (iv) candidates were asked to show how the investigation helped to demonstrate why digestion is necessary. While many candidates were able to demonstrate **why** digestion was necessary, too often digestion was synonymously used with absorption. This also showed quite clearly how imprecisely candidates use biological terms, for which they cannot be rewarded.

Part (c) (i) asked candidates to use the apparatus in Part (a) with different reagents to demonstrate that proteins can be absorbed after digestion. Although a few candidates provided some very good answers, the responses to this question were generally poor. The expected answer should have included details on: *set up of apparatus; a control; enzyme added to protein; food test carried out at intervals to note colour change over time; repeating of experiment.* A good response for this part of the question was:

Protein would be put in the visking tube and NaOH (aq.) and  $\text{CuSO}_4$  (aq.) in the graduated cylinder. When the solution diffuses into the tube, purple colour appears, hence protein present but cannot escape visking tube. Add proteases (trypsin and pepsin) into visking tube then test the contents of cylinder for amino acids using a suitable base. Proves that nutrients can only be absorbed after being broken down.

The protein test was generally known, but common misconceptions were that ‘amylase is a reducing sugar’ and that ‘amylase breaks down protein’. In Part (c) (ii) Candidates were asked to state one limitation of the method which they described. Most candidates did not gain the mark here suggesting once more weak Planning and Designing skills. Acceptable responses included *the problem of ensuring that enzyme and protein were thoroughly mixed or the extended period of time for protein digestion to occur.*

Questions in Part (d) were based on the components of a balance diet presented in the form of a pie chart. In Part (d) (i) candidates were asked to suggest why staples were the largest share of the diet. Most candidates obtained this mark by suggesting ideas that included the provision of one of the following - *energy, fibre, bulk or high satiety value.* In Parts (d) (ii) and (iii) respectively, candidates were required to convert the information on the pie chart to percentages and construct a bar chart. These were generally well done, although some candidates did not differentiate between a histogram and a bar chart. A few drew line graphs. In Part (d) (iv) candidates were required to state with a reason, which method (bar graph or pie chart) of displaying food groups would they consider more appropriate. Many candidates had difficulty in answering this question. Either response was acceptable with the appropriate reason. *Bar graphs show the differences more precisely or pie charts are easier to see at a glance/understand.*

## Question 2

This question dealt with aspects of an ecological study. Part (a) required that candidates use the table of data on the number of plants and animals collected in an ecological investigation to answer specific questions. In Part (a) (i) candidates were asked to use the estimated numbers of organisms to identify one species that was likely to be a predator and two that were likely to be herbivores. The majority of the students scored full marks for correctly identifying the appropriate species. Some candidates lost one of the available marks because they identified only one herbivore and not the **two** for which the question asked. In Part (a) (ii) candidates were asked to give a reason for each of the choices made. Very few students scored marks here. The majority of candidates did not use the numbers given in the table, but simply stated what predators and herbivores ate. In addition, many candidates gave a reason for **one** choice only. Candidate responses to this part of the question highlight two examples of the poor test-taking skills that candidates habitually display – **not reading the question carefully and not using the information provided as stimulus material for the question**. Part (a) (iii) was well done by candidates. The majority were able to suggest ways in which a class of students might affect the organisms in a field study and included in their responses ideas such as: *removal/killing organisms; disturbing/disrupting their activities; trampling the grass/ destroying the habitat*.

In Part (b) (i) candidates were asked to use the information provided in the table to explain how the students carrying out the investigation were able to estimate the number of Rabbit Bush in the field. Many candidates did not know how a quadrat is used and were thus unable to provide an appropriate explanation. They generally knew how to calculate the average number of bushes per quadrat but could not explain how to estimate the number of bushes in the field using the data from the quadrat counts. In Part (b) (ii) candidates were expected to explain whether the method used to estimate the plants would also work for estimating animal populations. While the majority of candidates were able to state that the animals moved and plants did not, they often failed to show that their moving would affect the counts and introduce more than acceptable error through animals being counted twice, more than twice or not at all if they are hiding or have moved out of the quadrat. Candidates were generally able to state at least one way in which the students carrying out the investigation might have collected animals which was asked for in Part (b) (iii). Candidates are expected to have experience in using bottles, nets, *jars/traps* for collecting small animals in the field following prescribed guidelines.

In Part (c) candidates were asked to give reasons why the leaf litter habitat was important for the survival of woodlice. The expected responses were to specify that the habitat afforded protection from any two of: *desiccation, predators* and *high temperatures*. Most often candidates cited the leaf litter as a food source, which though accepted was not a completely satisfactory response. Further, many candidates simply said “for protection” which was considered too vague a response. Some candidates seemed to be confused by the terms ‘predator’ and ‘prey’ and suggested that animals in the leaf litter were ‘protected from prey’. Reference is again drawn to the imprecise use of terms and the resulting inaccuracies.

## Question 3

This question dealt with the structure and function of stomata, guard cells and epidermal cells of a variegated leaf. Overall candidate performance was weak. The majority of candidates knew little about the structure and function of guard cells and stomata or the relationship between them. In their answers, many candidates confined the function of the stomata to their role in transpiration and excluded their role in photosynthesis. It is important for students to note that stomata serve gaseous exchange in leaves for **all** processes in which exchange of gases is a feature.

In response to Part (a) far too many candidates claimed that ‘guard cells were for guarding. They were expected to indicate that guard cells *regulate the size of the stoma* while the stoma *allows the exchange of gases*. An acceptable response to Part (a) (iii) was:

Guard cells are sausage-shaped cells, whose inner walls are thicker than their outer walls, the cells bulge when they are turgid. This results in the opening of the stomata, they collapse when flaccid resulting in closing of the stomata. They contain chloroplast and can photosynthesize. In contrast epidermal cells are closely packed rectangular cells with no chloroplast, to allow light to enter the

leaf for photosynthesis. They are covered by a cuticle to prevent excessive water loss and to protect the inner cells from damage and disease.

Common misconceptions were: 'Guard cells are like muscles, seeds, fruits and pollination.'; 'Water was obtained via the stoma'; 'epidermal cells have chloroplasts and guard cells do not'.

In Part (b) candidates were asked to examine a table showing the distribution of stomata in a variegated leaf. In Part (b) (i) they were required to compare the numbers of stomata on the lower and upper surfaces of the leaves and to suggest ONE advantage of the difference in the number of stomata between the surfaces. Many candidates provided calculated differences as their comparison while others ignored this part of the question altogether indicating lack of the basic practical skill of reading data. In offering an explanation for the difference some candidates suggested that the 'stoma admits light so that by being underneath it was protected', and 'water entered the stoma so when rain fell water could not enter'. One of the better responses was:

There were more stomata on the lower surface of the leaf to reduce water loss. With fewer stomata on the exposed upper surface water loss is reduced from that surface.

Candidates performed poorly on Part (b) (ii) in which they were asked to suggest the conclusion that the researcher might draw about the function and importance of stomata based on their distribution in the areas of the lower epidermis given in the table. Candidates were expected to consider the preponderance of stomata in the green areas and make the link with photosynthesis. However, many candidates linked the importance to transpiration and could provide no rationale for this claim. Part (b) (iii) of the question was well done by a majority of candidates. They were required to identify the habitat in which plants with few stomata on both sides of the leaf were found. They were also to explain the benefit of this adaptation. Many candidates identified dry habitats and the fact that fewer stomata on both surfaces reduced water loss. In Part (b) (iv) candidates were required to suggest what difference in their function might allow plants found in dry habitats to thrive despite the fact that their stomata remained closed throughout the day. Candidates were expected to think of the plant taking up carbon dioxide when the stomata were open at night for use in photosynthesis during the day. A good response was worded as follows:

The plants absorb carbon dioxide (which they store) during the night when their stomata are open. This stored carbon dioxide is used during the day in photosynthesis.

#### Question 4

This question examined candidates on their knowledge of the menstrual cycle, development of the zygote and sexually transmitted diseases. Candidate performance on this question was moderate with a mean of **6.4** out of **16** and a mode of **7**.

In Part (a) candidates were asked about the events that take place during the monthly cycle of oestrogen and progesterone. In Part (a) (i) they were required to use arrows on the graph of the menstrual cycle presented to show where certain changes would occur during the monthly cycle. This part of the question was not well done. Candidates were expected to place the arrows to show that pregnancy could occur after Day 14 of the cycle, the breakdown of the lining of the uterus before Day 7 and that the corpus luteum would shrink after Day 25. Candidates did not use the arrows as required by the question. Some used arrows of different lengths and types than given. Some had the arrows overlapping so that the examiner was not sure where they pointed and others used their own versions of the arrows so the examiner could not identify the event to which the candidate referred. In Part (a) (ii) candidates were asked to name the hormone identified as Q on the graph and to give one function. This question was fairly well done. The majority of the candidates identified hormone Q as oestrogen and were able to give one of its function.

In Part (b) candidates were questioned about further changes in the female after fertilization. Part (b) (i) required candidates to add a line to the graph to show changes in the level of progesterone after fertilization. This part of the question was fairly well done. Most candidates recognized that the level of the hormone

would remain high and indicated this in various ways on the graph. Part (b) (ii) which asked candidates what happens to the zygote after fertilization was also fairly well done. Candidates generally indicated that the zygote divided and became implanted in the uterus. However, few candidates specifically stated that fertilization actually occurred in the fallopian tube and after several divisions the developing embryo moved down to the uterus for implantation. A common and serious **misconception** was that the zygote divided by meiosis. In Part (b) (iii) candidates were asked for two ways excluding a pregnancy test that would suggest a woman is pregnant. This was well done with candidates providing a range of responses such as ‘menstruation stops’, ‘nausea and vomiting occurs’, and ‘increase in size of the abdomen’. There was also the misconception that pregnancy is a ‘sickness’.

Part (c) examined candidates on the effects sexually transmitted diseases (STDs) might have on the reproductive process. They were told that STDs can cause scar tissue which block ducts in the male and female reproductive systems and were asked to explain how this blockage can lead to sterility. Most candidates performed well, citing that in the female if the fallopian tube is blocked the egg could not come down to be fertilized, and in the male sperm would not be present in semen. A few candidates erroneously thought that the blockage would prevent the release of the egg or sperm.

Part (d) asked candidates to explain why AIDS, although a sexually transmitted disease did not directly affect the reproductive system. This section was poorly done. Candidates were generally able to state that the AIDS virus destroyed and weakened the immune system. However, they did not explain that while the immune system was the target, the virus actually **gained entry** into the body through the reproductive system. A common misconception was that AIDS is a deficiency disease.

#### Question 5

This question required candidates to interpret data from a table, which gave the effect of temperature and IAA (an auxin) on the germination of passion fruit seeds in six different locations. The table gave the results for seeds treated with IAA and untreated at room temperature and under refrigeration. Candidate performance on this question was fair with a mean of 7 out of 15 and a mode of 7.

In Part (a) (i) candidates were asked to calculate the percentage germination in a specific location at room temperature for seeds treated with IAA. Many candidates were unable to use the data from the table for the calculation. Candidates generally identified the number of seeds that germinated at the location but they could not identify the correct denominator in order to compute the percentage. Candidates clearly need more practice in making simple mathematical calculations that provide a means to manage and interpret biological data. In Part (a) (ii) candidates were required to draw a conclusion about the effect of temperature on the germination of the seeds based on data provided in the table. Most candidates were able to conclude that the rate of germination was higher at room temperature. Too many candidates, however, were unable to distinguish a conclusion from an observation and simply indicated the number of seeds germinated at the temperature. In Part (a) (iii) candidates were to explain how the difference in temperature accounted for the results shown in the table. This section was poorly done. Many candidates simply repeated the answer they had given for Part (a) (ii) rather than give a reason why there was a difference in germination shown by the data in the table. Many candidates merely gave a general answer such as “seeds germinate better at higher temperatures” with no reference to the data nor to the particular question asked. The response to this question was expected to include the idea of *reduced enzyme activity and metabolism as a result of lower temperature*.

In Part (b) candidates were asked about the influence of IAA (auxin) on plants. In part (b)(i) they were asked to explain whether the table showed that IAA affected the results. This section was well done by most candidates. However, too many candidates seem to believe that a difference of 1 is significant when compared to no difference. This error also underscores candidates’ unfamiliarity with reading and interpreting data. Candidates did not perform well on Part (b) (ii) which asked about the role of IAA in a plant. They narrowly thought of IAA as important in the response of plants to stimuli such as light or gravity and did not seem to recognize the more general role of IAA as a *growth hormone produced in the tips of shoots and roots and responsible for elongation of the respective organs*.

Part (c) asked questions in which candidates were required to extrapolate about the conditions that may have affected the growth of the seedlings suggested by the results given in the table. In Part (c) (i) candidates were required to identify the location in which the seedlings grew fastest. Most candidates were able to correctly identify the location as required. In attempting to identify two conditions needed for growth of seeds which Part (c) (ii) of the question required, a surprisingly large proportion of candidates gave “light” as a condition and explained that it was needed for photosynthesis. This is a familiar misconception of candidates and there is need for teachers to re-emphasise that the conditions which seeds usually require for germination are: *oxygen, water and a suitable temperature*. In addition, candidates seemed unaware of the reasons why these conditions are required for seeds to germinate. For example, many candidates who correctly identified water failed to give its significance in *activating enzymes and transporting dissolved and/or soluble nutrients*. Many candidates who identified oxygen did not indicate its *role in respiration so as to provide energy for growth and other metabolic activities*. Part (c) (iii) asked candidates to suggest how the way in which humans took care of their embryo before birth was **different** from that in the plant. This part was only fairly well done. Candidates who responded reasonably well to the question generally referred only to the provision of nutrients. Very few referred to *gaseous exchange, excretion or protection from bacteria*. Many of the candidates who referred to how the nutritional needs of the human embryo were met did so without reference to the role of the placenta or umbilical cord.

### PAPER 03 – Extended Essay

Candidates’ performance on this paper was slightly better than that in June 2003 with the mean at **40%** compared with the previous mean of **39%**. Nevertheless some observations about candidate performance remain consistent. Candidates demonstrated a continuing ability to write at length about biological events, principles and concepts. They also continued to display the tendency to provide all the information they knew on a topic rather than select what was pertinent to answering the question. There was also evidence that in spite of time allotted for reading the paper, candidates missed key words in the questions and provided answers which were off the point. It is thus reiterated that candidates should be advised that the reading time should be used to read through each question carefully, highlighting key words on which the questions hinge, so that they would be less likely to misread and misinterpret questions. **The reading time should also be used to plan their responses so that they are more likely to stick to the relevant topics.** It is clear that much time is spent on teaching and learning the content of the syllabus. However, more attention needs to be paid to important examination techniques which will allow candidates to make the best use of what they know.

#### Question 1

This question tested candidates’ knowledge of fruit and seed dispersal and ways in which plants are adapted for successfully inhabiting their environment. The question also examined candidates’ understanding of the role of ‘nature’ in controlling plant and animal populations. Candidate performance on this question was unsatisfactory.

In Part (a) candidates were required to describe two different methods of seed or fruit dispersal including relevant adaptations and examples. This part was badly done. This was rather disappointing given the basic biological knowledge involved. The most frequent errors made by candidates were: describing pollination rather than dispersal; describing flower, seeds and seedling as one and the same; mistaking egestion for excretion. Many candidates stated how the seeds / fruits were moved from one point to another without stating the relevant adaptations.

Part (b) of the question asked about alternatives for plants without special dispersal mechanism and required candidates to deduce possible plant adaptations for a given scenario. Both sections of Part (b) were not at all well done. In Part (b) (i) candidates were required to suggest why although many seeds from plants with no special dispersal mechanism germinate, few reach maturity. Candidate responses were expected to include ideas such as: *overcrowding; competition for nutrients/ light/ water; some were better adapted than others – more viable; more efficient; some grew faster* for those that grew to maturity compared to those that *were less well adapted and died*. Some candidates who included the ideas of overcrowding and competition for food were not specific and thus failed to gain many of the available

marks. An example of such responses was simply stated as: “over-crowding and competition for resources” – omitting what the resources were. Part (b) (ii) described the behaviour of the fruit, seed and seedlings of a type of forest tree and asked candidates to suggest the characteristics that these parts of the tree might have. This part of the question was not well done. Many candidates re-wrote the information provided in the stimulus material or gave a list of the conditions required for germination, ignoring the stimulus material. Candidates were expected to indicate that *the fruit/seed would be large/heavy; have tough outer coverings – not easily rot; store large amounts of food material. They were also expected to consider that the seedlings would grow faster and not need much light.*

Part (c) of the question, which examined candidates’ understanding of the natural ways by which the growth of human populations might be controlled, was not done well. Candidates were expected to refer to such conditions as: *adverse climatic conditions/ weather; disease; scarcity of food.* They were then required to explain how these factors affect human populations and why human populations may be less vulnerable to some of their adverse effects. The most frequent misconception shown by candidates was in the meaning of the term ‘nature’. In Biology ‘nature’ refers to natural conditions or conditions not caused by human interference. In a Biology examination the precise biological meaning of a term is expected and this may be different from the use of the same word by the layman.

## Question 2

This question was more popular among candidates than its counterpart in Section A. It tested candidates’ knowledge of heterotrophic and autotrophic nutrition, adaptations of heterotrophs and some aspects of ecology. Candidates performed poorly on this question and their performance was quite similar to their performance on Question 1. Candidate performance was all the more disappointing given the fundamental nature of the topics in the subject. The mean for this question was consequently low and candidates failed to score across the range of marks.

In Part (a) (i) candidates were asked to distinguish between heterotrophic and autotrophic nutrition. Candidates were unable to make a satisfactory distinction. Their responses were expected to make distinctions between autotrophic and heterotrophic in terms of *the use of simple substances compared with complex ones; inorganic versus organic; making of own food compared with depending on other organisms*, respectively. Candidates generally need to develop their comparison skills. When making comparisons candidates need to draw attention to the distinctions or similarities point by point and not simply provide two consecutive descriptions.

Part (a) (ii) required candidates to identify three types of heterotrophic organisms found in food webs, giving examples, and to explain why different types of nutrition are found in food webs. This part of the question was also not very well done. The expected response was: *carnivore, herbivore and omnivore* with appropriate examples. Most candidates failed to consider these nutrition types and cited ‘saprophytes’, ‘parasites’, which were rewarded, and others such as ‘predator-prey’ and ‘symbiotic’, which were not rewarded. Few candidates were able to provide an adequate explanation for different types of nutrition in food webs and seemed unfamiliar with the following ideas: *in food webs there is a dependence on plants as the energy source; there is interdependence among organisms in the food chains; the variety of types of nutrition reduce competition for resources; there is a concept/existence of the ‘niche’ in food webs.*

Part (b) required candidates to explain the adaptations heterotrophs possessed to obtain food, extract nutrients and absorb the extracted nutrients. Although candidates were guided to frame their responses using humans as an example of a heterotrophic organism, they did not perform very well on this part of the question. Candidates spent an inordinate amount of time addressing the process of digestion rather than singling out adaptations for the functions asked and describing how these features are designed to efficiently carry out their functions. For example, candidates were expected to refer to: *hands, mouth, teeth, to catch/grind food; alimentary canal with appropriate muscles to move food; enzymes to break large molecules into smaller ones; increased surface area in absorptive parts of the alimentary canal to facilitate the uptake of digested food.*

Part (c) asked candidates to suggest why food webs can be considered large recycling systems and farms disrupted food webs. Performance on this part of the question was poor. Candidates needed to show how the cycling of materials occurred in food webs. They were expected to capture the following in their responses: *plants absorb simple substances from the air and soil, materials pass from one trophic level to the next, waste from plants and animals are broken down by micro-organisms, products of the breakdown process are reused by plants.* With respect to the view that farms were disrupted food webs. Candidates were expected to show how the farm, although generally functioning like a food web, had a number of key differences primarily related to the artificial nature of farms: *plants removed as crops and not recycled; farm animals and pests are killed; artificial chemicals are added to the soil.*

### Question 3

In Section B, question 3 was the preferred choice of the candidates. It examined their knowledge of the relationship between photosynthesis and respiration, the impact of humans on the environment and conservation methods. Candidate performance was fair as shown by a mean of **9** and a mode of **10**. In addition, candidates were able to score across the range.

In Part (a) candidates were asked to explain the relationship between photosynthesis and respiration outlining the processes involved. Most students were able to give information on photosynthesis although many could not give a balanced chemical equation for the process and felt that it occurred in either of the 'chlorophyll', the 'palisade tissue' or simply in the 'leaf'. Candidates were expected to cite the chloroplast. The site where respiration occurred was also not well known. Few candidates identified the mitochondrion as the site of respiration and many stated that the process just took place in the cells. Candidates generally did not seem to know about the photolysis of water and reduction of carbon dioxide to carbohydrate in the photosynthetic process even though this is a clear syllabus objective. The text of a good response was:

The products of photosynthesis are glucose and oxygen. These are the reactants for respiration and the products of respiration, carbon dioxide and water are the reactants of photosynthesis. Photosynthesis takes place in the chloroplasts of cells and involves the splitting of water molecules into hydrogen and oxygen atoms using light energy from the sun. The hydrogen atoms react with carbon dioxide to form glucose which is converted to other carbohydrates. The process can be represented by ... (correct equation given).

Respiration is the process in which living organisms release energy from glucose. The reaction takes place within the mitochondria of cells and oxygen is usually used up in the process. It can be represented by the following equation: ... (correct equation given).

Several **misconceptions** were noted in the responses to this part of the question. These included: respiration is the same as transpiration; both processes give off energy; and perhaps the most common misconception - photosynthesis occurs in the day only, while respiration occurs in the night only.

In Part (b) (i) candidates were asked about the effects of removing vegetation on a large scale from a forested area and replacing it with a national park with ornamentals as a tourist attraction. Most candidates seemed well aware of the effects of removing large tracts of vegetation from a forested area and gained most of the available marks. A few candidates seemed to think that 'ornamental flowers' meant artificial flowers. Some were also confused by the concept of 'on a large scale'. Such candidates wrote extensively on 'global warming', 'increase in carbon dioxide concentration', and 'depleted oxygen levels'. A national park in their minds contained large animals that could be dangerous. Candidates were expected to include in their responses: *destruction of flora /fauna; soil erosion; introduction of pests and diseases among other ideas.* A good response follows:

Large-scale removal of trees will result in soil erosion. Leaves act to buffer the impact of rain drops and allow percolation of water into the soil. Roots also bind the soil particles together. The removal of trees, therefore, allows water and wind erosion to occur. In addition, there is the loss of fauna associated with the habitats created by the presence of trees. These animals will either die or be forced to move to other forested areas since their habitats and food supply will be destroyed.

Part (b) (ii) asked candidates to create rules relevant to conservation for visitors to the park and explain the importance of each rule to conservation. This part of the question was quite well done. Candidates' responses included: *proper garbage disposal; number of vehicles entering the park; no removal of plants; no walking on lawns; no picking of flowers* among other ideas. Some skilfully linked an economic rule to a 'conservation explanation'. However, some candidates ignored the part of the question that asked for an explanation of the importance to conservation and only stated the rules. This also shows how candidates unwittingly and /or unnecessarily lose marks.

#### Question 4

This question examined candidates understanding of the importance of blood to the body, blood constituents, the importance of blood groups, how blood groups might be inherited and the function of blood components. Of the pair of question in Section B, question 4 was less popular but was generally well done. The mean for the question was **10.58** and a mode of **14**, one of the highest scoring essay questions in the history of the examination. Several candidates scored full marks.

In Part (a)(i) candidates were asked about the effects of prolonged loss of blood. Most candidates were able to suggest several effects. However, candidates generally failed to mention those effects related to the *loss of water* and resulting *lowering of metabolism*. Generally, unsatisfactory responses were made to Part (a) (ii) which asked why it was necessary to place the child, who was involved in an accident, on a 'drip'. Candidates simply perceived the 'drip' as 'life saving' with the function of, replacing blood which was lost or making blood. Candidates were expected to include in their responses concepts such as *re-hydration of the body or increase energy level*.

Part (b) (i) of the question required candidates to use appropriate diagrams to show how the child in question could derive a blood type that is different from both parents. While most candidates were able to correctly represent the inheritance of the blood type, in several instances their diagrams and symbols did not adhere to genetic conventions. Adherence to the conventions for inheritance should be encouraged. One misconception was that blood-type inheritance is sex-linked. Part (b) (ii) asked for two reasons why people may be reluctant to donate blood. This part of the question was reasonably well done. The most common response was: 'fear of contracting or passing on diseases'. Common misconceptions were that deficiency diseases as well as hereditary diseases can be passed on through blood transfusion.

Part (c) was generally well done by candidates. They were required to explain the function of four essential components of artificial blood. A number of candidates did not identify the blood component for which they were highlighting the function. This shows inadequacy in test-taking skills. The better responses always made a clear relationship between the blood component and the function and thus accessed the marks allotted more readily.

#### Question 5

This question was the less popular of the pair of questions in Section C. It tested the candidates' knowledge of cloning, meiosis, sex determination and the application of genetic engineering. Candidate performance was only fair although candidates were able to perform across the range of marks for the question. The mean score was **6.44** while the mode was **7**.

In Part (a) (i) candidates were asked to explain why all members of a clone have the same genetic makeup. This question was fairly well done, but many candidates did not include in their explanation that *chromosomes replicate prior to mitosis, so that the daughter cells produced contain the same DNA or genotype as the parent cell*. Several candidates were unable to distinguish between mitosis, meiosis and binary fission. In Part (a) (ii) candidates were required to explain the terms –'separation of homologous chromosomes' and 'separation of chromatids' and further, to indicate why these events are important. This question was not well done. Many candidates described the stages of meiosis, but did not mention the importance of the separation of homologous chromosomes and chromatids. Candidates' explanations were expected to include such concepts as: *homologous chromosomes refer to the pairs of chromosomes; one member of this pair is derived from each parent; crossing over occurs prior to the separation of*

*homologous chromosome; separation of homologous chromosomes produces two haploid cell; haploid cells are genetically variable; chromatids separate in the second stage of meiosis to produce four haploid cells.'*

Part (b) of this question required candidates to explain why it was unreasonable for men to blame their partners for having too many female children. This part of the question was only fairly well done. Candidates often showed some misconception about the processes involved in sex determination. Some candidates even had the erroneous impression that male gametes were dominant to female gametes. Candidates were expected to describe the process by which the sex of an offspring is determined. Their responses were expected to demonstrate an understanding that: *sex is determined by the sex chromosomes; the female has two X chromosomes (XX) and the male has an X and a Y chromosome (XY); the female can contribute **only** an X chromosome to her offspring; the male can contribute **either** an X or a Y chromosome; fertilization is random; there is an equal chance of a couple producing a male or female offspring; neither parent directly controls the genetic process.*

Part (c) of the question examined candidates on their knowledge of genetic engineering and its potential. In Part (c) (i) candidates were expected to describe the advantages of removing a defective gene from a zygote or gamete and replacing it with a normal gene, instead of trying to develop a better treatment for the genetic disease. Candidates seemed to know very little about genetic engineering and some thought that AIDS and other STD's were genetic diseases. For some candidates, points were not well developed. A good answer was expected to include the following: *genetic diseases cannot be cured; treating the patient is not permanent; the altered genotype can be passed on to new cells in the organism/ passed on from generation to generation.* In Part (c) (ii) candidates were asked to suggest one advantage and one disadvantage of being able to select certain preferred characteristics and have the appropriate genes inserted into their embryonic offspring. While candidates made some reasonable suggestions, their responses were not well developed. They were expected to cite advantages such as: producing more intelligent, healthier offspring; society may benefit from higher productivity. Disadvantages were expected to include: *expensive only rich could afford the procedure; unethical; religious objections.*

#### Question 6

This question was by far the more popular of the pair of questions in Section C. It tested the candidates' knowledge of deficiency diseases and physiological disorders - hypertension and diabetes. Candidate generally performed well on this question and scored across the range of marks. The question had a mean score of **9.28** and a mode of **10**.

In Part (a) (i) candidates were expected to state the meaning of the term deficiency disease. This part of the question was well done, but sometimes candidates failed to give an appropriate example, such as scurvy, caused by a lack of vitamin C or anaemia, caused by lack of iron. Part (a) (ii) required candidates to explain why some nutritional disorders cannot be called deficiency diseases. Although this question was fairly well done, the responses were not well developed. For instance, some candidates mentioned with reference to a physiological disease the 'inability of an organ to function', but gave no example. A good response contained the following:

Anorexia / bulimia are eating disorders that may lead to deficiency disease, but is not caused by one. Diabetes is a physiological disease, which is related to nutrition but it is not caused by a deficiency in the diet. ...

Far too many candidates believed that these diseases are inherited diseases.

Part (b) of this question asked candidates to compare the causes, treatment and control of diabetes and hypertension. Few candidates made complete comparisons between the two diseases. They tended to describe one disease followed by the other. Most candidates equated treatment with control. Candidates should be informed that treatment deals with supplying care or medication to alleviate an illness and control deals with measures which are taken to prevent an illness or reduce the severity of an illness/condition. Many candidates described the condition and its symptoms rather than distinguishing between their causes, treatment and control as the question asked.

In Part (c) (i) candidates were required to comment on the long-term effect that the high incidence of diabetes and hypertension might have on the development of some Caribbean countries. It was gratifying to note how well students performed on this part of the question. In Part (c) (ii) candidates were to discuss how the change to a more modern life style may be contributing to the increasing incidence of these two diseases in the Caribbean. Some students misinterpreted the question and their responses were related to 'what would contribute to the increasing incidence of these two diseases'. The following was a good response:

Popularisation (sic) of fast foods has led to the consumption of foods with a high fat and sugar content. People drive in cars and have appliances to make housework easier, hence they seldom exercise. People experience a great deal of stress on the road and on the job. These factors contribute to an increase in the incidence of diabetes and hypertension.

A significant number of candidates scored full marks on this question.

## **PAPER 4 – School Based Assessment**

### **GENERAL COMMENTS**

Performance in the School-Based Assessment (SBA) was, for the most part, commendable; the work produced by the candidates was fairly good and most teacher assessments were satisfactory, the standard of marking being close to that expected by CXC. There was good coverage of the required syllabus topics and the number of activities included in the books was generally adequate. There is continuing evidence that Observation Recording and Reporting (ORR) was the best-developed skill while Analysis and Interpretation (AI) and Planning and Designing (PD) are still problematic. This observation highlights the need for a more experimental approach to the SBA. The suggestion is that more practical exercises should be attempted with an approach that facilitates the development of critical experimental skills which is a major goal of the SBA.

A review of previous reports will provide further suggestions for developing practical skills. Further suggestions have been made in this report and each teacher has been alerted to the specific strengths and weaknesses displayed by their candidates in the Moderation Feedback Form sent to schools from CXC headquarters. Teachers should also review the 2002 School's report to obtain an overview of the moderation processes and the expectations of the moderators.

The following are recurring problems:

- Many teachers show a tendency to mark weaker candidates less stringently than they mark more competent students.
- At some centres students are not being assessed the required number of times for each skill. Teachers should try to plan the terms work so that this does not happen in the future as it puts their students at a serious disadvantage.
- Teachers are reminded that body fluids such as saliva, blood and urine should not be used for practical work as these fluids can be sources of infection. Teachers who ask students to use body fluids leave themselves open to legal action should a student claim to have become infected as a result of lab work.

Please note that all lab books are expected to have a complete *Table of Contents, numbered pages* and a clear indication of *which labs have been marked for SBA*. In far too many cases moderators were unable to locate the source of the marks included on the record sheets. This means that moderators have to select the labs to be remarked as part of the moderation process. It should be clear to teachers that this often puts their students at a severe disadvantage.

## SPECIFIC COMMENTS ON THE ASSESSMENT OF SKILLS

### Observation / Recording / Reporting (ORR)

These skills appear to have been mastered at most centres. Tables and graphs were well done, methods were clearly described and observations sufficiently detailed. It should be noted that constructing graphs is a recording skill and is correctly assessed for ORR. However, interpreting graphical data is not a recording skill and must be assessed for AI.

*Fieldwork appears to be on the decline. At some centres little or none is being done. Those centres that attempted fieldwork frequently neglected either the quantitative or qualitative investigations. Both aspects of fieldwork are expected. Investigations need not be elaborate but students should be given the opportunity to learn the required skills.*

### Drawing (Dr)

The standard of drawings appears to have deteriorated at some centres and in some cases only the minimum number of drawings were found in the lab books. Copied text book drawings should not be assessed for drawing skills. Students should make drawings of specimens, seeds etc. Examination of lab books did not always support the excessively high marks shown on the record sheets.

The following should be noted: **All lab books are expected to contain drawings of at least flowers, fruits, a seed, storage organs and bones.** Although it is very useful for students to observe specimens under the microscope and attempt to record what they observed, at this level these drawings should NOT be used for SBA. 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.

### Analysis and Interpretation (AI)

This skill is still presenting problems for the majority of candidates. Discussions are expected to provide some background information or the general principles on which an investigation is based. Results should then be explained. When a control is used it provides 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.

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 of the AI skill. 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.

It should be noted 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.

Moderators were also concerned at the narrow range of investigations assessed for AI. With the exception of patterns of growth in seedlings, very few candidates seemed to have been exposed to investigations other than experiments. Investigations that require collecting observations over a period of time are ideal for discussing limitations as they lack controls and so many variables may change. These limitations can then be used as the basis for planning and design exercises. For example, students can be asked to

find out which of the flowers in a garden butterflies prefer or what types of moths a house lizard eats by completing a table of observations over a period of days or weeks. They can then use the observations to develop a hypothesis and design an investigation that would test it.

### **Planning and Designing (PD)**

Considerable improvements have been noted in this area. Some teachers have been very successful in getting their students to understand the general principles involved. There were also a number of very interesting observations provided for students to deal with. However, teachers must be careful that students are not only taught the format for writing up the exercise as happened in some cases. There were a number of **inappropriate observations** that follow the correct format but do not give students any real designing to do. The following example makes the point clear:

Observation: Bread rises when yeast is used.

Hypothesis: Yeast causes bread to rise.

Aim: To find out if yeast causes bread to rise.

Method: Mix some yeast with flour and see if it rises and compare to flour without yeast.

Expected Observation: Flour mixed with yeast will rise.

**To provide students with a reasonable challenge a suitable variation could be used.** For example, it may be observed that bread rises faster on hot days. Students can then be asked to develop a hypothesis and design an experiment to test it. This would allow a teacher to assess their students' ability to plan and design an experiment more fairly.

The following requirements are drawn to the attention of those teachers who are unfamiliar with them:

- Planning and designing activities should be based on an observation from which students can develop a hypothesis and then plan or design a suitable method for testing the hypothesis.
- A hypothesis that is provided by the teacher should not be awarded marks.
- The observation and the hypothesis, whatever their source, must both be included in the write up of the design, for purposes of assessment. Moderation of a plan is not possible without a hypothesis as the plan only makes sense when it can be matched to the hypothesis.
- Acceptable designs should focus on a single variable. For example, if salted fish is found to have a particular effect on boiled bananas it is reasonable to suggest that the salt is responsible for the observation. The hypothesis should refer to the salt as the variable affecting browning and not the fish.

It is clear that in many cases the only exercises attempted for PD are the minimum number required by the CXC syllabus. This is a disadvantage to the student's, as they cannot be expected to perform well in this skill without adequate practice. It should be remembered that Question 1 on Paper 2 also demands familiarity with this skill. It is suggested that, at the very least, students be encouraged to discuss plans for a given hypotheses from the time they begin preparing for the CXC syllabus.

Teachers should remind their students that practical activities written in the past tense and those that are commonly found in text books will not be accepted for assessing PD.

### **Manipulation and Measurement (MM)**

As in previous years, the marks for this skill were good. However, as was stated in the previous report, in many cases there was reason to suspect that these marks were not the result of rigorous marking. If, as happened in more than one case, virtually all students in a class gain full marks, perhaps the task is not demanding enough or the criteria not detailed enough to allow the necessary discrimination between different levels of performance. Teachers are reminded that marks for MM must be written down in the lab books, next to the labs for which they were awarded, and mark schemes and detailed criteria should be submitted as done for all other skills.