

## Biology

### Report on Student Performance in the Practice Papers

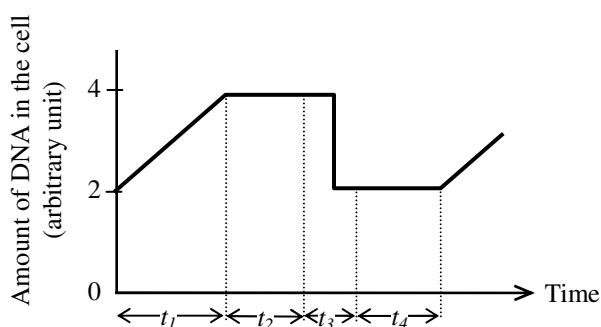
The practice papers were piloted in seven schools with more than 300 students participating in the pilot exercise. Despite the sample size being a little small; students' performance in this exercise should still reflect some weaknesses of students. Readers are advised to study this report together with the selected samples of student performance so that they can gain a better understanding of the high, mid and low performance levels of students in this pilot exercise.

#### Paper 1

##### Section A (multiple-choice questions)

There were 36 questions in this Section. Students' performance was good in general. The mean percentage score was 59.3, and the standard deviation was 13.3. Some misconceptions of students were revealed from their performance in the following items:

2. The graph below shows the change in the amount of DNA in a cell which is undergoing cell division:

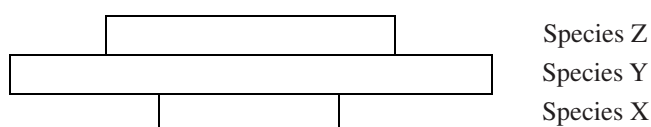


Which of the following statements correctly describes the event that is taking place in the respective time period?

- |      |  |       |
|------|--|-------|
| A.   | During $t_1$ , the nuclear membrane disappears.              | (9%)  |
| B.   | During $t_2$ , the homologous chromosomes pair up.           | (24%) |
| C.   | During $t_3$ , the homologous chromosomes separate.          | (46%) |
| * D. | During $t_4$ , the synthesis of cell organelles takes place. | (21%) |

This was the most poorly answered question in this Section. It tested students' ability to identify the type of cell division from the graph and recall the processes involved in different phases of cell division. About 70% of the students did not pick up the clue from the graph that the DNA content of the daughter cell remained the same as the parent cell. They wrongly chose option B or option C, which are processes involved in meiosis. The increase in DNA content during  $t_1$  indicates that the cell was preparing for cell division. Thus, option A is incorrect as the nuclear membrane was still intact at this phase.

18. In an aquatic ecosystem, species X, Y and Z form a food chain. The following diagram shows the pyramid of biomass of this ecosystem:

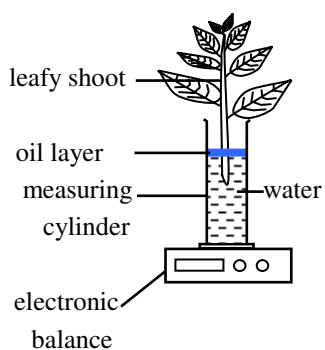


With reference to the above pyramid of biomass, which of the following statements are correct?

- (1) Species Z is the secondary consumer in this food chain.
  - (2) The body size of species X is larger than that of species Y.
  - (3) There is an energy loss when energy flows from species Y to species Z.
- A. (1) and (2) only (5%)
  - \* B. (1) and (3) only (55%)
  - C. (2) and (3) only (14%)
  - D. (1), (2) and (3) (26%)

This question required students to apply their biological knowledge in a pyramid of biomass which was unfamiliar to them. About half of the students did not realise that the body size of the organism has been taken into account in calculating the biomass at a particular trophic level and wrongly chose options that included (2).

27. The diagram below shows a weight potometer used in an experiment. The leafy shoot was left in the laboratory for 3 hours. The change in the reading of the electronic balance and the change in the volume of water in the measuring cylinder were recorded. The experiment was then repeated under the same environmental conditions with the upper surface of all the leaves of the shoot smeared with vaseline. The results are shown in the following table:



Treatment	Change in the reading of the balance (g)	Change in the volume of water in the measuring cylinder (mL)
(I) Leaves <b>not</b> smeared with vaseline	$p$	$r$
(II) Upper surface of all leaves smeared with vaseline	$q$	$s$

Note:

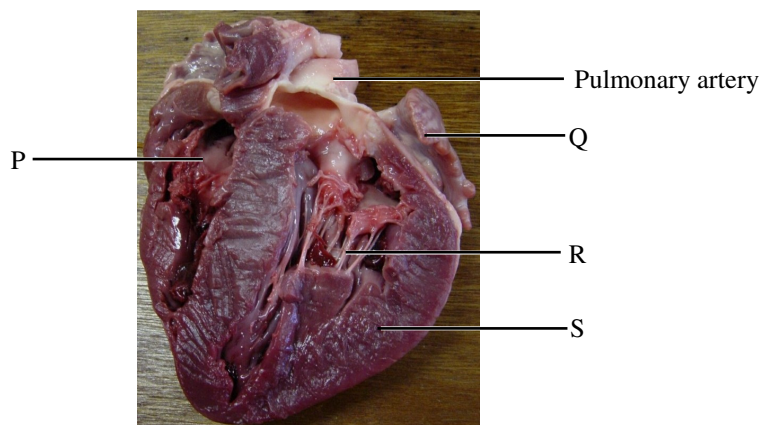
1.  $p, q, r$  and  $s$  are numerical values
2. mass of 1 mL of water = 1 g

From the results of the experiment, we can calculate the amount of

- A. water absorbed by the shoot in Treatment (I) from  $p - r$ . (12%)
- B. water transpired by the shoot in Treatment (II) from  $r - s$ . (23%)
- \* C. water retained by the shoot in Treatment (II) from  $s - q$ . (30%)
- D. water transpired by the lower surface of the leaves of the shoot in 3 hours from  $p - q$ . (35%)

This question required students to understand the design of the experiment. Students had to realise that the change in the balance reading ( $p$  and  $q$ ) indicated the amount of water transpired, and that the change in the volume of water in the measuring cylinder ( $r$  and  $s$ ) indicated the amount of water absorbed. In addition, they needed to realize that smearing the upper surface of the leaves in treatment (II) allowed transpiration to take place in the lower surface only. Hence, the difference between  $p$  and  $q$  indicated the amount of water transpired by the upper surface of the leaves.

31. The following photograph shows a dissected pig's heart:



Which of the following descriptions of the labelled structures is correct?

- A. Structure P contracts to deliver blood to various parts of the body except the lungs. (5%)
- \* B. Structure Q receives blood from the pulmonary veins. (55%)
- C. Structure R controls the opening and closing of the valve. (23%)
- D. Structure S contracts to force the blood out of the heart through the pulmonary artery. (17%)

This question tested students' ability to identify the various structures of a real dissected heart and required an understanding of the functions of these structures. The heart string (R) is responsible for preventing the valve from being turned inside out. However, 23% of the students wrongly associated its function with controlling the opening and closing of the valve. 17% of the students chose option D. They might not have realized from the thick wall that S is the left ventricular wall or that they failed to recall that the left ventricle is connected to the aorta.

**Section B** (conventional questions)

Section B consists of 12 questions set on Topics I to IV of the curriculum. All questions were compulsory. The mean percentage score was 41.3, and the standard deviation was 16.9. The students' performance is summarised in the table below:

Question Number	Performance in General
1.	Performance was good in general. Some students might not have been familiar with the disease 'dengue fever' and wrongly matched the preventive measure 'wrapping rubbish properly before disposal' with it.
2. (a)	Some students gave 'eukaryotic cell' or 'plant cell' as the answer and did not point out the specific type of cell found in the leaf.
(b)	Most students were able to identify the sites where ATP is synthesized. However, quite a number of students gave 'respiration' or 'photosynthesis' and did not give the specific process by which ATP is synthesized.
3. (a)	Performance was quite good. A few students wrongly gave 'yellow spot' as the answer. A number of students wrongly wrote '視網膜' as '視網膜'.
(b)	Some students were weak in interpreting the electronmicrograph and were unable to identify the photoreceptors correctly. Some may not have realized that the naming of the photoreceptors is related to their shapes. Some students did not attempt to identify the photoreceptors and just put down the differences between rods and cones in their answer. Students knew very well that cones are responsible for colour vision. However, they did not realise that more cones will be stimulated in bright light than in dim light. This explains why a coloured object is perceived as more colourful in bright light than in dim light.



<p>9. (a)</p> <p>(b) (i)</p> <p>(ii)</p>	<p>Students were unable to relate the appearance of an extra chromosome in the gamete to the failure of separation of the chromosomes during gamete formation. Some gave very vague answers such as 'meiosis went wrong'.</p> <p>Students showed confusion in the use of genetic terms in their answers (e.g. using the term 'genes' when they were referring to 'alleles') and they were generally weak in presenting the deduction. Some students ignored the fact that the trait in the question was sex-linked. They put down a typical answer for deducing the genotype of an individual in a typical cross of monohybrid inheritance without due reference to the fact that the alleles concerned were located on the X chromosome.</p> <p>Most students were able to work out the probability correctly. However, a large number of students were unable to define the alleles correctly with the appropriate symbols. Many wrongly defined the allele for colour blindness using the symbol 'X<sup>b</sup>', which should be a symbol for 'an X chromosome bearing an allele for colour blindness'. Some students used different letters in defining the alleles for normal vision and colour blindness (e.g. N and b). In addition, some students could not produce a proper format for the genetic diagram.</p>
<p>10. (a)</p> <p>(b)</p> <p>(c)</p>	<p>Some students were careless in reading the question and gave 'wind pollination' instead of 'wind' as the pollinating agent. Some students did not realise that the structure shown in photograph 2 was the anther and gave a wrong answer.</p> <p>Some answers were quite vague (e.g. water is important for growth) and did not point out the important role of water in germination. Some students wrongly used terms like 'epidermis' when they were referring to the seed coat. Some students erroneously stated that water is important for dissolving the stored food.</p> <p>Most students were able to design a workable experiment with due consideration being given to setting up a proper control and keeping the controlled variables constant for a fair experiment. However, some students overlooked the importance of using a sufficient number of seeds for the experiment and some did not state how the effect could be measured (i.e. by comparing the germination rate).</p>
<p>11. (a) (i)</p> <p>(ii)</p> <p>(b)</p>	<p>Most students were able to point out that the fatty acids diffuse through the phospholipid bilayer but not many of them were able to explain this with reference to the fact that fatty acids are fat soluble. Some did not make reference to 'the structure of the cell membrane as illustrated by the fluid mosaic model', as required for answering the question.</p> <p>Students generally were aware that amino acids are transported across the membrane by / via the membrane proteins. Most of them, however, did not explain why the polar nature of the amino acids prevents them from diffusing across the membrane.</p> <p>Well answered. Some students, however, wrongly stated 'osmosis' as the mechanism for transport of glucose across the membrane and hence gave a wrong comparison.</p>
<p>12.</p>	<p>Quite a number of students just put down 'phototropism' without specifying the part of the flowering plants which shows the phototropic response, nor did they specify whether the response is positive or negative. Hence, they could not illustrate the importance of the phototropic response of the specific part of the plant for its survival. Some students gave wrong examples such as 'the flowers are positively phototropic'. In addition, many students wrote a lengthy account of the mechanism of phototropic response (i.e. how the phototropic response is brought about by the redistribution of auxins under the influence of unilateral light), which was not required in answering the question.</p> <p>Instead of contrasting the nature and process of tropic response and reflex action, a lot of students gave a separate account of each of them without any comparison.</p> <p>The performance of students who gave a comparative account of the nature of tropic response and reflex action was satisfactory. However, their performance in contrasting the processes of the two was quite poor. A weakness that was common among the students was that they were unable to express their ideas using appropriate terms or precise wording. Another weakness was that lots of students elaborated at length on a particular point (e.g. tropic response being mediated by auxins while reflex is mediated by nerve impulses) with little relevance to the question (e.g. giving a detailed description of the origin of auxins and how an impulse is set up). Few students presented their answers in an organised way.</p>



## Paper 2

Paper 2 consists of four sections. Section A contains questions set on Topic V 'Human Physiology: Regulation and Control'; Section B on Topic VI 'Applied Ecology'; Section C on Topic VII 'Microbiology'; and Section D on Topic VIII 'Biotechnology'. Students were required to attempt all questions in two of the sections.

Question Number	Performance in General
1. (a) (i) (ii) (iii) (iv)  (b) (i) (ii) (iii) (iv)	<p>Some students wrote the word '卵' incorrectly.</p> <p>Most students were able to explain the rise in progesterone level from day 14 onwards. However, not many of them realised that the persistently high progesterone level indicated that the woman was pregnant and the corpus luteum had not degenerated.</p> <p>Well answered.</p> <p>Some students gave a description of the effect of high progesterone level on secretion of LH and FSH by recall without making reference to the graph. Some students, instead of stating that 'the high progesterone level inhibits the <i>secretion</i> of both LH and FSH', stated that 'the high progesterone level inhibits both LH and FSH'.</p> <p>Well answered.</p> <p>Most students were able to explain the importance of the changes. Some students did not specify that more nutrients and oxygen were supplied to the 'muscle cells' and simply stated there was a greater supply of nutrients and oxygen to the body.</p> <p>A number of students described the changes instead of describing how the activity of the sympathetic nerve brought about the changes. Although students knew that the sympathetic nerve innervates the SA node, they failed to point out that the SA node was stimulated by the increased output of the sympathetic nerve.</p> <p>Most students were able to give the correct explanation. Some students could not express their ideas clearly. Some used 'water content in the body' instead of 'water potential of the blood' in their answers.</p>
2. (a) (i) (ii)  (b) (i) (ii) (iii)	<p>Most students were able to suggest a workable method.</p> <p>Students' performance was generally satisfactory on parts (1) and (3).</p> <p>In part (2), most students were able to state the change in wintering destination of the birds, but some students wrongly interpreted the arrows and thought that the birds migrated from south to north. Many students were unable to suggest an ecological reason for the change in wintering ground.</p> <p>In part (4), most students were able to state the type of human activity and the gas that caused the trend. However, few could explain clearly how an increased amount of greenhouse gases caused a rise in temperature.</p> <p>Most students were able to state the cause leading to an impact (e.g. acid rain reduces the pH of the soil and hence affects plant growth), but they were unable to state what the impact on the environment was (e.g. reducing the population size of the plant species). Some students included 'causing corrosion of buildings' as an environmental impact.</p> <p>Few students realised that logging removed only the biomass above the forest floor.</p> <p>Well answered. In part (2), some students missed the focus of 'using a single tree species for reforestation' and gave answers like 'increasing the competition between local and introduced exotic species'.</p>

<p>3. (a) (i)</p> <p>(ii)</p> <p>(iii)</p> <p>(iv)</p> <p>(b) (i)</p> <p>(ii)</p>	<p>While students generally realised that Stage 1 was essential for providing the necessary substrates for fermentation in Stage 2, they missed the point that these substrates have to be obtained from the digestive action of the enzymes from the fungus on the soy beans and wheat grains.</p> <p>Many students misinterpreted the role of the brine. They did not pick up the clue in the process outlined that 'a salt-tolerant lactic acid bacteria' was inoculated in Stage 2 for further fermentation, and rather thought that the brine was used to add flavour to the soy sauce.</p> <p>Applying their knowledge that the proteins in milk will be preserved after pasteurisation, most students stated that pasteurization preserves the proteins / flavour of the soy sauce. However, few students were able to relate the use of pasteurisation to denaturing the enzymes to stop further fermentation.</p> <p>Students could were generally able to give one principle.</p> <p>Students' performance in parts (1) and (2) was good. Most students were able to identify microbe M, state the difference between this microbe and <i>E. coli</i>, and describe the event shown in Figure 2. Students were able, in general, to give one advantage in part (3)</p> <p>When attempting part (1), students might have overlooked the fact that <i>E. coli</i> is a natural inhabitant of the human intestine. A high level of <i>E. coli</i> in a body of water would indicate a high level of faecal contamination and suggest the possible presence of disease-causing microbes. In part (2), students showed an understanding that the number of colonies observed corresponds to the number of bacteria retained on the filter, but they did not explain the reason behind this. However, they were able to use this concept in calculating the <i>E. coli</i> count and performed very well in part (II).</p>
<p>4. (a) (i)</p> <p>(ii)</p> <p>(iii)</p> <p>(iv)</p> <p>(b) (i)</p> <p>(ii)</p> <p>(iii)</p>	<p>Students generally knew that the transplanted stem cells help restore the production of lymphocytes in SCID patients. However, they did not clearly state that stem cells are cells capable of differentiating into the lymphocyte producing cells.</p> <p>Students performed very well in giving an advantage of somatic gene therapy over stem cell transplantation. Some students thought that the defective gene is 'corrected' after somatic gene therapy and were unable to explain clearly that the normal gene inserted helps by compensating for the function of the defective gene.</p> <p>Most students stated that the normal gene could be passed to the offspring with germ-line gene therapy and that the normal gene cannot be passed to the next generation with somatic gene therapy. However, not many students realised that all cells of an individual developed after germ-line gene therapy will contain the normal gene. Quite a number of students contrasted the processes involved in the two types of therapy rather than contrasting the biological consequences of the two processes.</p> <p>Some students thought that the virus vector might have elicited an immune response that caused the illness.</p> <p>Students performed quite well in this question. They showed quite a good understanding of the events taking place in the principal steps in a cycle of PCR.</p> <p>Students were generally aware of how the products of PCR could be used for DNA fingerprinting.</p> <p>Students were generally able to suggest the purpose which the marker serves in the process of producing GM maize in part (1) and most students were able to give a correct example for part (2) (e.g. golden rice). Students were generally able to describe one possible impact on the ecosystem in part (3). Some students, however, gave an unlikely outcome of 'extinction of the insects' as a possible impact.</p>