

3.3 BIOLOGY (231)

Biology (231) is examined in 3 Papers; two theory and one practical.

Both paper 1 and 2 are marked out of 80 while paper 3 is marked out of 40.

Paper 1 assesses concepts across the secondary school Biology syllabus. The questions are usually structured and are all compulsory.

Paper 2 consists of 8 questions; divided in two sections, **A** and **B**. Section **A** has five compulsory, structured questions, sampled from 5 topics across the syllabus, each carrying 8 marks. Section **B** has three questions, each carrying 20 marks. Question six is usually compulsory; assesses concepts on data manipulation and interpretation while questions seven and eight are essay based. A candidate is expected to attempt only one of the two essay questions.

Paper 3 is usually a practical paper, with three questions drawn from any three topics within the secondary school Biology syllabus.

3.3.1 CANDIDATES' GENERAL PERFORMANCE

The performance of the candidates in the three Biology papers from 2009 to 2019 is outlined in the Table below.

Table 10: Candidates' Overall Performance in Biology from to 2009

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2009	1	299,302	80	20.14	12.31
	2		80	18.41	10.30
	3		40	15.86	8.43
	Overall		200	54.29	28.80
2010	1	317,135	80	20.14	13.76
	2		80	18.41	10.82
	3		40	15.86	8.31
	Overall		200	58.39	30.44
2011	1	363,817	80	22.74	12.41
	2		80	23.31	13.04
	3		40	18.84	8.10
	Overall		200	64.87	31.05
2012	1	389,523	80	19.77	12.84
	2		80	20.70	12.09
	3		40	11.97	6.59
	Overall		200	52.41	29.43
2013	1	397,319	80	28.03	14.49
	2		80	22.36	12.70
	3		40	12.88	7.64
	Overall		200	63.26	32.06

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2014	1	432,977	80	23.91	14.49
	2		80	18.92	11.83
	3		40	20.82	8.39
	Overall		200	63.65	32.57
2015	1	465,584	80	27.42	14.46
	2		80	19.56	11.86
	3		40	22.62	9.15
	Overall		200	69.59	31.55
2016	1	509,982	80	27.30	16.40
	2		80	20.11	14.14
	3		40	10.99	6.76
	Overall		200	58.37	35.16
2017	1	545,663	80	13.74	10.24
	2		80	16.43	10.37
	3		40	7.68	5.05
	Overall		200	37.85	23.45
2018	1	589,900	80	15.81	9.26
	2		80	11.92	8.67
	3		40	13.65	7.38
	Overall		200	51.38	23.26
2019	1	618,654	80	18.00	11.210
	2		80	18.00	10.036
	3		40	16.00	6.484
	Overall		200	51.38	23.26

From the Table it can be observed that:

- There has been a continuous increase in candidature for the past ten years.
- There has been progressive improvement in performance since 2017.
- The standard deviation values indicate that the papers adequately discriminated learners of different abilities.

3.3.2 ANALYSIS OF PERFORMANCE IN THE PAPERS

3.3.3 Biology Paper 1 (231/1)

(i) ANALYSIS OF POPULAR ITEMS IN PAPER 1, (231/1)

Questions 2. (a) Besides venation, state **two** other external characteristics of leaves that can be used to classify plants. (2 marks)

Questions 16. State **two** benefits of mutation in living organisms. (2 marks)

Questions 18. Name the type of tooth in carnivores mainly used for piercing and killing of preys. (1 mark)

Question 20. State how each of the following features enhance efficient movement of fish in water:

(a) Scale (1 mark)

(b) body shape (1 mark)

Most candidates scored maximally in the items above. This could be attributed to the fact that these are knowledge questions in terms of the Bloom's Taxonomy.

(ii) ANALYSIS OF POORLY PERFORMED QUESTIONS

None of the questions in paper one (231/1) was reported to have been difficult. However, there is need for learners to be exposed to tasks that require them relate their daily life experiences with concepts learnt in class, for instance in Cell Physiology, Respiration, Gaseous Exchange, Ecology, Reproduction, Genetics, among other topics. Besides using learner-centred approach where charts, video clips are used to enhance conceptualization of scientific facts, a practical teaching approach should be encouraged to nurture the observation, recording and interpretation skills among learners. This will also accord learners an opportunity to familiarize themselves with common laboratory apparatus and processes. Using a variety of text books, scientific journals and documentaries enhance understanding of concepts from different perspectives.

3.3.4 PAPER 2 (231/2)

(i) ANALYSIS OF POPULAR ITEMS IN THE PAPER

None of the eight questions in the paper fully recorded consistent scores as to be regarded as popular to the candidates.

(ii) ANALYSIS OF POORLY PERFORMED QUESTIONS

It was further generally observed that most learners had difficulty in interpreting data from tables, hence performing dismally in data-based questions.

Question 1

In an experiment to investigate the effect of sodium chloride on the growth rate in a spinach seedling, seeds were treated with different concentrations of sodium chloride. The results are as recorded in the table below.

Concentration of sodium chloride (mol/l)	Percentage of spinach seeds which started to grow roots	Mean root length (mm)
0.00	99.98	17.70
0.06	98.20	15.60
0.12	92.0	10.20
0.18	54.0	7.60

- (a) From the results in the table above, explain the effect of increasing the concentration of sodium chloride. (3 marks)
- (b) Apart from a ruler, state two other equipment one would need to determine the rate of growth in the roots. (2 marks)
- (c) With a reason, state one other part of the seedling the students would focus on to determine the effect of sodium chloride on growth. (2 marks)
- (d) State the likely effect on the seedling of increasing the concentration of sodium chloride to 2.20mol/l. (1 mark)

Weakness

Most of the candidates displayed low comprehension of the data hence being unable to make the necessary deductions and inferences. They were not able to relate how presence of sodium chloride in the soil of germinating seedlings affected the osmotic pressure, hence availability of water for germination and growth. This further illustrates the students' inability to apply the knowledge learnt in class to real life situations as well as their inability to link/apply the concept learnt in one topic to other topics/content areas; in this case, linking the concepts acquired in Cell Physiology; a topic learnt in Form one, to Growth and Development in Form three.

Learners should be exposed to all possible approaches to various topics and sub-topics in the course and how they are related. Emphasis should further be laid on data manipulation and interpretation, presented graphically or in tabular form.

Expected responses

- (a) Increased sodium chloride concentration/having more sodium and chloride ions decreases osmotic potential/makes water potential more negative outside the seed/seedling in the surrounding solution/the surrounding solution to be hypertonic to the cell sap in the seedling/seed cells; seeds take in less water by osmosis/are dehydrated/lose water molecules to the surrounding solution; reducing the (growth) enzyme activity, hence reduced growth rate; OWTTE
- (b) -Thread;
-Marker pen;
-Dye;
- (c) (Rate of growth/increase in length of) the shoot tip/apex;
It is a region of (active) cell division/growth;
- (d) The seedling will be dehydrated, hence wither/die;

Question 4

In cats, the gene for fur colour is sex-linked. Letter G represents the gene for ginger fur colour while letter B represents the gene for black fur colour in a given cat species. These genes are codominant. Heterozygous females have ginger and black patches of fur and their phenotype is described as tortoise-shell.

- (a) With reference to the information given above, what is meant by the term codominance? (1 mark)
- (b) Explain why male cats with a tortoise-shell phenotype do not usually occur. (2 marks)
- (c) A tortoise-shell female was crossed with a black male. Determine the genotypes and phenotypes of the offspring. (5 marks)

Weaknesses

Most candidates did not understand the concept being tested in the question, responding to it in the context of sex-linkage instead of codominance. Others did not comprehend the description, "tortoise shell", for fur colour in cats, confusing it with the actual tortoise.

Learners should be exposed to crosses involving a variety of characteristics/traits in a range of living organisms.

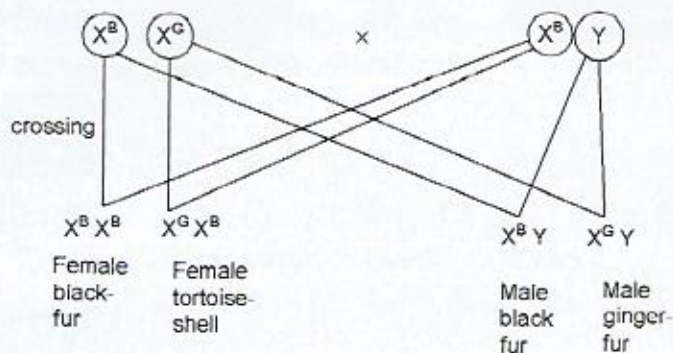
Expected responses

- (a) Both alleles are expressed/shown equally in the phenotype (of the offspring) /non suppresses the other gene for ginger and black fur colour from expressing themselves in the phenotype;
- (b) The gene for coat colour is sex-linked; contained in the X-chromosome; males have only (inherit) one X-chromosome (from females/mothers)/Y-chromosome does not carry gene;
- (c) Parental Phenotype, Tortoise-shell fur female Black fur male

Parental Genotype: $X^B X^G$

$X^B Y$

Gametes



3.3.5 Biology Paper 3 (231/3)

(i) ANALYSIS OF POPULAR ITEMS IN THE PAPER

Paper three, 231/3 was generally popular as the overall performance indicated a significant improvement compared to the previous year. It was, however, observed that students displayed poor drawing and labeling skills as well as spelling mistakes of biological terms. Some students also presented wrong steps in the dichotomous key. To remedy this, learners should be adequately exposed to tasks that require them to draw and label parts of various specimens. Thorough practice on the construction and use of dichotomous keys using photographs and real specimens will also help.

(ii) ANALYSIS OF POORLY PERFORMED QUESTIONS

Question 3(c)

- (c) (i) Name the joint labelled **K** on photograph **P**. (1 mark)
- (ii) Explain **two** features of the joint named in (c) (i) above that makes it adapt to its function. (2 marks)

Weaknesses

This was the most unpopular item. Most candidates correctly identified the joint, sutures, but were unable to explain how the joint is adapted to its function. Candidates should be adequately exposed to practical tasks that require them to observe, analyze and make appropriate inferences.

Expected responses**Question 3(c)**

- i) Suture; (1 mark)
- ii) Bones of the skull interlock, making strong hard joints, hence the hardness in the skulls of animals (to protect the delicate brain);
Are fixed/immovable, tightly holding bones in place/no lines of weaknesses, hence the hardness of the skull (to protect the delicate brain); (2 marks)

3.3.6 GENERAL ADVICE TO TEACHERS

Inquiry-based learning should be strongly encouraged as besides enforcing curriculum content, it promotes a deeper understanding of content, builds initiative/creativity and self-direction.

A wider variety of Biology materials in form of text books, scientific journals and publications should be availed to enrich the students' learning environment. Testing and assessment approaches should also be diversified, integrating ICT, with more hands-on practical activities.

Thematic teaching and learning should also be embraced as it freely and naturally allows learners to connect topics and subjects.

Learners should be encouraged to understand biological principles, processes, general content and present it precisely and accurately. Closer mentorship and/or pupillage (from teachers) or fellow students through functional, guided groups and closely supervised/assessed tasks (practical and theoretical) can help in achieving this.

Gradual and systematic development of manipulative skills amongst learners (as opposed to sheer memorization of facts). Resources/materials within the students' environment should be used to demystify and reinforce students' understanding of some Biological concepts and processes.