CHAPTER 9

LIFE SCIENCES

The following report should be read in conjunction with the Life Sciences question papers of the November 2014 Examination.

9.1 PERFORMANCE TRENDS (2011–2014)

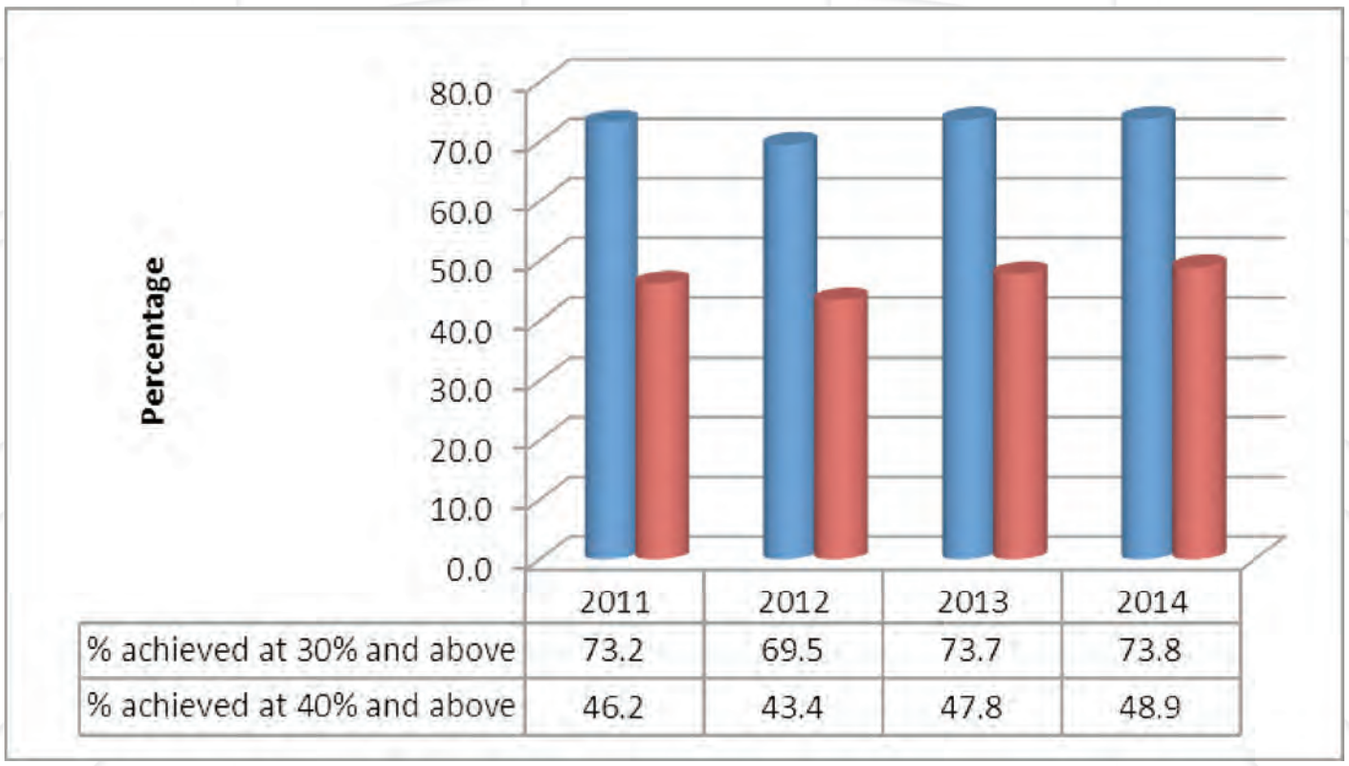
The general performance of candidates is in line with that of 2011 and 2013. In comparison to 2013, the following features were noted:

- The number of candidates who wrote the subject decreased by 17 420;
- Candidates passing at the 30% level improved marginally by 0.1 percentage points whilst candidates passing at the 40% level improved by 1.1 percentage points; and,
- Candidates achieving distinctions over 80% improved from 2.5% to 3.3% of the total candidates.

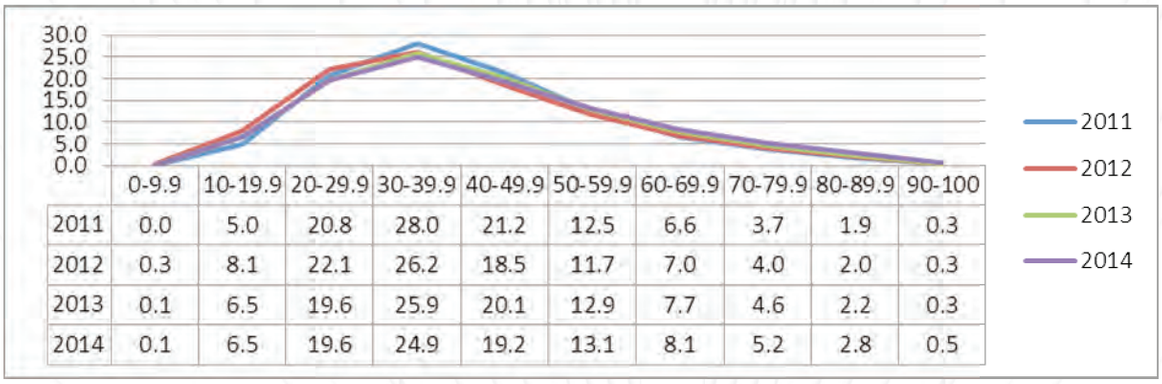
Table 9.1 Overall achievement in Life Sciences

Year	No. Wrote	No. achieved at 30% and above	% achieved at 30% and above	No. achieved at 40% and above	% achieved at 40% and above
2011	264 819	193 946	73.2	122 302	46.2
2012	278 412	193 593	69.5	120 734	43.4
2013	301 718	222 374	73.7	144 355	47.8
2014	284 298	209 783	73.8	139 109	48.9

Graph 9.1.1 Overall achievement in Life Sciences



Graph 9.1.2 Performance distribution curves in Life Sciences



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2011	0.0	5.0	20.8	28.0	21.2	12.5	6.6	3.7	1.9	0.3
2012	0.3	8.1	22.1	26.2	18.5	11.7	7.0	4.0	2.0	0.3
2013	0.1	6.5	19.6	25.9	20.1	12.9	7.7	4.6	2.2	0.3
2014	0.1	6.5	19.6	24.9	19.2	13.1	8.1	5.2	2.8	0.5

As per the graphs, even though there was a marginal decline in candidates' performance at the 40-49% in 2014 compared to 2013, there was overall improvement in performance at both the 30% and 40% levels in 2014 compared to the three previous years.

9.2 OVERVIEW OF LEARNER PERFORMANCE IN PAPER 1

General comments

(a) Some candidates had problems distinguishing between action verbs such as: state, suggest, describe, explain, discuss, etc.

(b) Candidates should have used the correct scientific names and done away with the common names. Teachers should have also attended to the spelling of the terms.

(c) Many candidates were not familiar with basic terminology in the different topics. This resulted in the unnecessary loss of marks even in the lower-order questions.

(d) Poor performance was recorded in questions on scientific investigations based on plant hormones and on human impact.

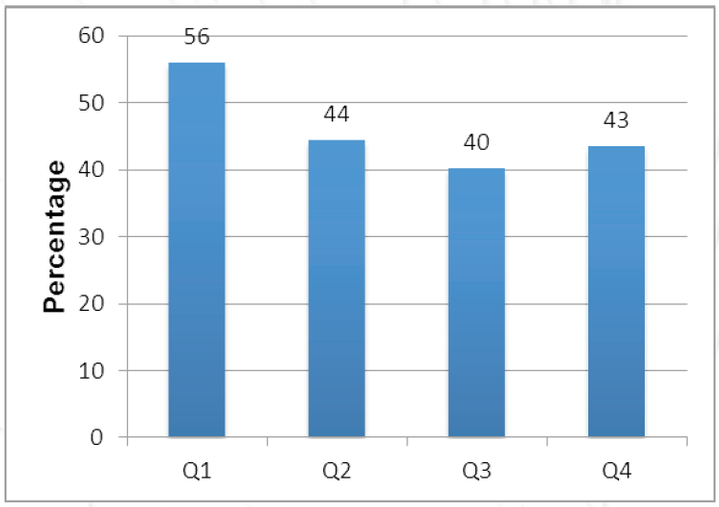
(e) Candidates demonstrated limited knowledge of concepts relating to Human Impact.

(f) Many candidates demonstrated difficulty in interpreting the questions. They failed to give reasons when asked to do so, or they provided reasons that were not observable when observable reasons were asked for.

9.3 DIAGNOSTIC QUESTION ANALYSIS FOR PAPER 1

The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

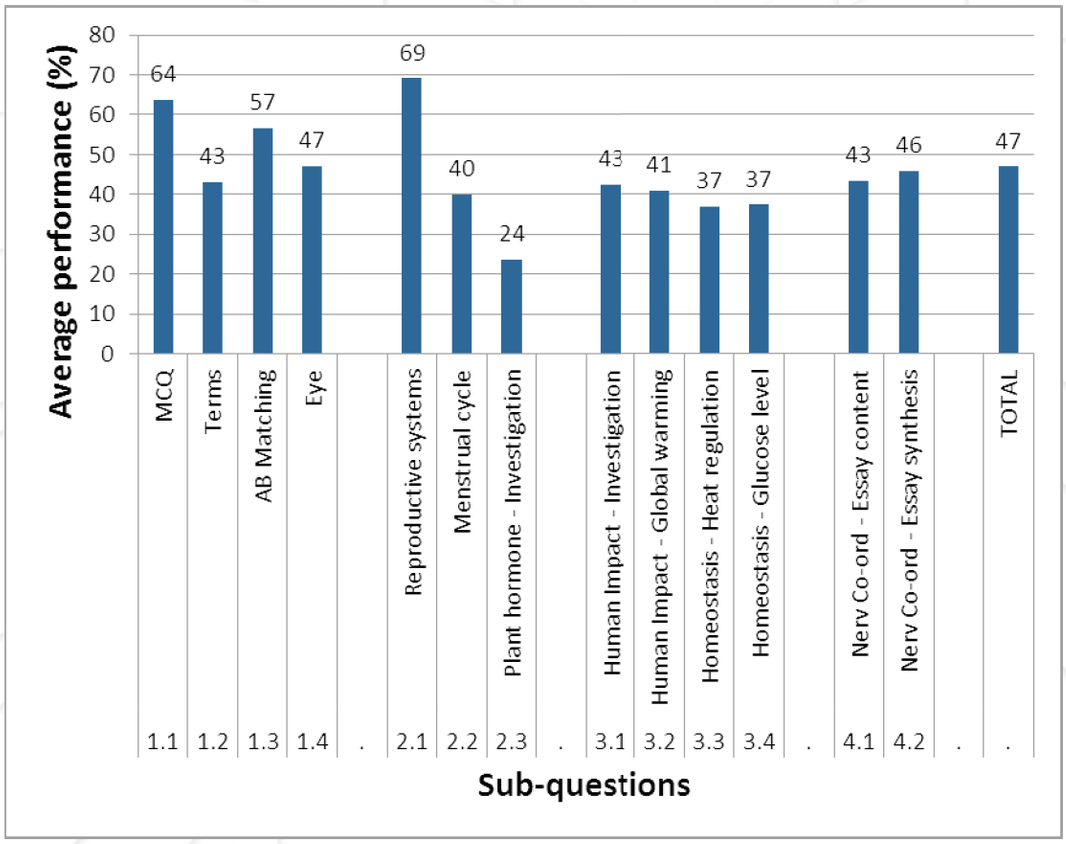
Graph 9.3.1 Average marks per question expressed as a percentage: Paper 1



Q1	Multiple choice, terminology, matching and eye
Q2	Reproduction systems, menstrual cycle and plant hormone investigation
Q3	Human Impact - Investigation, Human Impact – Global warming, homeostasis – Heat regulation and Homeostasis - Glucose level
Q4	Nervous co-ordination

The worst performance by candidates was in the questions on plant hormone investigation, homeostasis (heat regulation and glucose), menstrual cycle, human impact (global warming and investigation) and biological terminology.

Graph 9.3.2 Average performance per sub-question: Paper 1



9.4 ANALYSIS OF LEARNER PERFORMANCE IN INDIVIDUAL QUESTIONS IN PAPER 1

QUESTION ONE: Multiple Choice, Terminology, Matching and Eye

Common errors and misconceptions

(a) Performance in Q1.1 showed that candidates lacked basic knowledge of terminology. Performance was poor in Q1.1.4 (application question on negative feedback), Q1.1.9 (gamete formation) and Q1.1.10 (crossing over and random arrangement of chromosomes).

(b) Q1.2 on biological terminology once again posed a great challenge to many candidates. This poor understanding of basic terminology and concepts has an adverse effect on the interpretation of and responses to questions. In Q1.2.3/4, candidates were confused between the terms autonomic nervous *system*, *parasympathetic nervous system* and *sympathetic nervous system*. They confused similar terms such as *choroid* and *chorion* in Q1.2.5, and in Q1.2.10 *acrosome* and *chromosome*. Instead of writing *thyroid stimulating hormone* in Q1.2.8, some of the candidates wrote *thyroxine stimulating hormone*.

(c) Candidates use unauthorized abbreviations or cell phone language: e.g. PNS cannot be accepted for *parasympathetic nervous system* but TSH is an acceptable abbreviation as it is recognized by scientific communities around the world. GHE cannot be accepted for *Green House Effect*.

(d) In Q1.3, candidates did not follow the instructions when answers were given e.g. A + B or A, B instead of both A and B.

(e) Marks for Q1.4 were forfeited because many of the candidates failed to read the whole question and hence lost half of the marks (5 out of 10). Candidates were expected to write the LETTER and the NAME of the part it represented. Some candidates wrote only the LETTER. From the candidates' responses it was evident that the structure of the eye was taught in isolation from the functions of parts.

Suggestions for improvement

(a) There needs to be a greater emphasis on the learning of appropriate terminology related to the various topics, together with the correct spelling of these terms. Teachers should use the following strategies to improve the teaching of terminology:

- Identify new terms in every lesson and write them on the board;
- Instruct learners to take down these terms at the back of their notebooks, noting the correct spelling;
- Encourage learners to write down the meanings of these words, as ascertained by being attentive during the lesson or finding the meaning in a dictionary or textbook;
- Break down the terms where possible, giving the meanings of prefixes, suffixes and other components: for example, photo (light) + synthesis (to build up);
- Make learners aware of the meanings of new terms by using them in sentences.
- Include biological terms in all daily assessment tasks; and
- Ensure that by the end of the year, all learners have a comprehensive glossary of all the relevant terms.

(b) Teachers could also highlight the differences between the spellings of words that sound similar, e.g. ureter/ urethra; glucagon/glycogen.

(c) Learners should be warned about the use of unacceptable abbreviations e.g. PNS for parasympathetic nervous system, since learners will lose the marks during assessment.

(d) Candidates must follow the instructions as prescribed in Q1.3. Answers should be written as *A only* (not A), *B only* (not B), *both A and B* (not A + B; A, B; A and B). In future, learners will be penalised if they do not follow the instructions. Teachers should enforce this in all assessment activities done at school.

(e) Teachers are advised to provide learners with multiple opportunities to label drawings and write-in the functions next to the labels. Refer to the blank diagrams found in *Mind the Gap*.

(f) After assessment has been done, feedback to the learners is important and should be provided by teachers on a continuous basis.

QUESTION 2: Reproductive systems, Menstrual cycle and Plant hormone Investigation

Common errors and misconceptions

(a) Although Q2.1 was fairly well-answered, candidates still lost marks for the following errors: In Q2.1.1, many candidates wrote *ureter* instead of *urethra* for A. In Q2.1.6, an explanation of why the testes are kept 'outside' the body of males was required. Many candidates responded incorrectly by stating that the testes are kept at 2°C/-2°C for sperm production. Learners could not express what the optimum temperature is.

(b) Q2.2 was generally poorly answered. In Q2.2.3, many candidates did not know the difference between the words *describe* and *explain*. They merely stated *presence of corpus luteum* and *secretion of progesterone* instead of explaining the concepts by using the diagram. In Q2.2.4, candidates had to describe the developmental changes from a fertilised ovum until implantation occurs, but could not provide all the details necessary to attain maximum marks. The sequence of events was often jumbled. Some could not identify the fertilised ovum as a zygote. Some candidates mentioned *meiosis* as a means of multiplication of cells after fertilisation, instead of *mitosis*. Others confused the development of the zygote with events of the menstrual cycle. Some candidates used words or flow charts instead of describing the events. In Q2.2.5, many of the candidates responded by naming progesterone as the hormone that is likely to be monitored by the ovulation monitor.

(c) Q2.3 was the worst-answered question in this paper. Lack of exposure to practical investigations in the classroom was probably the main causative factor. The candidates' knowledge of geotropism was also poor. Many candidates were not familiar with how a clinostat worked. Candidates did not know the difference between the effect of auxins in roots and stems. In Q2.3.3, many candidates could not interpret the experiment; neither could they explain the results. In Q2.3.5, some candidates did not read the question properly and therefore failed to identify the factors to improve validity for this experiment.

Suggestions for improvement

(a) In teaching the section on reproductive organs, it is always advisable that teachers use charts, pictures and diagrams from a variety of resources to reinforce and enhance understanding. In Q2.1.6, candidates should have explained that the testes are kept 'outside' the body to maintain a temperature that is 2°C lower than the body temperature for the production of healthy sperm.

(b) Teachers must highlight the difference between different verbs used in the question papers, e.g. describe, explain, discuss. *Describe* means to give a detailed account of e.g. a process (Q2.2.4 describe the developmental changes). *Explain* means to give a reason in order to justify something (Q2.2.3: explain evidence from the diagram). To *discuss* means to write about a topic in detail, taking into account different ideas or issues e.g. giving views about the advantages and disadvantages of using an ovulation monitor.

In Q2.2.5 (b), progesterone was not accepted as an answer because the level of this hormone gradually rises and will remain constant for a long period after ovulation and not during ovulation. Therefore the level of progesterone does not serve as an indicator to confirm the actual day of ovulation. Whereas the rapid rise in the levels of LH, FSH and oestrogen trigger ovulation.

Teachers need to teach the role and function(s) of FSH, oestrogen, LH, progesterone and its effect on the menstrual cycle by using graphs and diagrams. There are many questions on this topic in previous examination papers that teachers can use.

(c) Investigative skills can be effectively acquired only by exposure and practice. Practical work must be incorporated into daily teaching practice. Teachers must do the prescribed practical work. The practical on geotropism and phototropism are both prescribed in the CAPS document. It was obvious that candidates could not visualise the working of the clinostat in this question. Therefore if clinostats are available teachers should do the investigation. If not, the practical on geotropism should be done as a 'minds-on' investigation. A rotating clinostat eliminates the effect of gravity.

(d) Teachers need to teach learners to differentiate between validity and reliability in scientific investigations, because the principles of validity and reliability are fundamental cornerstones of the scientific method. For example:

What is reliability?

- The idea behind reliability is that any significant results of an investigation must be more than a once-off finding and be repeatable.
- Other researchers must be able to perform exactly the same experiment, under the same conditions, and generate the same results.
- This would reinforce the findings of the experiment and ensure that the wider scientific community accepts the hypothesis.
- For the questions which required learners to state how the reliability of the investigation could have been improved, the following answers apply: Repeat the investigation OR Increase the sample size.

What is validity?

- Validity questions show how the experiment/investigation was carried out. It is important to be sure that all the factors/variables have been controlled/fixed except the variable/factor being tested.
- The samples must be chosen randomly.
- The design for the investigation must be appropriate.
- Validity therefore speaks to whether the scientific research method was used with the appropriate degree of care and diligence.
- In questions which require learners to suggest some factors that might have decreased the validity of an investigation, the answers should centre on the criticism of the scientific process; for example, some factors/variables that were not fixed/controlled when carrying out the investigation.

QUESTION THREE: Human Impact and Homeostasis

Common errors and misconceptions

(a) Q3.1 and Q3.2 on Environmental Studies were poorly answered. Many candidates could not provide the correct response for the dependent variable in Q3.1.1. In Q3.1.2, many candidates could not explain the purpose of having a control in the investigations and in Q3.1.3 confused reliability with validity. In Q3.1.5, candidates confused the process of eutrophication in the river as a result of excess fertilizer run-off from the agricultural land with general water pollution. The process of eutrophication was not understood very well.

(b) In Q3.2.1, definitions were not accurately provided by many candidates. Many lost at least 1 of the 2 marks for each definition.

(c) Answers to Q3.3 showed that many candidates confused the physiological responses on hot and cold days. Others provided behavioral responses instead. In the questions that required extended writing, learners omitted specific details required. In Q3.3.2 and Q3.3.3, candidates wrote only part of the answer, e.g: 'sweat is formed' instead of 'more sweat is formed'. Sentences were also not completed, for example, 'more heat is lost instead of more heat is lost by radiation. Candidates lost important marks.

(d) The words 'describe' and 'explain were not understood by many candidates. They provided a description in Q3.4.1 and Q3.4.2 instead of the explanation part for Q3.4.2.

Suggestions for improvement

(a) Teachers should clearly differentiate among the three types of variables as follows:

Controlled/fixed variable – refers to the factors that should be kept constant so that the results of an investigation can be considered valid.

Independent variable – refers to the factor that is being investigated. This factor is usually manipulated by the investigator either at the start of or during the course of the investigation. The independent variable appears on the X axis of a graph.

Dependent variable – refers to the effect of the independent variable. This effect is usually measured in some way and appears on the Y axis of a graph.

The control was Hectare A where no fertiliser was used. The purpose of this control was to ensure that the results that were obtained were due to the addition of fertilisers and not any other factor.

Teachers need to teach the concept of *eutrophication* and its effect on biodiversity.

(b) Teachers should ensure that the section on Human Impact is properly taught and assessed in Grade 11 and should be thoroughly revised in Grade 12. Learners should have greater exposure to questions based on information extracted from newspapers and journals as these will better prepare them to answer questions based on Human Impact on the environment.

(c) Learners should know that normal body temperature is 36,9°C in order for them to recognize if the hypothalamus will respond to higher or lower body temperature.

(d) Refer to the meaning of *explain* as described in Q2 under suggestions for improvement. Level C and D questions must become part of the learning experience. These questions must be included in classwork, homework and in formal assessment throughout the year.

QUESTION 4: NERVOUS CO-ORDINATION

Common errors and misconceptions

(a) Marks attained ranged from extremely poor to exceptionally good. Marks ranged from 0 to 20.

(b) Some candidates used flow charts in their answers in spite of the instruction below the essay question indicating that 'No marks will be awarded for answers in the form of flow charts, diagrams or tables'.

(c) The concepts of pupillary mechanism and accommodation in the eye were confused. Some candidates confused distant and near vision. Many learners provided a detailed account of the soccer game instead of focusing on accommodation, hearing and balance in humans.

(d) The process of balance was poorly answered and often confused with equalizing the pressure on the tympanic membrane.

(e) The words *taut*, *slack*, *relaxed*, *loose* and *tension* were incorrectly applied in the candidates' responses. Some also confused the terms *constrict* and *contract*', as well as *convex* and *concave*. Some candidates' responses revealed that they were not conversant with the receptors for balance (ear) in terms of their location and function.

(f) Some candidates still wrote the heading *Synthesis* and wrote information under it.

Suggestions for improvement

(a) Teachers should offer more opportunities for learners to write answers in paragraph and essay formats. The logical sequence of an account is best obtained through a good understanding of the cause-effect sequence. Teachers must teach the cause and effect e.g. the cilliary muscle contracts; therefore the suspensory ligament moves closer to the lens, etc. This would allow learners to write better accounts of various processes such as accommodation, hearing and balance.

(b) Teachers must make use of the 'Mind the Gap' study guide, p110 to explain how learners should make use of mind maps in the planning of an essay.

(c) Candidates should be reminded that *synthesis* is made up of three parts: relevance, logical presentation and a comprehensive answer. The synthesis should be explained to them and used from grades 10 to 12.

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic	Ideas are arranged in a logical/cause-effect sequence	All aspects required by the essay have been sufficiently addressed
In this essay	Only information relating to accommodation, hearing and balance &equilibrium is included. (There is no irrelevant information)	Logical sequence of events in accommodation, hearing and balance & equilibrium	Includes sufficient information on all 3 processes, i.e. accommodation (min 3/5) , hearing (min 4/7)and balance & equilibrium (min 3/5)
Mark	1	1	1

(d) Teachers should use as examples, the current and past examination essay questions to deliberately teach learners the skill of interpreting questions to determine what is required. Key words in the question should be underlined.

9.5 OVERVIEW OF LEARNER PERFORMANCE IN PAPER 2

General comments

(a) Essay writing has improved, but many candidates still lack the skill of putting a good essay together.

(b) Graph-drawing skills have improved. However, some candidates still lost marks for aspects such as working out a scale, stating a caption and correctly labelling the axes.

(c) Many candidates were not familiar with basic terminology in the different topics. This resulted in poor performance even in the lower-order questions.

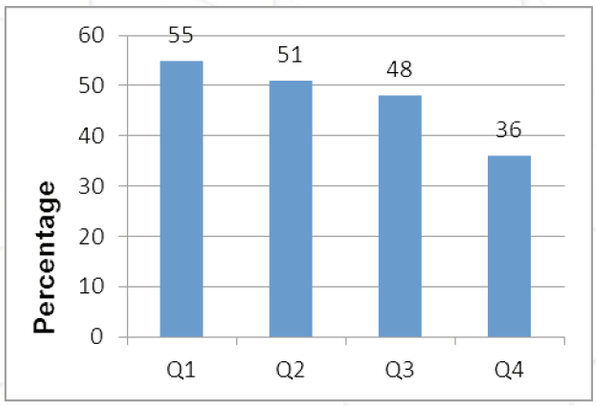
(d) The question on the dihybrid cross which is 'new' content was not well answered.

(e) Poor performance was recorded in questions based on scientific investigations and hypothesis testing.

9.6 DIAGNOSTIC QUESTION ANALYSIS FOR PAPER 2

The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

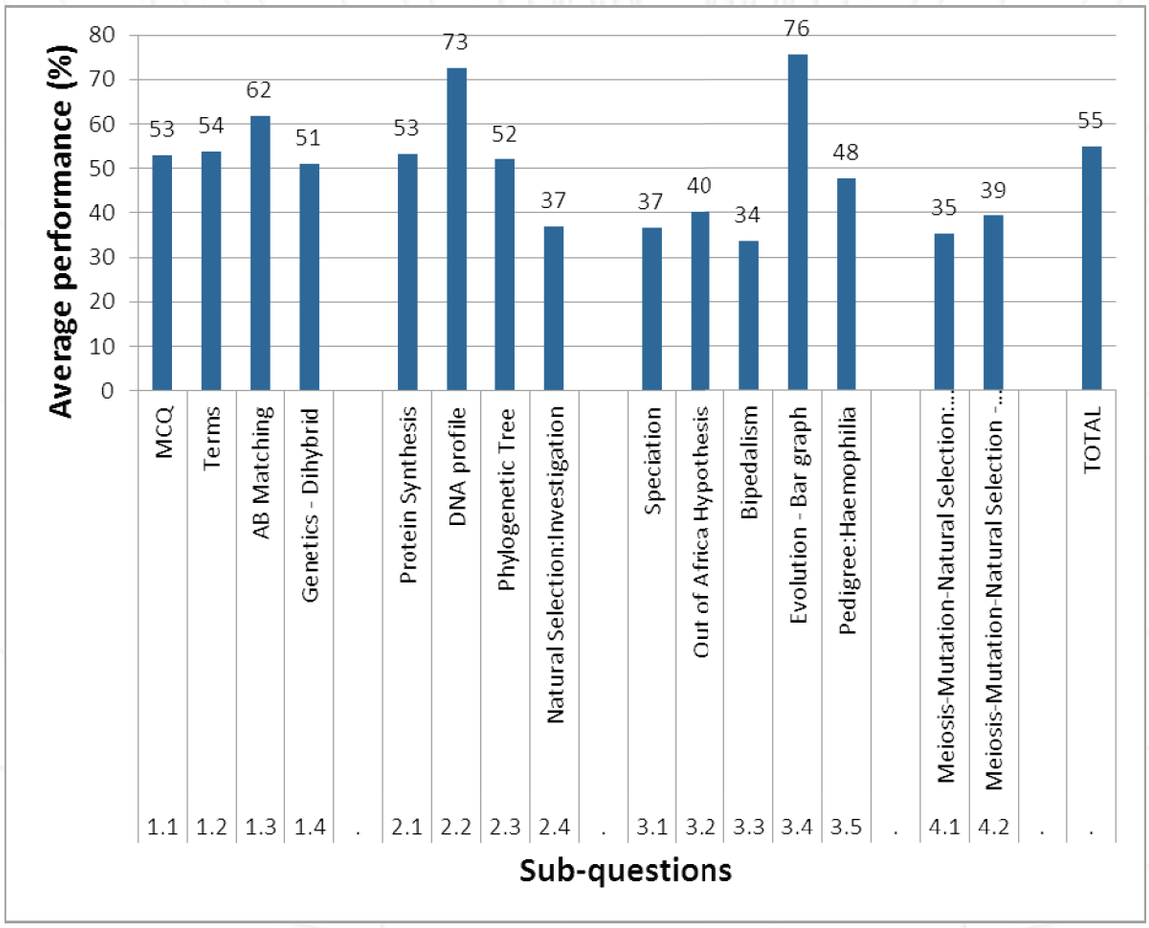
Graph 9.6.1 Average marks per question expressed as a percentage: Paper 2



Q1	Multiple choice, terminology, matching, logistic growth and Genetics - Dihybrid
Q2	Protein Synthesis, DNA profile, Phylogenetic Tree and Natural Selection: Investigation
Q3	Speciation, Out of Africa Hypothesis, Bipedalism, Evolution - Bar graph and Pedigree: Haemophilia
Q4	Meiosis-Mutation-Natural Selection: Content

The worst performance by candidates was in the questions on the significance of bipedalism, the essay on causes of variation, investigation on natural selection, speciation and 'Out of Africa' hypothesis.

Graph 9.6.2 Average performance per sub-question: Paper 2



9.7 ANALYSIS OF LEARNER PERFORMANCE IN INDIVIDUAL QUESTIONS

QUESTION 1: MULTIPLE CHOICE, MATCHING, TERMINOLOGY AND GENETICS-DIHYBRID

Common errors and misconceptions

(a) Q1.2 on biological terminology still posed a great challenge to many candidates. This poor understanding of basic terminology and concepts had an adverse impact on the interpretation of questions and the responses to them. Some candidates confused the terms *genetic engineering*, *genetically modified organisms* and *biotechnology*. In Q1.2.7, many candidates mentioned *Anaphase* only instead of *Anaphase I* and were therefore not credited. In Q1.2.8, candidates were not familiar with the term *Non- disjunction* and many used the terms *trisomy* or *Down's syndrome*.

(b) In Q1.3, candidates did not follow the instructions when answers were given e.g. A + B or A, B instead of both A and B.

(c) Q1.4 which dealt with the application of the dihybrid cross was poorly answered by many of the candidates. Many candidates did not identify a dihybrid cross as being a cross involving two genetic traits/characteristics, but stated that it was a cross involving two alleles, which is actually a description of a monohybrid cross. Stating the genotypes of the parents for the dihybrid cross was a challenge for many candidates.

Suggestions for improvement

(a) There needs to be a greater emphasis on the learning of appropriate terminology related to the various topics, together with the correct spelling of these terms. Teachers should use the strategies identified in Paper 1.

(b) Learners must follow the instructions as prescribed in Q1.3. Answers should be written as A only (NOT A), B only (NOT B), both A and B (NOT A + B; A, B; A and B). In future, learners will be penalised if they do not follow the instructions. Teachers should enforce this in all assessment activities conducted at school.

(c) Learners need a lot more exposure to working out dihybrid crosses using examples from different books, *Mind the Gap* and other study guides. Teachers must clearly explain the concepts of genes, alleles, traits, and characteristics when explaining a dihybrid cross. It should be emphasised to learners during the teaching of genetic crosses that the allele combinations of parents and offspring in a dyhibrid cross need to be indicated correctly with no spaces or punctuation between the letters: e.g. ttnn (not tt nn or tt; nn) or TTNN (not TT NN or TT:NN) because spaces and/ or punctuation mean that they are referring to gametes.

QUESTION 2: PROTEIN SYNTHESIS, DNA PROFILE, PHYLOGENETIC TREE AND NATURAL SELECTION: INVESTIGATION

Common errors and misconceptions

(a) In Q2.1, candidates lost marks because they confused the concept of *transcription* with *translation* as well as *nucleotides* with *nucleic acids*. In Q2.1.6, the question required a description of a process in the nucleus and many candidates confused *transcription* with *DNA replication*.

(b) Many of the candidates failed in Q2.2 to identify the biological offspring of the parents.

(c) Analysing a phylogenetic tree posed problems for many candidates.

(d) Q2.4.1 is based on the scientific investigation and most candidates failed to perform well in it. Hypothesis, reliability, precautions, etc still pose a problem to many candidates. In answers to Q2.4.4, many candidates mentioned some of the 'precautions' that should be taken into consideration in this investigation, but they could not provide a reason for their statements.

Suggestions for improvement

(a) Learners should be given sufficient exercises on how to do 'base pairing in protein synthesis' i.e. from DNA to mRNA (codons) to tRNA (anticodons) to amino acids, and the reverse process. Teachers can use the questions on this section from previous national question papers.

(b) The biological children will have bands that correspond to the banding patterns from both parents. Learners must identify that each of the DNA bands came from one or the other parent.

(c) Teachers should expose learners to more questions on the interpretation of phylogenetic trees. Teachers can expose learners to interpretation of phylogenetic trees by using the many questions available in previous national question papers.

(d) Teachers in Grades 10, 11 and 12 must ensure that their SBA tasks include an investigation in which skill 7 is emphasised. Special attention should be paid to the following:

- the stating of a hypothesis;
- dependent and independent variables;
- precautionary measures;
- reliability; and
- validity.

Teachers can use the following guide to assist learners with the stating of a hypothesis.

What is a hypothesis?

A hypothesis is an attempt to explain some event or observation using whatever information is currently available.

How to state an hypothesis

A hypothesis must:

(a) have two variables (dependent and independent variables);

(b) state the relationship between the two variables;

(c) be testable; and

(d) state the independent variable first (cause) and then the dependent variable (effect).

An example of a hypothesis question is as follows:

The peppered-moth, *Biston betularia*, has two phenotypes for body colour, dark (blackish) and pale (whitish). The trunks of the trees on which the moths rest are black in polluted environments compared to the white trunks of trees in unpolluted environments. In both unpolluted and polluted environments, birds are the predators of the moths.

An investigation was carried out to determine the number of dark and pale pepperedmoths present in polluted and unpolluted environments, using a sampling technique.

Formulate a hypothesis for the above investigation.

More/fewer dark peppered moths/ pale peppered moths survive in the polluted /unpolluted environment than in the unpolluted / polluted environment

OR

No difference in the number of dark/ pale peppered moths that survive in both environments

A precaution comprises steps that are taken when conducting an investigation, to ensure that the design of the investigation gives valid and reliable results.

Refer to validity and reliability in Paper 1.

QUESTION 3: SPECIATION, OUT OF AFRICA HYPOTHESIS, BIPEDALISM, EVOLUTION – BAR GRAPH AND PEDIGREE: HAEMOPHILIA

Common errors and misconceptions

(a) Some candidates struggled with Q3.1.1 and Q3.1.2 because their knowledge of the concept, *species* appeared questionable. In Q3.1.2, many candidates could not explain why there are only 2 species represented by the 3 populations in the diagram – many simply copied the text above the diagram and provided that as an answer to Q3.1.2.

(b) In Q3.1.3, many candidates gave only a general account of *speciation* when populations are separated by a *geographical barrier*, but could not put it into context with the given example. Some also confused *speciation* with the process of *natural selection*.

(c) In Q3.2, the question on the Out of Africa hypothesis was poorly answered by many of the candidates as it is taught on the basis of fossil and genetic evidence according to the CAPS policy; however, candidates found it difficult analysing, comprehending and applying their knowledge to the text.

(d) Q3.3.3 was the worst-answered question because learners could state but not explain the advantages of bipedalism.

(e) Many candidates are still finding the interpretation of the pedigree diagram in Q3.5 and the solving of a genetic cross challenging.

Q3.5.1(a) and Q3.5.1(b): Some candidates have swopped their answers to questions (a) and (b) and clearly did not know the difference between *phenotype* and *genotype*. Many candidates stated that the phenotype in (a) is 'carrier female' instead of 'normal female'. They could not work out the genotype of individual 2 in (b) as 'X^HX^h' i.e. that two different phenotypes for males (normal and haemophiliac) in the offspring are only possible if the female parent is heterozygous for haemophilia because the male parent is normal.

Q3.5.2: Many candidates could not explain or could only partially explain why females have a smaller chance of suffering from haemophilia.

Suggestions for improvement

(a) Terminology and concepts such as *species*, *population* and *speciation through geographic separation* need to be thoroughly explained by teachers. It is not enough that learners know only the general account of processes such as *natural selection*, *speciation*, etc, but they also need to be given exercises on how to apply their knowledge of these processes in unfamiliar/new contexts with the use of examples.

(b) Learners should be given more opportunities to read contextual passages and answer questions based on them.

(c) Refer to the meaning of 'explain' in Paper 1.

(d) Refer to the *Mind the Gap study guide*, where the steps to understand and interpret pedigree diagrams are described thoroughly.

Many candidates could score only a maximum of 1 mark for Q3.5.2 because they could give only the following common answer to this question, i.e. 'Females have two X chromosomes/Males have only one X chromosome'. They seldom mentioned that haemophilia is caused by a recessive allele that is carried on the X chromosome and females must inherit two copies of the recessive allele in order to be haemophiliac.

QUESTION 4: MEIOSIS-MUTATION-NATURAL SELECTION

Common errors and misconceptions

(a) Many candidates wrote the essay in a non-logical manner by mixing parts of the content of the respective topics.

(b) Many candidates listed all possible mutations, e.g. *frame shift-, point-, lethal-, harmful-, harmless-, insertion-, deletion-, inversion-, substitution* etc. without stating how mutations contribute to genetic variation.

(c) Some candidates confused *speciation* with *natural selection*.

Suggestions for improvement

(a) Teachers should use examples of the current and past essay questions to deliberately teach learners the skill of interpreting the question to determine what is required.

(b) Teachers need to emphasize to learners that the format of the Life Sciences 'essay' is not similar to that of a 'language essay' i.e. there is no need for an introduction and conclusion and *synthesis* refers to the style/format of the 'essay' and not to a process.

(c) Use p110 of the *Mind the Gap* study guide to explain how learners should make use of mind maps in the planning of an essay.

(d) Inform learners about the criteria for assessing the presentation of the essay (synthesis) i.e. 3 marks are allocated for relevance, logical sequence and comprehensiveness. Use these criteria when setting the essay question in tests and internal examination papers.

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the topic.	Ideas are arranged in a logical/ cause-effect sequence.	All aspects required by the essay have been sufficiently addressed.
In this essay in Q4	Only information relevant to the contribution of crossing over, random arrangements of chromosomes and natural selection is given.	Information regarding crossing over, random arrangements of chromosomes and natural selection is arranged in a logical way.	At least three correct points are included on each of the three aspects: crossing over, random arrangements of chromosomes and natural selection.
Mark	1	1	1