CHAPTER 9. LIFE SCIENCES

The following report should be read in conjunction with the Life Sciences question papers of the November 2016 Examination.

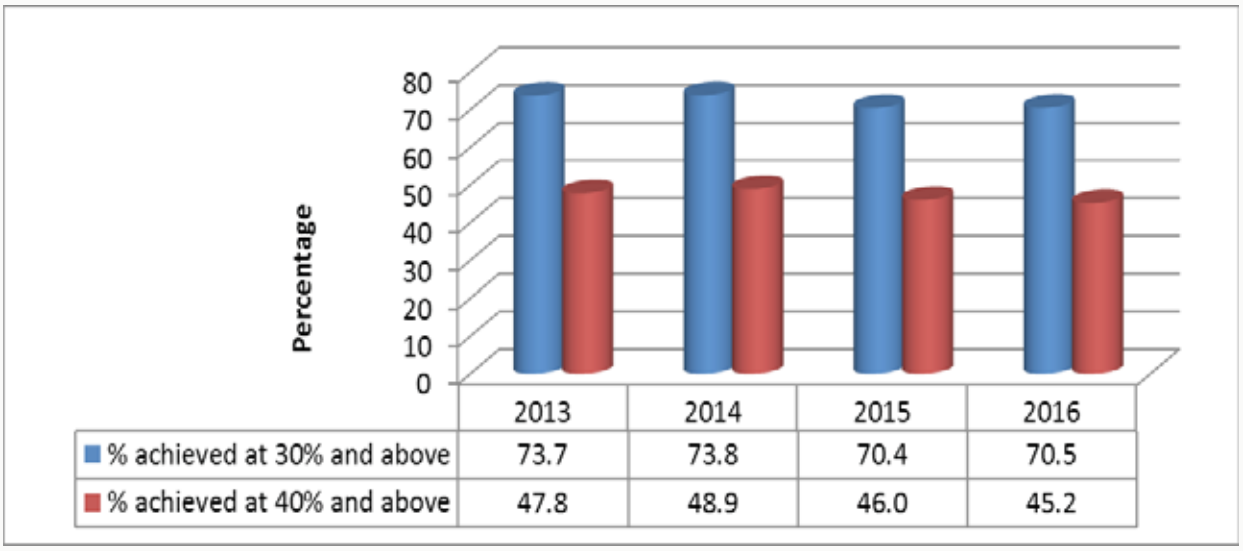
9.1. PERFORMANCE TRENDS (2013 – 2016)

The number of candidates decreased by 414 this year in comparison to 2015. The general performance of candidates improvedmarginally this year as indicated by the 70,5% of the candidates achieving at 30% and above. However, the number of candidates achieving at 40% and above declinedby 0,8%.

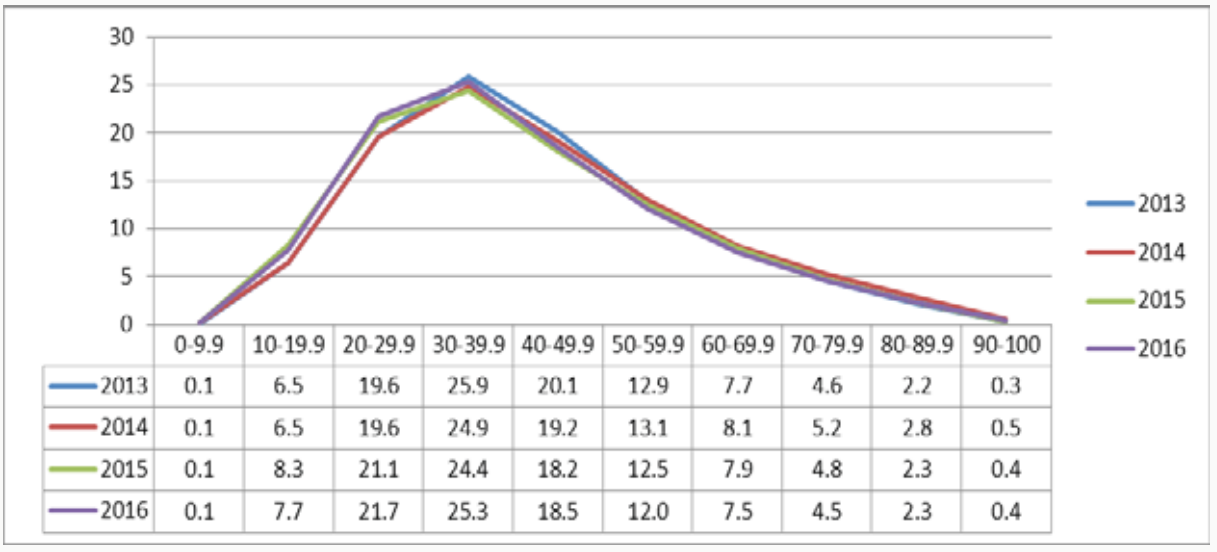
Table 9.1 Overall achievement rates in Life Sciences

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
2013	301 718	222 374	73.7	144 355	47.8
2014	284 298	209 783	73.8	139 109	48.9
2015	348 076	245 164	70.4	160 204	46.0
2016	347 662	245 077	70.5	157 177	45.2

Graph 9.1.1 Overall achievement rates 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
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
2015	0.1	8.3	21.1	24.4	18.2	12.5	7.9	4.8	2.3	0.4
2016	0.1	7.7	21.7	25.3	18.5	12.0	7.5	4.5	2.3	0.4

From the above graphs, it is evident that the results have remained more or less constant over the past two years.

9.2. OVERVIEW OF LEARNER PERFORMANCE IN PAPER 1

General comments

(a) Some candidates were not familiar with basic terminology in the different topics. This resulted in poor performances, even in the lower-order questions.

(b) Some candidates had problems distinguishing between action verbs such as state, suggest, describe and explain.

(c) Certain problem areas mentioned in previous reports e.g. investigations which form part of the work throughout the year, remain a challenge to some candidates.

(d) Learners must follow the instructions and start each question on a new page.

(e) The handwriting of some learners is illegible.

(f) Candidates' performance indicates that the questions on environmental studies which were taught in Grade 11 was not revised properly or covered again in Grade 12.

(g) Since textbooksdo not always carry accurate information, teachers should always be guided by the CAPS and Examination Guidelinedocuments for the Life Sciences.

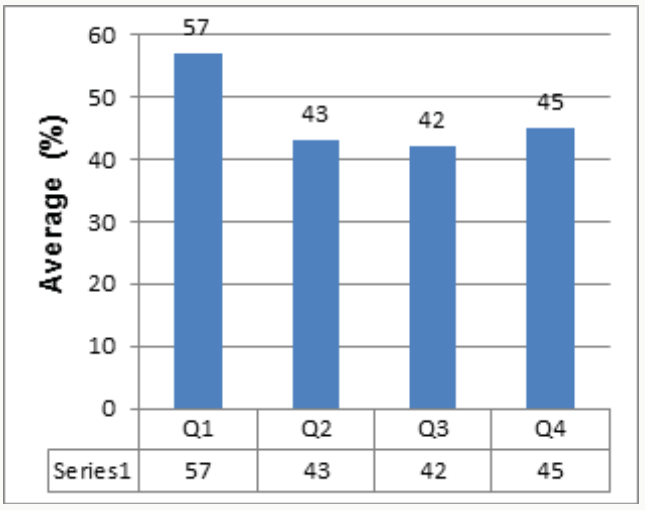
(h) Candidates generally performed better in Q1 when compared to the marks they acquired in the rest of the paper.

(i) Although some candidates performed well and obtained high scores in the essay, many candidates could not identify the aspects that were required and wrote on everything, losing marks for the synthesis.

9.3. DIAGNOSTIC QUESTION ANALYSIS FOR PAPER 1

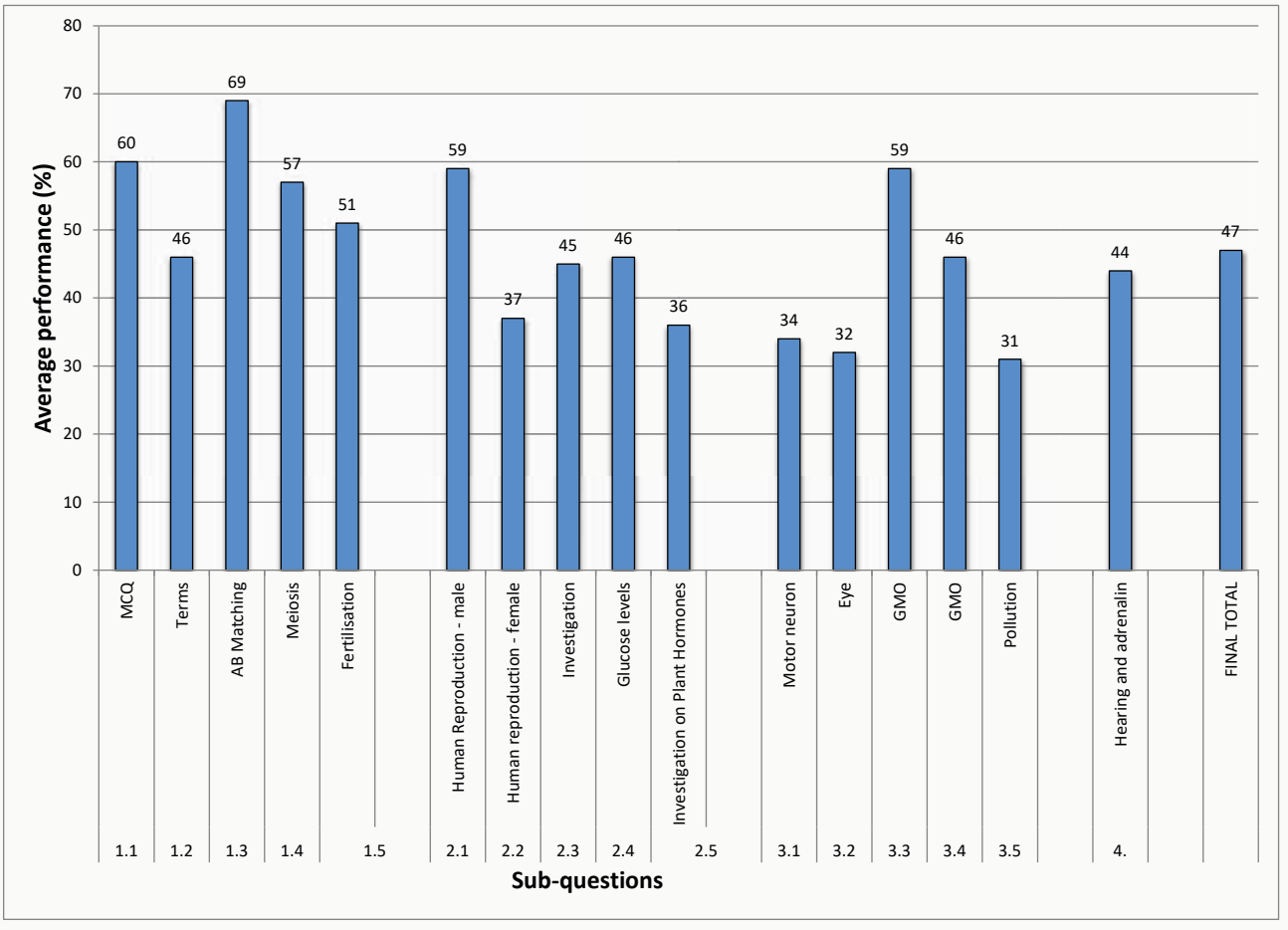
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

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



Q1	Multiple Choice, Terminology, Matching, Meiosis and Fertilisation
Q2	Human Reproduction,Scientific investigation on Temperature and Pulse rate, Glucose level and Investigation on Auxin
Q3	Neuron, Visual defect, GMO, Human Impact (gasohol) and Thermal Pollution
Q4	Hearing and the role of Adrenalin on muscles

Graph 9.3.2 Average marks per sub question: Paper 1



The worst performance by candidates was recorded in the sub-questions on thermal pollution,visual defect of the eye, the functioning of the neuron, the investigation on auxins, andfemale hormones.

9.4. ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN PAPER 1

QUESTION 1: MULTIPLE CHOICE,TERMINOLOGY, MATCHING, MEIOSIS AND THE HUMAN OVUM

Common errors and misconceptions

(a) Poor performance in Q1.1 showed that candidates lacked basic knowledge of terminology. Candidates lost marks since they were unable to:

- Correctly identify the cerebellum as the structure that receives nerve impulses from the semi-circular canals.
- Identify thatretina is responsible for the conversion of a light stimulus to a nerve impulse.
- Differentiate betweennumber of autosomes and gonosomes in the human body.
- Correctly identify the planning steps before and during an investigation.

(b) InQ1.2, biological terms remain problematic for many candidates. Some candidates did not use the correct scientific names but used common names instead. In Q1.2.2, candidates wrote '*automatic'* instead of '*autonomic'* nervous system. In Q1.2.7, candidates mistakenly wrote *uterine wall* instead of the *endometrium*, while the question clearly asked for the *inner lining of the uterus.*

(c) In Q1.3, candidates did not follow the instructions when answers were given. For example, they wrote *A+B* or *A,B* and sometimes *A/B* instead of *both A and B*. In Q1.3.1 candidates werenot able to differentiate between *vivipary* and *ovovivipary.*

(d) Many candidates lost marks inQ1.4 because theycould not identify the different phases of meiosis I and meiosis II in the correct sequence. Also,the skill of determining the number of chromosomes before and after meiosis posed a problem. In Q1.4.1(b), where the answer 'centriole' was required candidates provided the word 'pole' instead.

(e) In Q1.5,the structure of the ovum was not well known by 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 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 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 by finding the meaning in a dictionary or textbook.
- Break down the term where possible, giving the meanings of prefixes, suffixes andother components: for example, inter = between and therefore interphase refers to the phase *between* two successive divisions of the cell.
- Make learners aware of the meanings of new terms by using them in sentences.
- Include biological terms in all daily assessment tasks.
- Ensure that by the end of the year, all learners have a comprehensive glossary of all terms.

(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 or A/B). Teachers should enforce this in all assessment activities done at school.

(c) The events of the different phases of meiosis should be taught using annotated diagrams to clearly show what happens during each phase. The effects of crossing over should be followed through the different phases using the shading of chromosomes.

(d) Learners should be given sufficient practice at understanding the instructions as contained in questions. Some questions prescribe that a LETTER is required, whereas at other times a LETTER and NAME may be required.

(e) Teachersshould give learners multiple opportunities to label drawings and write in the functions next to the labels. Refer to the blank diagrams found in the *Mind the Gap*study guide.

(f) Teachers must adhere to the Examination Guidelines and not depend on textbooks alone to prepare learners for the examination. The diagram of a human ovum tested in Q1.5. is,for example, not included in several textbooks.

(g) Use a range of textbooks when preparing for the teaching of a section so that learners can be informed of alternative words.

QUESTION 2:
HUMAN REPRODUCTION, SCIENTIFIC INVESTIGATION ON HOMEOSTASIS AND PLANT HORMONES

Common errors and misconceptions

(a) In Q2.1, some candidates have a misconception that the testis should be at a temperature 2 to 3 ºC instead of 2 to 3 ºC *below body temperature*. In Q2.1.3, some candidates lost marks by only naming the consequence without linking it with either temperature or pressure (the path) or naming the effect.

(b) In Q2.2, which required the interpretation of a graph on the use of a fertility monitor that measured the concentration of oestrogen and LH, many candidates lost marks because they:

- Could not interpret the graph in Q2.2.2 and just gave functions of the hormones without linking them to the information required.
- Discussed in Q2.2.6 *the role of progesterone in relation to maintaining pregnancy* while the whole question was based on determining the *fertile period*.
- Were able to provide the CAUSE but not the EFFECT and therefore lost marks.
- Repeated the question which indicated that somecandidates struggled to formulate answers. Some candidates confused *fertility* with *fertilisation*.

(c) In Q2.3,candidates repeated the words in the question paper to answer questions. They only read part of the question and then only answered that part. They only provided a response to the effect of vasoconstriction and not the effect of metabolism. Many candidates did not know what metabolism is.

(d) Some candidates still confuse dependent and independent variables and could not state the factors that were kept constant during the investigation.

(e) In Q2.4,some candidates still use *glucagon* and *glycogen* interchangeably.

(f) In Q2.5, many candidateshad no knowledge on apical dominance and the role of auxins in apical dominance.

Suggestions for improvement

(a) Give learners more practice in questions that need an explanation.

(b) Use graphs to explain the role of the female hormones and link this knowledge with everyday life scenarios e.g. fertility monitor. Teachers must explain the difference between *hormones* and *glands*.

(c) Teachers should expose learners to the different steps of the scientific method andensure that learners understand the concept of metabolism with all the processes involved e.g. cellular respiration and heat regulation.

(d) Further to the above,learners should be clearly shown how to answer a question asking for a *description* of the effect of caffeineand how this would be different from a question requiring an *explanation*for the effect of caffeine on temperature change.A description requires a statement of the changes of the effect of caffeine on body temperature whereas an explanation has to includea *reason* for the effect on temperature. The term explain, refers to *cause* and *effect* in context.

(e) Teachers should ensure that the topic on plant growth substances is taught thoroughly and that the prescribed practical work is done, so that learners have a good understanding of this topic.

QUESTION 3:
NEURON, VISUAL DEFECT IN THE HUMAN EYE AND HUMAN IMPACT ON THE ENVIROMENT

Common errors and misconceptions

(a) Some candidates were not able to write the function of the axon in Q 3.1.3 but gave general functions of the neuron instead.

(b) In Q3.2,candidates lost marks because they:

- Confused the *choroid* with the *chorion*
- Showed little understanding of long-sightedness and lackedthe appropriate terminology to answer the questions.
- Could not link the *structure* of the lens with its specific *function*. Some explained accommodation in the eye instead and others only gave the function without linking it to the structure.

(c) In Q3.3.2,candidates confused *consumer* with *customer*.

(d) In Q3.4.3, candidates provided answers by using quotes from the passage only. They did not read the extract with understanding. Q 3.4.4 waspoorly answered since learners explained why it is better not to use gasohol in countries with warmer climates rather than why it was better to use it in colder climates, as instructed in the question.

(e) In Q3.5, candidates lost marks because they did not specify the impact that thermal pollution has on both the quality of water and biodiversity.

Suggestions for improvement

(a) Teachers should place greater emphasis on the teaching of the different parts of the organs (eye, neuron, etc.) and teach the *structure* and *function* of these organs using models and drawings.

(b) *State*, *describe* and *explain* are action words that need to be explained to learners.

Emphasise the cause and effect sequence, for example: *Cause*: organisms die,

Effect: it will reduce biodiversity.

(c) Teachers should provide multiple opportunities for learners to interpret textual and other information. Special attention should be given to strategies that would assist learners in identifying the key information in the text to be used as clues in the answering of the questions.

(d) There must be a greater emphasis on the teaching and learning of appropriate terminology related to the various topics, together with the correct spelling of these terms, for example, the definition of food security.

(e) Learners should be advised that two marks are generally allocated to each structural suitability, one mark for the part/structure and the second mark for the way it is suited to perform its function, e.g. the lens is elastic✓- *structure* and therefore it can change shape✓/convexity – *function*.

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

QUESTION 4:
HEARING AND THE ROLE OF ADRENALIN ON THE FUNCTIONING OF MUSCLES TO ASSIST A PERSON IN DANGER

Common errors and misconceptions

(a) Many candidates did not interpret the essay question appropriately and therefore did not identify the two aspects required by the question, namely:

- The pathway for hearing sound.
- The role of adrenalin on the functioning of the muscles to enable a person to run away from danger.

As a result of the above, many candidates did not address one or both of the aspects required by the question and were therefore not awarded the synthesis mark for comprehensiveness.

(b) Many candidates stated the path of a sound wave instead of describing it.

(c) Many candidates gave irrelevant information, for example a description of the semi-circular canals which is involved in balance rather than hearing.

(d) Many candidates are confused about sound, sound waves; vibrations, pressure waves and mechanical waves.

Suggestions for improvement

(a) Teachers should offer more opportunities for learners to write answers in essay-form. Teachers should informlearnersthat the essay in Life Sciences does not require an introduction and a conclusion.

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

(c) Teachers must make use of *Mind the Gap*study guideto explain to learners howmind maps may be used in the planning of an essay.

(d) Learners should be reminded that synthesis is made up of three parts: relevance, logical sequence and a comprehensive answer. The allocation of the synthesis marks should be explained to them and used from grades 10 to 12. The synthesis mark for the essay in Q4 was applied as follows:

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	All the information provided is relevant to hearing and how adrenalin ensures that muscles function efficiently. There is no irrelevant information.	All the information provided on hearing and how adrenalin ensures that muscles function efficiently, is arranged in a logical manner.	At least the following marks should be obtained: - Hearing (7/10) - How adrenalin ensures that muscles function efficiently (4/7)
Mark	1	1	1

(e) Subject advisors should train teachers on the application of the criteria for synthesis. This can be done by giving different teachers the same sample script to mark and to which synthesis marks are allocated. This should be followed by a discussion with reasons on whether the answer in the sample script should be awarded a mark for each aspect of synthesis.

9.5. OVERVIEW OF LEARNER PERFORMANCE IN PAPER 2

General comments

(a) Essay writing was very poor. Many candidates still lack the skill of constructing a good essay.

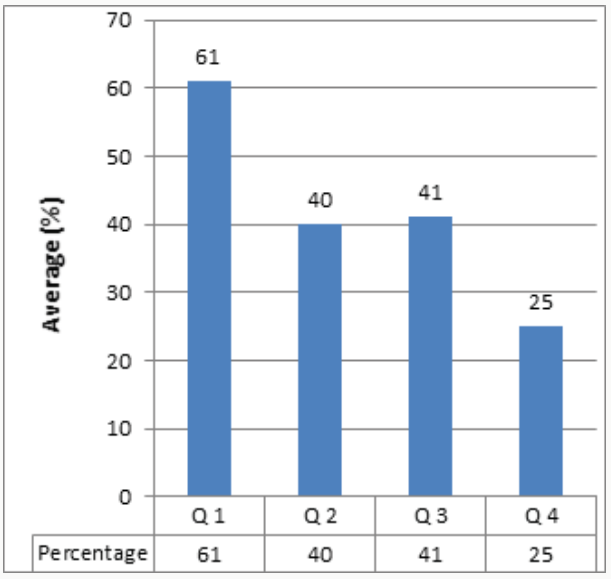
(b) Many candidates were not familiar with basic terminology in the different topics. This resulted in poor performance even in lower-order questions.

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

9.6. DIAGNOSTIC QUESTION ANALYSIS FOR PAPER 2

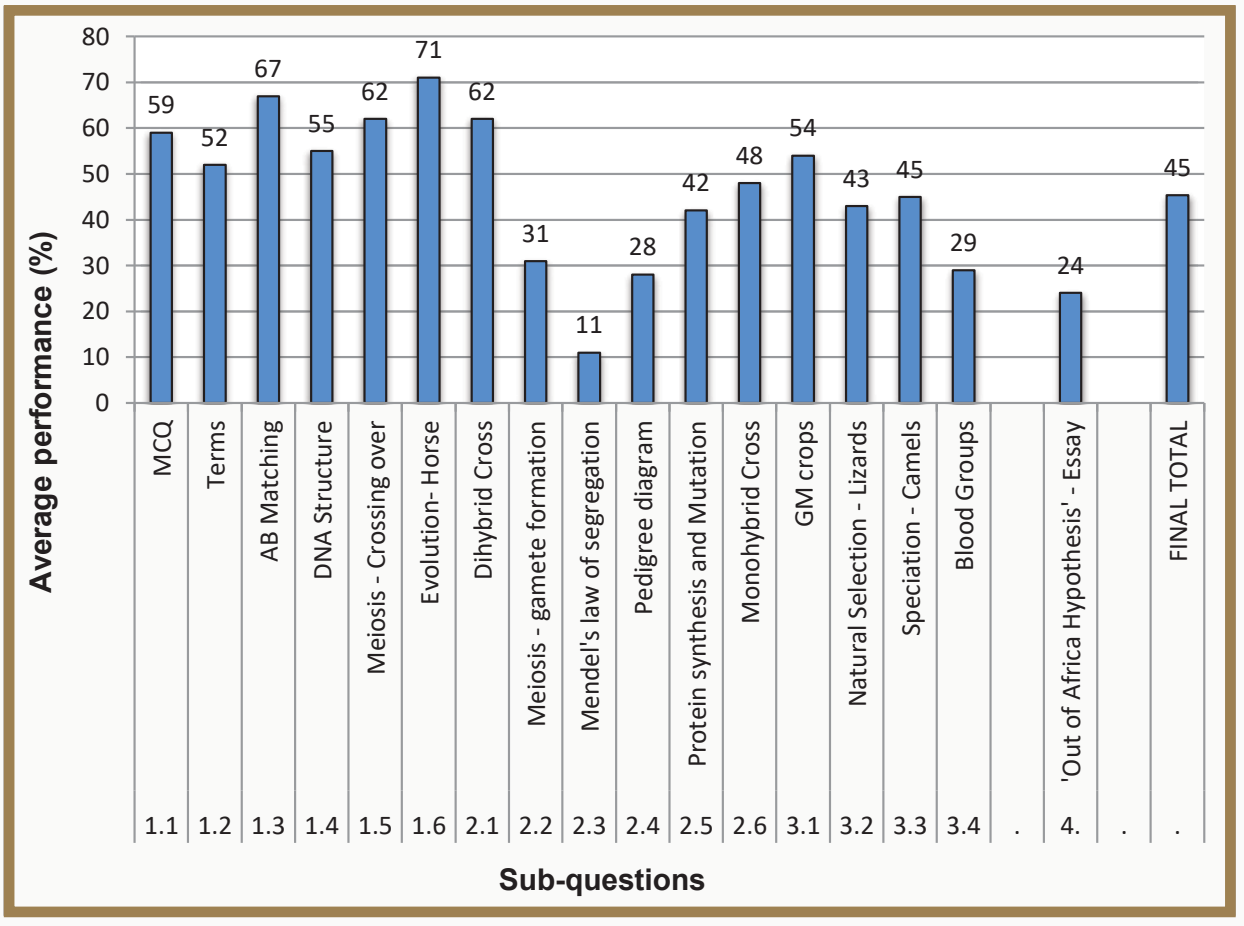
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

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



Q1	Multiple choice, Terminology, Matching, DNA molecule, Meiosis and Evolution of the Horse
Q2	Protein Synthesis, Meiosis and Genetics (dihybrid and monohybrid crosses)
Q3	Evolution (natural selection and speciation), Genetics, Scientific Investigation
Q4	'Out of Africa' hypothesis

Graph 9.6.2 Average performance per sub-question: Paper 2



The worst performance by candidates was in Q2 on Mendel's law of segregation, meiosis, pedigree diagram and protein synthesis, and in Q3 on natural selection and blood groups. In Q4, the essay on the 'Out of Africa' hypothesis was very poorly answered by most candidates.

9.7. ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN PAPER 2

QUESTION 1:
MULTIPLE CHOICE, TERMINOLOGY, MATCHING, DNA STRUCTURE, MEIOSIS AND DATA RESPONSE ON EVOLUTION

Common errors and misconceptions

(a) Performance in Q1.1 showed that candidates lacked basic knowledge of terminology.

(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 their interpretation of and responses to questions. Terms such as *peptide bond*, *non-disjunction* and *hypothesis* seemed not to have been known by many candidates.

(c) Candidates did not follow the instructions as prescribed in Q1.3 requiring answers to be written as A *only*, B *only*, both A and B or none.

(d) In Q1.4, candidates performed poorly since they were not able to identify that a nucleotide is made up of 3 components, viz. a sugar, a phosphate group and a nitrogenous base. Also, candidates did not use the information provided in the diagram to give the correct label for 1 (adenine), but rather gave a generic answer – nitrogenous base.

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 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 by finding the meaning in a dictionary or textbook.
- Break down the term where possible, giving the meanings of prefixes, suffixes and other components: for example, inter = between and therefore interphase refers to the phase *between* two successive divisions of the cell.
- Make learners aware of the meanings of new terms by using them in sentences.
- Include biological terms in all daily assessment tasks.
- Ensure that by the end of the year, all learners have a comprehensive glossary of all terms.

(b) Teachers should also highlight the differences between different concepts, e.g. *homologous/ homozygous, DNA profiling/fingerprinting, dipeptide/polypeptide/peptide bond, theory/hypothesis, codons/anticodons, transcription/translation, genotype/phenotype and chromatid/daughter chromosome/chromosome.*

(c) 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 or A/B) or *none*. Teachers should enforce this in all classroom assessment activities.

(d) Teachers should give learners multiple opportunities to answer questions based on data provided. Guidance should be provided to learners on how to read/interpret the data given so as to use the clues provided in answering the questions set.

QUESTION 2:
PROTEIN SYNTHESIS, GENETICS, MEIOSIS AND NUCLEIC ACIDS

Common errors and misconceptions

(a) The majority of the candidates were not able to draw and label the diagram required in Q2.2.3. These candidates were not able to apply their knowledge of meiosis to identify that they had to draw a gamete representing telophase II.

(b) The majority of the candidates were not able to state Mendel's law of Segregation. In fact, Q2.3 was the most poorly answered question in Paper 2.

(c) In Q2.4, many candidates incorrectly assumed that Huntington's chorea is a sex- linked disorder. Consequently, they wrote Sarah's genotype as X^hX^h. Many candidates also incorrectly as sumed that the genetic disorder is caused by a recessive allele. Many candidates could not differen tiate between *explain* and *describe* and consequently lost marks in Q2.4.3.

(d) Q2.5 on protein synthesis was poorly answered by many candidates for the following reasons:

- Inability to identify that the diagram represented *transcription*, and not *translation*, in spite of the fact that a DNA molecule was drawn and an mRNA strand was formed.
- Inability to recognise that the table given in the question referred to mRNA codons coding for specific amino acids. They needed to convert the DNA triplet of bases (CAG) to the mRNA codon (GUC) before they could read off from the table.
- Difficulty in explaining how a mutation could result in the formation of a different protein.

(e) Many candidates experienced difficulty in solving the monohybrid cross on incomplete dominance. Also, many candidates failed to get the 2 easy marks for simply writing the correct format for a monohybrid cross.

Suggestions for improvement

(a) Teachers should provide learners with multiple opportunities to label diagrams of different phases of meiosis. Blank diagrams provided in the *Mind the Gap* study guide can be used for this purpose. Teachers should not only teach the process of meiosis well, but also teach the process so that candidates could apply their knowledge to questions such as asked in Q2.2.3. Candidates had to first recognize the phase represented in the diagram given (metaphase I) and then represent how a cell at telophase IIwould appear.

(b) Teachers should briefly refer to Mendel's experiments with pea plants as an introduction to Genetics. In addition, an explanation of how his experiments translate to the modern-day understanding of his Law of Segregation must be thoroughly explained to candidates as follows: 'The pair of alleles on homologous chromosomes separate during meiosis, so that only one allele of each pair is found in each gamete'.

(c) Learners must not assume that a genetic disorder is sex-linked if this is not explicitly stated or implied in the question. Teachers should also give learners many examples of pedigree diagrams involving genetic disorders to eliminate the idea that all genetic disorders are sex-linked.

(d) Teachers should also expose learners to more questions on the interpretation of pedigree diagrams. Teachers can expose candidates to interpretation of pedigree diagrams by using the many questions available in previous national examination question papers.

(e) When learners are asked to explain something, they need to say HOW something works and to state a cause-effect sequence. In Q2.4.3, candidates needed to explain what the father's genotype needed to be so that there is a 50% chance of a child not having Huntington's chorea. The correct explanation: Emma's genotype is Hh, the father's genotype has to be hh. A cross between only these two genotypes (Hh and hh) will ensure that there is a 50% chance of a child not inheriting the disease because a child inherits one recessive allele from each parent.

(f) Learners should be given sufficient exercises on how to convert base sequences in protein synthesis, i.e. from DNA to mRNA (codons) to tRNA (anticodons) to amino acids, and the reverse process. Teachers should use the questions on this section from previous national question papers and also refer to strategies suggested in previous diagnostic reports.

(g) Learners should be given many opportunities to work out monohybrid crosses involving complete dominance, incomplete dominance and co-dominance.Learners must also be taught the format for writing out genetic crosses (which can be found in previous diagnostic reports) so that they can get at least 2 marks even if they did not successfully solve the genetics cross.

QUESTION 3:
EVOLUTION, GENETICS, SCIENTIFIC INVESTIGATION

Common errors and misconceptions

(a) Poor performance in Q3.1 despite answers being accessible in the text provided, indicates that candidates experienced difficulty in comprehending and interpreting textual information.

(b) In Q3.2.1 (b), many candidates failed to identify the dependent variable in the investigation. Many candidates also failed to identify that Q3.2.3 was a question on *reliability* and that Q3.2.4 was a question on *validity*.

(c) Most candidates simply described the process of natural selection in Q3.2.5 without contextualizing it to the specific example of the lizards given in the question. They mentioned *variation* without describing the variation as it applied to the lizards in the question. In cases where the variation was described, many candidates did not identify the favourable and unfavourable characteristics relating to this variation. Many candidates also failed to identify the appropriate selection pressure that was at play in this specific example which in this case was *predation* (the black colour lizards were camouflaged well against the dark rocks and escaped predation, while the brown and red lizards were easily spotted and thus susceptible to predation).

(d) In Q3.3, most candidates provided a general account on speciation without contextualizing it to the specific example given in the question. For example, they failed to mention that the geographical barrier in this particular case was the sea/continental drift which separated the original population of camels into 3 populations.

(e) In Q3.4, many candidates could not write down the alleles that control blood groups and explain how offspring inherit these alleles from their parents.

Suggestions for improvement

(a) Teachers should provide multiple opportunities for learners to interpret textual and other information. Special attention should be given to strategies that would assist learners in identifying the key information in the text so that it could be used as clues in the answering of the questions. Teachers must select appropriate material from other sources, not only from textbooks e.g. newspapers and science journals. Subject advisors should also give some exemplars of source material that teachers could use to summarise the information and set contextual questions based on the source material, including questions that assess higher order cognitive levels.

(b) Independent and dependent variables should be identified from the aim of the investigation. In Q3.2, e.g. scientists investigated the relationship between the colour of lizards in a population and their survival rate on an island, the independent variable is *the colour of lizards* and the dependent variable is *the survival rate of the lizards*.

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.

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.

What is reliability?

- The idea behind reliability is that any significant results of an investigation must be more than a once-off finding and should be repeatable.

- Other researchers must be able to perform exactly the same investigation, under the same conditions, and generate the same results. This would reinforce the findings of the investigation and ensure that the wider scientific community accepts the hypothesis.

- For questions that require learners to state how the reliability of an investigation could have been improved, the following answers may apply depending on the nature of the investigation:

  - Repeat the investigation

  - Take many readings and use the average

  - Randomly select a sample

  - Increase the sample size

  - Increase the period of the investigation.

What is validity?

- Validity questions how the investigation was carried out. It is important to be sure that all the factors have been controlled/fixed except the factor being tested.

- In questions that require learners to suggest some factors that might have decreased the validity of an investigation, learners should identify some factors that were not fixed/controlled when carrying out the investigation.

(c) Teachers should provide multiple opportunities for learners to answer questions based on an application of the concept of natural selection. Particular guidance must be provided on how to contextualize the general account to the specific example stated in the question. In any example, the learner must be able to describe the variation and be able to differentiate between the characteristic that is favourable from that which is unfavourable. In addition the selection pressure for natural selection should be identified for the specific example cited in the question.

The table that follows indicates how a general account (based on recall) can be adapted to answer an application question (as in Q3.2.5).

General Account on Natural Selection	**Natural Selection in the Lizard Population**
There is variation amongst the offspring	There is variation amongst the lizard population
Some have favourable characteristics and some do not	Some are black and are better camouflaged/ warm up faster to have energy to avoid predators, whilst others are red or brown and are NOT camouflaged/cannot warm up fast enough to have energy to run away from predators
Sometimes there is a change in the environmental conditions which acts a selection pressure	Predation acts as the selection pressure. Survival depends on the colour of the lizards.

Organisms with characteristics that make them less suited to the environment, die	Red and brown lizards are caught by predators and die
Organisms with characteristics which make them more suited to the environment, survive	Black lizards survive
The organisms that survive, reproduce	The surviving black lizards will reproduce
They will pass on the favourable characteristic to their offspring	The allele for black colour will be passed on to the next generation
Over many generations, the proportion of individuals with the favourable characteristic, increases	Over many generations the proportion of lizards that are black, increases

(d) Teachers should provide multiple opportunities for learners to answer questions based on an application of the concept of speciation. Particular guidance must be given on how to contextualize the general account to the specific example stated in the question.

(e) Subject advisors should ensure that the attention of the teachers is drawn to the correct allelic nota tion that should be used when writing genotypes for the various blood groups as prescribed in the 2014 Exam Guideline Document for the Life Sciences. The allele notation $\mathbf{I^A}$, $\mathbf{I^B}$and **i** must be used.

QUESTION 4:
'OUT OF AFRICA' HYPOTHESIS

Common errors and misconceptions

(a) This question was generally poorly answered. Candidates lost marks or did not receive credit because they:

- Did not state the 'Out of Africa' hypothesis as asked for in the question
- Did not write the essay under sub-headings – candidates were credited for recognising the types of evidence, i.e. fossil evidence, genetic evidence and cultural evidence
- Confused fossil evidence with genetic evidence
- Wrote extensively on Y chromosome evidence when this is not in the Examination Guideline document – 2014
- Did not write about the structures in fossils, that indicated that the fossils of *Ardipithecus*, *Australopithecus* and early *Homo* species were bipedal. The 3 features, which are evidence for bipedalism (position of the foramen magnum, shape of the spine and shape of the pelvic girdle) are stated explicitly in the Examination Guideline Document – 2014
- Described the significance of bipedalism, which was not required in this question
- Did not select and apply information that they learnt about the fossil record in Africa

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 on the 'Out of Africa' hypothesis should have the steps in the correct order, for example:

- State the 'Out of Africa' hypothesis – All modern humans/*Homo sapiens* originated in Africa and migrated to other parts of the world. The use of the concept 'modern humans' excludes *Homo neanderthalensis* which originated in Europe.
- Fossil Evidence – Fossils of *Ardipithecus*, *Australopithecus* and *Homo habilis* were ONLY found in Africa and nowhere else in the world. The OLDEST fossils of *Homo erectus* and *Homo sapiens* were found in Africa. Candidates needed to select/apply the knowledge learnt about the fossil record found in Africa to the question asked in this essay.
- Genetic Evidence – Describe evidence from mitochondrial DNA.
- Cultural Evidence – The oldest/most primitive artefacts were found in Africa.
- Bipedalism – Candidates needed to describe the position of the foramen magnum, the structure of the spine and the pelvis in fossils as evidence that the 3 genera were bipedal.

(b) Teachers must make use of the *Mind the Gap* study guide to assist learners in the use of mind maps in the planning of an essay.

(c) Learners should be reminded that synthesis is made up of three parts: relevance, logical presentation and a comprehensive answer. The allocation of marks for synthesis should be explained to them and used from grades 10 to 12. The following mark allocation for synthesis applies to Q4 in this paper.

Criterion	Relevance (R)	Logical sequence (L)	Comprehensive (C)
Generally	All information provided is relevant to the question	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 'Out of Africa' hypothesis and bipedal features of the three genera are described. No irrelevant information included.	The description of the evidence for the 'Out of Africa' hypothesis and the evidence of bipedalism is presented in a logical and sequential manner.	At leastthe following marks should be obtained: - **7/11** for the 'Out of Africa' hypothesis and the evidence - **4/6** on evidence for bipedalism.
Mark	1	1	1

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

(d) Subject advisors should train teachers on the application of the criteria for synthesis. This can be done by giving different teachers the same sample script to mark and to which synthesis marks are allocated. This should be followed by a discussion with reasons on whether the answer in the sample script should be awarded a mark for each aspect of synthesis.