

NSC 2016 CHIEF MARKER'S REPORT

SUBJECT	LIFE SCIENCES		
PAPER	TWO		
DATE OF EXAMINATION:	14 NOVEMBER 2016	DURATION:	2 $\frac{1}{2}$ HOURS

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The 2016 paper 2 question paper was generally perceived as fair and credible in terms of addressing the subject content, cognitive levels and degree of challenge. It was an encouraging feature to observe that almost all candidates engaged with every question.

Out of the total candidates who wrote we can estimate that approximately 45% of the candidates did not meet the minimum passing requirements for Life Sciences Paper 2. Approximately 55% of the candidates achieved a pass i.e. from 2 Level upwards. Life Sciences paper 2 for 2016 although having a similar format to previous years, was more scientific in terms of the marking guidelines, emphasizing the scientific nature of the Life Sciences subject. It was overwhelmingly disappointing to note that only few of the learners managed to achieve a level 6 to level 7 pass. The vast majority of the learners achieved a level 2 pass, which is a minimum pass requirement.

Some candidates were not familiar with the basic terminology in the four topics assessed in Life Sciences Paper 2. This resulted in poor performance, even in questions which required simple recall, such as stating functions of various parts.

Some candidates have problems in responding to action verbs such as : **explain- they were predisposed to providing illustrations instead of using these illustrations as a thinking process to fully express the answer in descriptive words.**

Certain problematic areas highlighted in previous year reports such as scientific investigations which form part of the work throughout the year remains a challenge to most of the learners. Learners are still confused between validity and reliability.

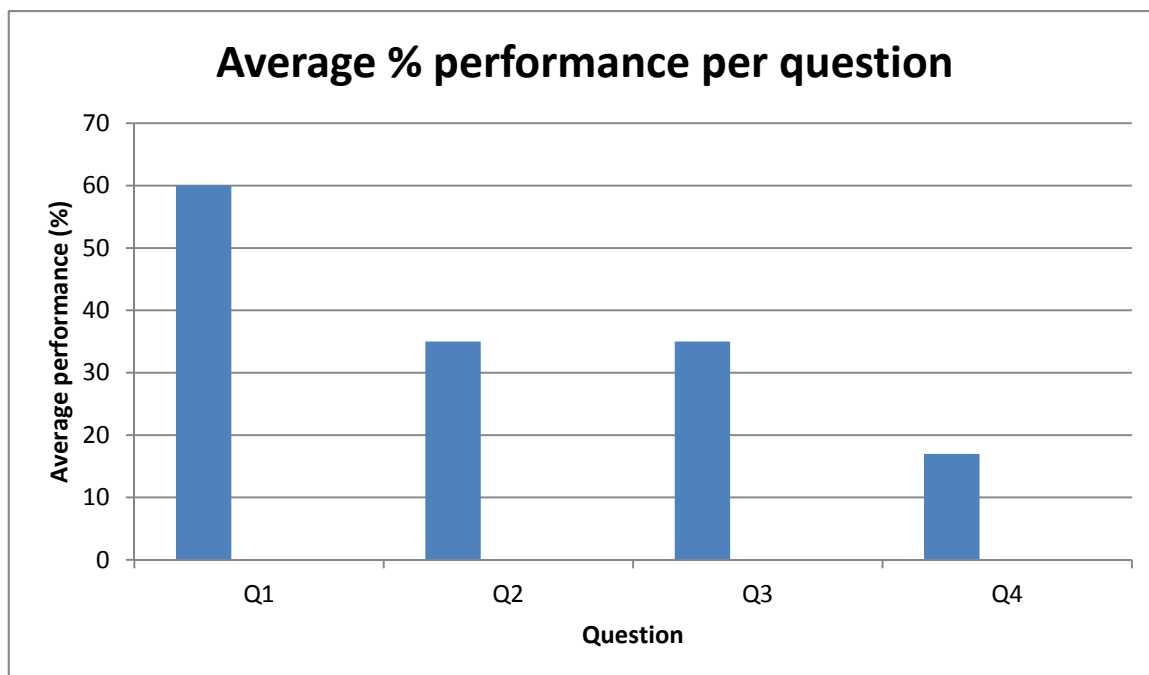
Many candidates could not identify that aspects that needed to be addressed in the



essay question, although the focus was on genera, they deviated to species, thus losing marks although it was clear that they know about the OUT OF AFRICA HYPOTHESIS.

All topics in the paper have been covered in the previous year's including the current year supplementary papers, Senior Certificate Examinations written in June and Trial papers.. Teachers and learners thus had extensive resource material to assist them in preparing for the 2016 paper. It is evident that some centres did not make use of even the recently available past papers to prepare the learners.

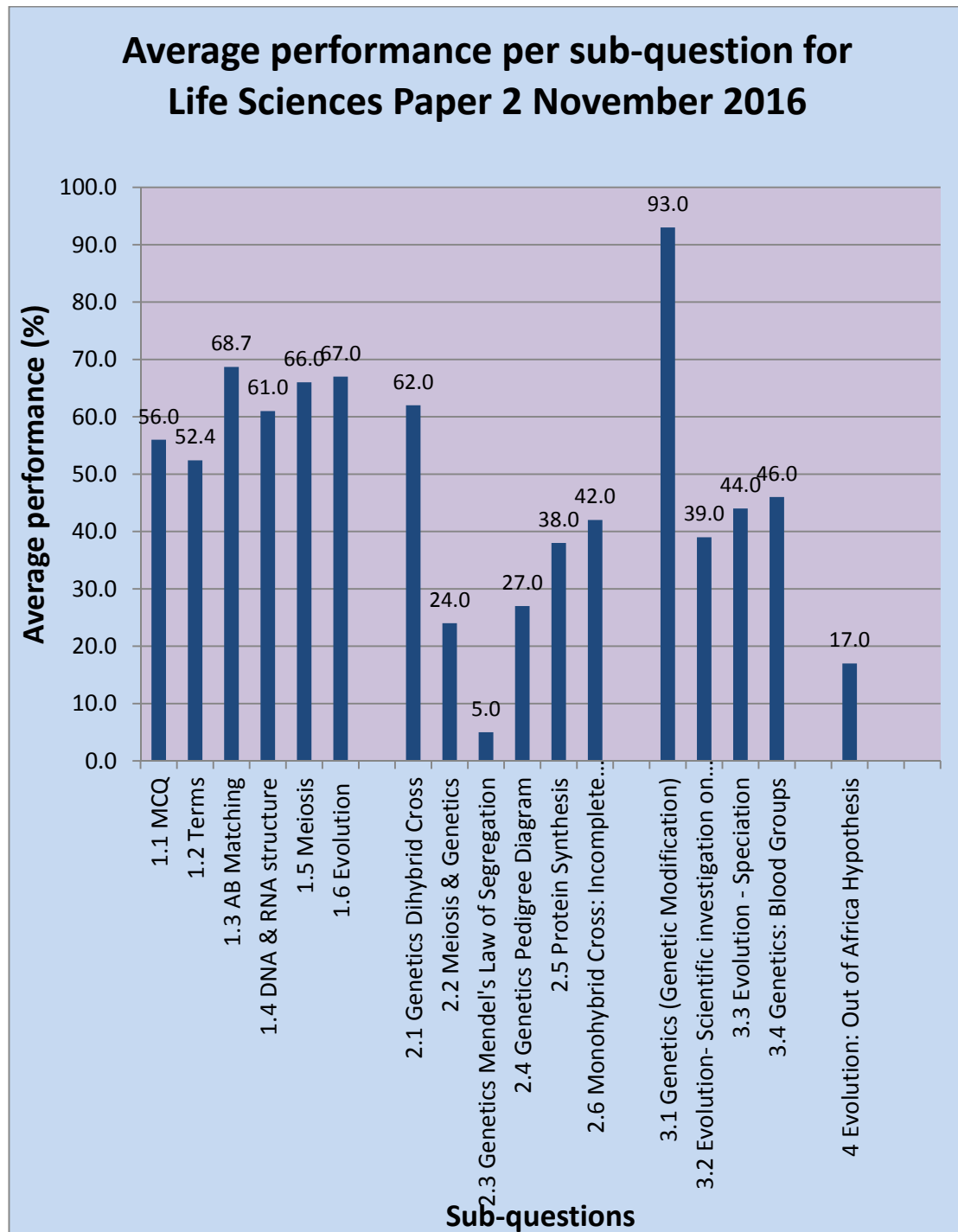
On interrogation of 100 randomly sampled learner scripts the average percentage per question is reflected on the graph below.



QUESTION	TYPE OF QUESTION	AVERAGE PERCENTAGE (%)
Q1	MCQ, Terminology, Matching questions, DNA & RNA structure, Meiosis diagram on crossing over, Interpretation of a phylogenetic diagram based on evolution	60
Q2	Dihybrid cross, phase of meiosis and independent assortment of alleles, Mendel's law of segregation, Interpretation of a pedigree diagram, Protein Synthesis, Genetic cross	35
Q3	Extract on genetic modification, Natural selection & Scientific Investigation, Speciation, Inheritance of blood type	35
Q4	Out Of Africa Hypothesis	17

The graph below reflects the average performance per sub- section of the question paper for a random sample of 100 learners selected from each of the 23 districts in the Eastern Cape.

The small sample size can thus be used to extrapolate on the performance of the 56399 learners which were marked for paper 2.



QUESTION 1

- (a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**

Most of the learners were able to achieve satisfactory results, with a few learners actually achieving above 80 % in this section. A breakdown of the learner performance in the sub questions is as follows:

Average mark from the sample of 100 :		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
1.1	MCQ	56
1.2	TERMINOLOGY	52
1.3	MATCHING QUESTION	69
1.4	DNA AND RNA STRUCTURE	61
1.5	CROSSING OVER DIAGRAM	66
1.6	INTERPRETATION OF A PHYLOGENETIC TREE BASED ON THE EVOLUTION OF THE HORSES	67

- (b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

1.1.7 & 1.1.9 Learners still confuse fingerprinting and DNA profiling. Learners also seem to battle when asked to choose from a list of possibilities as was the case in 1.1.7 & 1.1.9.

1.5.1 Learners still confuse the terms homozygous and homologous.

1.6.2 & 1.6.3 Learners lost marks for writing incorrect units or not writing them at all.

In 1.2.2 it was evident that learners cannot differentiate between the terms dipeptide, polypeptide and peptide. It should be emphasised that the bond between amino acids is a peptide bond. Most learners were writing hydrogen bond as the one linking the different amino acids.

Most learners cannot make a distinction between the terms theory and hypothesis and as such failed to score marks in question 1.2.6. Generally learners do not know the functions of tRNA and mRNA; they were thus not able to recall the RNA that carries a specific amino acid.

Of the 100 sampled learners in the rash analysis only 50% of the learners were able to identify the nitrogenous base labelled as number 1 in Question 1.4.1 (a). In this question they were expected to specify the name of the nitrogenous base by identifying the complementary bases in the diagrams in terms of shape. Although learners know the definition of nucleotide, approximately 36% were able to count the number of nucleotides in the diagram. This clearly indicates that when it comes to terminology, the learners memorise without any understanding.

Although the examination guidelines stipulate that learners should describe the events

that occur in each phase of meiosis and also explain the significance of crossing over, most learners did not know that crossing over occurs during prophase 1 as required in question 1.5.4, most were mentioning metaphase I. Instead of stating the significance of crossing over as causing variation most learners described what happens (that is the exchange of genes without stating the consequence of the exchange).

The learner performance in question 1.6 which is interpretation of a phylogenetic tree diagram should be commended since they managed to achieve 66% overall. Concessions were made in question 1.6.3 due to the different ways of interpreting the diagram.

(c) Provide suggestions for improvement in relation to Teaching and Learning

The teachers are advised to always use diagrams to illustrate and explain certain concepts.

Teachers are encouraged to provide learners with informal tasks testing the skill of interpreting phylogenetic tree diagrams. Learners must be able to see where the species are diverging from the ancestor, they should also be able to read the timeline and note that it always works from the earliest to the recent time. This will thus assist them to identify the species which are most closely related and which ones have become extinct. When teaching, teachers should no longer use the term DNA fingerprinting as it is incorrect and misleading to learners when teaching. They should rather refer to DNA profiling.

Learners must be specific when answering questions. For example write tRNA / mRNA not just RNA. Deoxyribose sugar not just sugar.

Teachers must always emphasize the importance of always including units when asked for values/measurements to avoid losing marks.

(d) Describe any other specific observations relating to responses of learners

Learners have a tendency of writing more than one answer when asked for one answer. Teachers must be familiar with the principles related to marking Life Sciences and alert their learners to **Marking Principle no2** which says: **if, for example, three reasons are required and five are given. The candidate will only be credited for the first three answers whether all or some are correct /incorrect.**

(e) Any other comments useful to teachers, subject advisors, teacher development etc.

In each lesson the teacher must write new terms to be copied by learners and explain their meaning.

Learners must be given more informal tasks assessing terminology so as to get used to spelling.

Teachers must make use of Past Examinations as revision to consolidate teaching. Teachers can also create crossword puzzles incorporating terms from various topics. This is also a good way of re-enforcing spelling.

QUESTION 2

- (a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was poorly answered especially the application questions on independent assortment of alleles which required learners to draw a gamete indicating the independent assortment of alleles during meiosis. Learners are struggling to interpret the pedigree diagram.

Average mark from the sample of 100 :		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
2.1	DIHYBRID CROSS	62
2.2	MEIOSIS AND ASSORTMENT OF ALLELES	24
2.3	MENDEL'S LAW OF SEGREGATION	5
2.4	INTERPRETATION OF THE PEDIGREE DIAGRAM	27
2.5	PROTEIN SYNTHESIS	38
2.6	GENETIC CROSS (INCOMPLETE DOMINANCE)	42

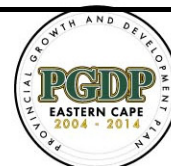
- (b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

In (Q 2.1) learners could not differentiate between the genotype and phenotype, and they also struggled to work out genotype from the punnet square when provided with the gametes. The learners failed to refer to the second paragraph when asked to list the four genotypes which are phenotypically different from the original pair. They thus could not describe the phenotype from the given genotype.

Only 14 % of the learners were able to differentiate between a somatic human cell and another organism's somatic cell in terms of chromosome number. Lack of comprehension skills resulted in learners not being able to identify that the given cell had 4 chromosomes lined up at the equator in pairs. So it could not be a human cell since there should have been 46 chromosomes if it was.

Although 51% of the learners sampled provided the number of chromosomes at the end of Telophase I, they had difficulty in providing the chromosome number that would be found in a daughter cell at the end of Telophase II thus only 27% of the learners responded correctly.

Q2.2.3 Most learners drew a cell with two paired chromosomes indicating the alleles sometimes but most of the time the alleles were not indicated. This clearly showed lack of application of existing knowledge as most cells were representing a cell at the end of Telophase 1. Most learners only showed the nucleus in their drawing without showing the cell membrane and the cytoplasm and this resulted in them losing marks. The mere fact that only 21 % of the learners could draw a gamete with the correct allele on the unreplicated chromatid attest to the fact that learners need more exposure on application questions of this type.



Q 2.3 was a simple recall question, where learners had to state Mendel's Law of segregation but only 5 % were able to state it correctly. Most learners described the separation of chromosomes during anaphase 1 instead of the separation of a pair of alleles so that each gamete contains one allele for that particular characteristic. Most learners referred to the separation of "factors" that control the characteristics and thus lost the 2 marks for failing to refer to the factors as alleles. A few learners stated Mendel's Law of dominance instead of the required Law. The marking guideline did not take into account the original description of Mendel's Law of Segregation and only catered for the modern scientific version whereas in the CAPS document and the examination guidelines it simply says state Mendel's principle of segregation. Most learners could have scored full marks if the old version was allowed.

Question 2.4 was based on the interpretation of the pedigree diagram where it was evident that learners cannot differentiate between a sex-linked genetic disorder and an autosomal disorder. The main learner misconception in this question was that they regarded the allele as being carried on the X chromosome although there was no mention of this in the question. Most learners could not identify Sarah's genotype in 2.4.1 as hh since the disease is caused by a dominant allele. Learners also failed to read the key and answer question 2.4.1 where they were asked to identify Susan's phenotype. Learners were providing the genotype instead of the phenotype required. Although learners could work out the father's genotype in 2.4.2 they failed to explain their answer in 2.4.3. Learner's average in Q2.4.3 was a disappointing 8%. A few learners used the genetic cross to explain their answers and thus lost marks as the answer required a description not a diagram. **(Marking principle 6 was applied which states that if diagrams are given with annotations when descriptions are required, candidates will lose marks).**

In question 2.5.2 learners stated transcription as occurring in the ribosomes. They should differentiate between the two protein synthesis processes with respect to site where each process occurs: transcription occurring in the nucleus and translation occurring in the cytoplasm at the ribosomes.

Most learners struggled with working out the mRNA codons from the DNA template. If the DNA template has codon ATG then the corresponding codons on mRNA is UAC. Most learners provided glutamine as the answer for 2.5.4. They clearly failed to work out the mRNA codon that corresponds to CAG so that they could identify the amino acid as valine. Although question 2.5.5 appeared in previous years' question papers, learners could not explain how mutations result in the formation of a different protein. This requires the learner to apply his/ her knowledge of protein synthesis, stating that a change in the DNA nucleotide sequence will cause a different mRNA to be transcribed. Thus a different tRNA with its anticodon will bring a different amino acid than the one originally intended. This will thus change the sequence of amino acids causing a different protein to be formed. Most of the learners had the misconception that a different amino acid will be formed.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers should provide ample opportunity to the learners to practise questions on Dihybrid crosses. They should be guided on how to describe the phenotype from the provided genotype.

It is important for teachers to stress that in a human somatic cell the diploid number of chromosome is 46, and that all organisms have a different number of chromosomes in the somatic cell.

It is also important for teachers to emphasize that chromosome number is only halved during meiosis 1 and also that the two daughter cells formed contain the same number of chromosomes. The chromosome number remains constant in meiosis II.

Teachers should always show how the process of meiosis links to inheritance of alleles. A diagram of meiosis, gametogenesis and a genetic cross should be used to explain Mendel's laws so that learners can understand that these topics should not be studied in isolation.

Teachers should stress that amino acids are already present in the cytoplasm during translation. Mutation only affects the sequence in which amino acids are joined.

(d) Describe any other specific observations relating to responses of learners

In the Monohybrid cross many learners are still getting confused about when the two processes meiosis and fertilization take place. They should note that gametes are formed only after meiosis and before fertilization.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.

Subject advisors must arrange workshops for teachers specifically on Dihybrid crosses and Interpretation of Pedigree diagrams. It is important that school managers understand that Life Science is a Science and teachers cannot just be deployed to teach life Sciences without the necessary qualifications.

QUESTION 3

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

<i>Average mark from the sample of 100 :</i>		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
3.1	Genetic Modification	93
3.2	Natural Selection & Scientific Investigation	39
3.3	Speciation	44
3.4	Blood Types	46

The average for the whole question was 35%

3.1.1 Most learners answered this question very well it required them to extract information from the passage which was very clear.

3.1.2 Poorly answered as learners had to explain their answer

3.1.3 Fairly well answered as learners were able to extract answer from text.

3.2.3 Only 15% of the sampled learners could explain why the scientists had to conduct the investigation over 30 generations. It is clear that many learners are struggling to answer questions which require them to think and not just simply recall information.

3.2.4 Was very poorly answered with learners only getting a 4% average.

3.3 Most learners attempted this question on Speciation.
 3.4. Learners either understood the blood groups or they did not, so responses varied widely
 3.4.1 Many learners still not do differentiate between blood groups, genotypes and alleles.
 3.4.2 Most were able to answer this question
 3.4.3 Learners failed to explain why there are only 2 alleles
 3.4.4 Most learners received the 1 mark for “future children” but did not understand the question at all.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

3.1.2 Learners had to explain why a plant that was weed killer resistant was a problem for the farmer. Many learners were not specific in their answers and just gave a reason why modified plants were bad rather than being specific towards farmers. Learners could not explain their answers clearly and just quoted from the text. This may be due to the language barrier and not having had enough practice in questions that needed explaining. Answers for 3.1.3 were given for 3.1.2. Learners also don't take time to read for understanding.

3.1.3 This question asked them to give two examples from the passage. Many were able to answer this, however, many quoted the paragraph straight from the text and started the question with “GM foods could have unforeseen effects” which then cost them a mark as we were required to mark the first two answers only. **(see Marking Principle 2 in the marking guideline)**

3.2.1 b) Learners took the dependant variable from the table rather than taking it from the aim given.

3.2.3 / 3.2.4 Learners cannot differentiate between reliability and validity especially if not asked directly to give reliability and validity.

3.2.5 Learners' response to the natural selection question has improved. This is as a direct result of it being asked in every exam paper. However, the memo did not allow for the usual responses to this question and the compulsory marks were too many and limited the learners' ability to score marks. Most wrote many points that were correct but not compulsory. Most learners stated that the black lizards were able to camouflage but did not write that the brown and red lizards were not able to camouflage, thus losing 2 compulsory marks. Learners are still writing in general terms rather than answering using the specific example.

3.2.6 Learners did not write all the variables in the caption and so lost the mark. Some also did not stick to the required data that need to be in the graph. Either giving too much or too little.

3.3 Although most learners have been taught speciation and can recite the process, many learners still wrote in general terms and were not specific to the example. Many lost the compulsory mark as they did not mention the geographic barrier. Many learners are still answering this question in point form and only writing key words rather than writing full sentences explaining the process. This shows that they do not really understand the process but rather they have learnt the steps in parrot fashion.

3.4 Many learners still do not differentiate between phenotypes and genotypes of blood

groups as well the correct notation of the three alleles for gene coding for blood groups. The examination guidelines clearly stipulate that ONLY the following alleles should be used for blood groups: I^A , I^B and i . Many learners wrote phenotypes of blood groups instead of alleles.

3.4.3 Learners failed to explain why there are only 2 alleles.

3.4.4 Most learners received the mark for “future children” but did not understand the question at all. The phrasing of the question was confusing and many learners battled to understand what was required. Perhaps “What will be the blood groups of the future children?”

(c) Provide suggestions for improvement in relation to Teaching and Learning

3.1 Teachers need to give learners more data response questions to practice and should include at least one of these types of questions in each test.

3.2. More emphasis needs to be put on scientific investigation. A handbook needs to be published as teachers are not clear on scientific investigations themselves. As the questions are becoming more scientific, teachers need to be developed through workshops and handbooks on scientific investigation as most textbook do not cover this section in the detail and insight required by the exam paper.

3.2.1 Teachers need to point out that if an Aim is given then dependant and Independent variables should be extracted from the aim, not the graph.

3.2.5 More emphasis needs to be placed on answering Natural selection questions using the specific example given in the question.

3.2.6 Learners are improving in drawing the scale on the x- and y-axis. However, they often make the gap between the zero and first number smaller than the other intervals.

3.3 Teachers need to teach learners to apply the process of speciation to specific examples rather than just reciting the process step-by-step.

3.4 Teachers need to explain the terminology of genetics and differentiate between alleles, genes, genotypes and phenotypes(blood groups) Teachers should expose learners to more varying questions on genetics and not only stick to crosses. Many teachers still do not understand this topic.

(d) Describe any other specific observations relating to responses of learners

Learners still confuse natural selection and speciation. They should be asked in different questions e.g. Natural selection in question 2 and speciation in question 3. This will reduce confusion for both learners and those marking the question.

Poor spelling is still a problem as is the language barrier. Many teachers are still not teaching in clear English. We have however seen a reduction in the use of code switching of languages when writing so there is an improvement.

Generally learners and teachers have a gap in scientific investigation.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.

Teachers still do not understand genetics. Many ask others to help but are satisfied with other teachers just teaching their classes and do not make an effort to improve their own knowledge.

Teaching workshops should include a test at the end that certify teachers in sections of

work (e.g. Genetic, Evolution etc.) These tests should be at a slightly higher level than a matric exam. This is because many teachers attend these workshops but go away still not understanding and do not apply what they have learnt. There needs to be a motivation to improve their knowledge. Certificates should be issued on completion of the tests.

Examination guidelines used in conjunction with the CAPS document should be stressed as the first point of reference when teaching. It should be regularly consulted rather than following the textbook. These guidelines should be handed out by all subject advisors in January as many teachers do not know where to access them.

Workshops need to be arranged in scientific investigation. Handbooks need to be published and scientific investigation needs to be added into the year planner to ensure that it is taught. The department through the assistance of the MST GRANT needs to ensure that all schools are well equipped with resources to conduct practical activities.

Tertiary institutions should be approached to facilitate with capacitating teachers with practical skills to eliminate the tendency of teachers to treat practical work as a **minds-on** activity thus ignoring the seven practical skills stipulated in the CAPS document that learners should be exposed to.

Although departments have put together common tasks to help with practicals they arrive very late after many teachers have already completed the own practicals.

They need to be distributed before the beginning of the year/term so that teachers can include them in their planning. They should also be sent with a teacher's guide and marking guideline which will explain to the teacher exactly what the practical hopes to achieve and what knowledge is required to complete the practical.

Subject Advisors in conjunction with selected teachers need to develop a concise booklet on scientific investigation based on paper 2 content as most of the textbooks fall short on this criterion.

QUESTION 4

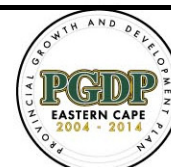
- (a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**

Average mark from the sample of 100 :		
SUB-QUESTION	TOPIC OR ASPECT TESTED	AVERAGE % FROM SAMPLE
	Evolution: Evidence Out of Africa Hypothesis	17

Most learners scored less than 10 for this question with the highest mark being 17/20.

- (b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

The memo was too closed and did not follow the trend of previous examinations.



The requirement to have ONLY and OLDEST in the answer was unfair and too closed as there are no textbooks that mention this and exam guidelines do not highlight this point. Many learners wrote very good essays and explained specific areas in South Africa and Africa (as is stipulated in the Examination guidelines) where all the fossils were found but got no credit because of the requirement for ONLY and OLDEST. The most any learner got for the 3 marks allocated to ONLY/OLDEST was 1 mark. Even our top learners who got level 7 lost all the marks in this section.

Description for shape of pelvis did not allow for “bowl shape’ pelvis.

If we look at this question in previous examinations, the memos do not have anything in common. Many learners study from past papers and memos and wrote accordingly giving all the evidence.

Many learners answered fossil evidence poorly as they focused on the names of fossils, the sites where they were found and who found them as the Examination guidelines required.

Most learners have understanding of the apes and humans but lack information on characteristics of bipedalism etc. Giving advantages rather than evidence.

Many responses mirrored questions on bipedalism and fossils that were asked in previous question papers and learners did not identify what was specifically being asked in this paper.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Examiners need to make it clear to teachers what they expect when they teach the “Out of Africa” hypothesis.

The examination guidelines do not give indication to ONLY/OLDEST.

Most teachers are teaching about the different fossils as learners do show knowledge of the fossils.

Teachers need to instruct learners in essay writing. Learners must write in full sentences not in bullet points as this often results in losing sense of the sentence.

They should be guided on how to breakdown the question into the different sub-titles and identify what is being asked. They should be taught to write each sub-section as a separate paragraph and to stick to the sub-topic within that paragraph in order to obtain the mark for logic and relevance.

Teachers also need to stress full scientific names and terminology. Many learners wrote only Homo for *Homo sapiens* and foramen for foramen magnum.

Teachers MUST teach in English to improve learners’ English writing ability. Many learners are directly translating from their Xhosa understanding incorrectly into English.

Teachers who are teaching Grade 10 must make sure that they teach classification of living organisms and the naming of organisms. Learners should know the difference between a genus and species in the scientific name of living organisms.

(d) Describe any other specific observations relating to responses of learners

Most learners gave examples of species from the different genera e.g. mentioning Mrs Ples, Lucy, Taung child, Karabo etc.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.

Subject advisors need to communicate with teachers on how an essay should be laid out and how marks are allocated for synthesis. It is also advisable to provide all possible essay questions per topic so that teachers and learners can use them in their informal tasks even as mini essays or as debate topics or oral presentations.