BIOLOGY

Overall grade boundaries

Grade:	E	D	C	B	A
Mark range:	0 - 7	8 - 15	16 - 22	23 - 28	29 - 36

General comments

This is the first report on the performance of candidates using the current *Extended Essay Guide* (first examinations 2009). Extended essays in all subjects are assessed against the same eleven criteria which are interpreted on the basis of subject guidelines (the subject specific guidelines for biology can be found in the current *Extended essay guide* on pages 46 to 51). Marking in the May 2009 session was preceded by a series of online training sessions for examiners aimed at ensuring consistency in marking and in the interpretation of the guide.

It is rewarding and encouraging to see that the extended essay in biology continues to be a popular choice (despite the challenges it poses for candidates as well as for the supervisors). It is also rewarding to see that, in most cases, candidates are being encouraged to adopt a practical approach to their research, using a combination experimentation and/or field work. The work submitted for this session revealed a high level of enthusiasm for biology as well as ample evidence of independence and insight on the part of the candidates. The new guide is more explicit in terms of the roles of the school and the supervisor and it is clear that the majority of schools and supervisors are meeting these demands and that schools are providing an appropriately structured and safe environment for candidates to conduct their research.

The remainder of this report will deal primarily with those areas where candidates are in need of guidance and supervision and where the attention of both candidates and supervisors needs to be more clearly focused on the new criteria. There can be no doubt that the quality, and to a lesser extent the quantity, of supervision received by a candidate can play a significant role in the success of an extended essay. Consequently there is a strong need for supervisors to familiarize themselves with the current guide and to assist the candidates in interpreting the requirements.

The range and suitability of the work submitted

Examiners reported a wide range of appropriate topics and research styles in this session.

Successful topics included essays on plant growth and physiology (rates of transpiration and photosynthesis), microbiology (in particular antibacterial action of commercial and natural products), factors affecting germination and growth of seedlings, experiments with genetically modified plants, biochemical investigations (especially activity of enzymes and molecular genetics) , behavioural studies in invertebrates and fish, a variety of human biology topics (including behaviour, exercise physiology, perception of stimuli, and nutrition) and ecological studies based on particular local phenomena or environmental issues.

Less successful topics tend to come from areas such as health (focusing on the symptoms and treatment of particular diseases or the effects of specific drugs), soil properties, comparisons of western and eastern medicine, ethical issues in genetics and the teaching of evolution, the behaviour of the family pet(s) and surveys of student (or community) attitudes to biological issues. As in previous sessions, the most successful essays had a small number of a clearly defined and easily manipulated independent variables and a quantifiable and easily measured dependent variable. Successful essays often relied on the use of basic equipment of the type that can be normally found in a school, and were carried out in the school laboratory or in the local environment.

It is very important that essays entered under biology contain a significant biological component. While the assessment of the extended essay no longer uses subject specific criteria (criteria are common to all subjects), candidates and their supervisors need to be aware that the subject specific guidance is considered in conjunction with the assessment criteria. This means that the topic and research approach must be firmly biological. This is particularly significant for those criteria that carry specific reference to the “subject” in which the essay is registered. These include criterion C, (methods employed to collect the data as well as the sources accessed), criterion D (the levels of knowledge and understanding demonstrated), criterion F (the analytical and evaluative skills that are applied to the data/information) and criterion G (the language used). An essay with a strong biological element will have the potential to perform well against these criteria while one that is only marginally biological may not reach the top levels.

The top level of criterion C refers to "appropriate" sources and data as well as "relevant" material. Examiners interpret this to mean relevant and appropriate within the biological context. In addition, a "well planned investigation" will use a recognizable biological methodology. For criterion D, the top level requires that the essay locates the investigation clearly and precisely in an "academic" context, in other words it must have a clear "biological" context. In addition the knowledge and understanding demonstrated should be biological. As far as criterion F is concerned, "appropriate analytical and evaluative skills” are those that are typically biological, such as the use of deductive reasoning, graphical analysis and statistical approaches.

Criterion G has presented a new challenge to candidates, supervisors and examiners alike. More is said about this under Section B below. In principle examiners read "terminology appropriate to the subject" to mean biological terminology.

Essays based on practical work carried out at a university or other research institution, have become less common. However some schools continue to use this approach although it is not always clear that this is happening within the spirit of the extended essay requirement. The new guide makes it very clear (p 48) that essays of this type must be accompanied by a covering letter from a qualified person at the external institution. Examiners report that in the vast majority of cases, this requirement was not met. The experience of this session has shown that in some cases such essays have not been able to reach the top levels for certain criteria. This applies for example to criterion C where the assessment statement “the investigation has been well planned" is interpreted to mean well planned by the candidate. Often these essays have highly technical introductions and extensive protocols about one or other complex procedures. It is often evident that the terminology and description of the method is beyond the student's understanding but it is nonetheless described and is a major

part of the EE. This is inappropriate. When work of this type is submitted, clear evidence must be provided (in the form of a covering letter), that the candidate has had a sufficient level of input into decisions about the research approach and selection of methodology and sources. The candidate should justify these decisions within the text of the essay. The person(s) responsible at the outside institution should be appraised of the assessment criteria and be asked to ensure that the candidate will have ample opportunity to plan and work independently. Above all the supervisor at the school must take full responsibility for steering the candidate through the essay-writing process and for authenticating the essay.

Essays which are essentially “reports” (of the type "find out everything you can about a topic and write it down) rather than investigations (in the sense of a research paper that is aimed at answering a research question), continue to be submitted. While examiners search for qualities in these essays that show some merit, and try to reward these, it is often difficult for work of this type to perform well against the assessment criteria (particularly D, E and F).

Candidate performance against each criterion

A: research question

Few candidates experienced difficulty in expressing their research question. Many essays report the research question in the title or as a separate item before the introduction. The research question must also appear in the abstract and in the introduction and may be repeated in the later part of the essay or in the conclusion. While it is not essential that these all be identically worded, candidates should ensure that there is consistency between the different statements of the research question. When new aspects are introduced or elaborated this should be explained and justified.

B: introduction

The requirement for an introduction, in which the context of the research is clearly outlined, is a new aspect of assessment and, as such, was not always adequately addressed in this session. It would be helpful to both the candidate and the examiner if the introduction were clearly identified as a subsection of the essay with a chapter heading. There are three aspects to this criterion: the context, the significance and the worthiness of investigation. In order to reach the top level, all three aspects must be adequately dealt with. Demonstrating the context and significance of the essay requires the candidate to refer to the sources that have been accessed and this section needs to be carefully referenced. In many cases candidates tended to deal only with “worthiness of investigation” and in doing so tended to refer to personal motivation rather than what the results of the study might reveal about the question being investigated.

C: investigation

This criterion covers both data collected from printed sources as well as data collected by the candidate (through experimentation or field work). The way in which this criterion is applied will depend on the style of the essay to some extent (literature based, practically based or a

combination of both). Examiners make a judgement about the range and appropriateness of data gathered by the candidate as well as the methods used to gather the data. In addition there must be clear evidence that the investigation has been planned by the candidate. Candidates can achieve this by explaining how information obtained from the sources helped to guide their decisions about which approach to follow. In any case candidates need to justify the approach and not simply report a method. Achieving level 4 (an imaginative range) proved to be difficult for candidates using standard techniques.

D: knowledge and understanding of the topic studied

In order to reach the top level for this criterion, candidates are expected to show that they understand the topic they are investigating. The can do this for example by providing explanations and justifications for their decisions about the research direction (why was something included, why was something else omitted). Essays that consist mainly of tracts of text taken directly from the sources will fail to convince the examiners that there is in fact an appropriate level of understanding. This also applies to highly technical texts that provide no explanation for terminology. Candidates also need to show that they understand how their own investigation fits into the existing academic framework. They can do this by referring to texts they have read and showing how they have used the information from these sources to guide their own research.

E: reasoned argument

Many candidates struggle to sustain a line of argument throughout the essay. In order to achieve a more fluent and coherent argument, candidates need to be explicit about their reasoning. In many cases candidates tend to leave it up to the reader to see the significance of the information they are providing or to make the connections between the research question and the conclusions reached. Key elements of the argument include answers to the following questions: “What am I trying to find out?”; “How am I going about finding out?”; “What did I find out?” and “What does this new information tell me?” These need to be linked clearly throughout the text of the essay. A clear line of argument can be picked up when there is regular reference to the research question throughout the essay and where findings and discussion points are presented in the context of the overall aims of the research.

F: application of analytical and evaluative skills appropriate to the subject

The most appropriate approach to analysis depends on the type of data/information collected and presented by the candidate. The challenge for the candidate is to carry out the analysis in such a way as to address the research question. While candidates should be encouraged to use statistical analysis where appropriate they must also be selective about the techniques used and should be encouraged to explain and justify their approach. Supervisors should note that there is no requirement to include statistical analysis and that the top level can be reached (depending on the type of data/information presented) without the use of statistical tests. It is often helpful, if there is a large body of raw data, for this to be included in an appendix and for summary charts and tables to be in the main body of the essay.

Essays that are essentially “reports” rather than “investigations” (see page 4), often fail to address this criterion well. The exceptions include cases where the candidate analyses published data or attempts to re-evaluate information from a range of sources.

G: use of language appropriate to the subject

While this is a new aspect of assessment of the extended essay it is one that is central to producing a coherent and intelligible piece of writing. There are in fact two aspects to this criterion: the use of clear and precise language on the one hand and the use of terminology appropriate to the topic on the other. Candidates need to adopt and sustain a clear and precise style and show an understanding of and fluency with the main technical terms associated with the topic. Note that there is no requirement to write in the passive voice. Writing in the first person singular, active voice may be clearer and may in fact be easier to sustain (especially for non-native speakers of the target language). In order to reach the higher levels for this criterion the candidate must show an understanding of, and an ability to accurately use, the key terms in the research question as well as many if not most of the associated terms.

Essentially, examiners are looking at the level of sophistication of the language used especially in terms of scientific, and in particular biological, language. The weakest essays display a complete lack of sophistication with no fluency in the language of the topic. Problems arise with very technical investigations where an essay consists largely of descriptions of detailed experimental protocols with little or no attempt to explain the technical language. Such essays often suffer from the fact that the candidate is unable to sustain a consistent linguistic style throughout.

H: conclusion

Many candidates struggle to write an effective conclusion and/or highlight unresolved questions. Candidates should try to express the conclusions carefully and not overstate their findings. Where possible the conclusions should be verified by reference to the literature.

I: formal presentation

Some weaknesses in presentation skills that were noted in previous sessions are still apparent and these will probably need to be highlighted in every session. As such it will be helpful if candidates receive regular guidance on these points:

All of the sources accessed must be included in the bibliography. For the majority of the items in the bibliography there should be some in-text reference. The candidate should make clear how other more general sources were used. Care needs to be taken to provide appropriate and complete bibliographic entries for online sources – simply providing the URL is not sufficient. There are a number of publications available on how to do this.

Some essays have no obvious structure. This is often reflected in a less than helpful table of contents along the lines of: “introduction”, “body”, “conclusion”. Headings used in the table of

contents should appear in the text of the essay and candidates should carefully check the page numbers for chapters. Candidates tend to use the heading “conclusion” for the section in which they interpret and discuss their data. Often only the final paragraph of this section is the conclusion proper.

Candidates need to be selective about the use of supporting illustrative material. Diagrams copied directly from the sources need to be accompanied by a commentary or an explanation that highlights their significance. Digital images should only be included if they enhance the quality of the work.

Candidates need to be selective about whether to include in an appendix as the essay should make sense without any reference to the appendix. Important information such as the results of statistical analysis should be in the body of the essay. The details of calculations associated with this can be in an appendix (if it is a lot of material). Large tables of raw data can also be presented in an appendix but should be referred to in the text of the essay. If the candidate reports the results of statistical analysis in an appendix but makes no reference to these in the text then the statistics will not be taken into consideration when assessing the essay (since the appendix is not part of the essay).

J: abstract

Writing the abstract is a technical part of the essay that even good candidates find difficult to do. In some cases there are what might be called “careless omissions” (no research question, no conclusion). In other cases that candidate fails to deal adequately with the scope of the essay: in other words does not explain how the research was conducted (what methods were used, what type and quantity of data were collected, how test and control groups were selected or established).

K: holistic judgment

Supervisors should be aware that the comments they write on the extended essay cover sheet (on the circumstances surrounding the research and level of personal involvement of the candidate) can be of considerable assistance to the examiners in assessing criterion K.

Note that an essay does not have to show evidence of all of the qualities mentioned in the descriptor and/or guidance notes in order to reach the highest level. The qualities referred to in the stem of criterion K are examples of the type of quality that can be rewarded.

Recommendations for the supervision of future candidates

Although section B above focuses on problems and weaknesses, it is obvious from the quality of the work submitted in the session as a whole that the majority of candidates enjoyed and benefitted from the experience. It is also obvious that the majority of supervisors had worked hard in guiding and encouraging their students. Biology is one of the most popular subject choices for the extended essay and supervisors in many schools may be stretched to meet the needs of their students. However effective supervision is a crucial part of the learning process involved in writing the extended essay and the role of the supervisor is detailed in the

current guide. Without effective ongoing supervision the process becomes a chore for the candidate and a fruitless exercise in the end.

Poor essays are produced when there has not been early intervention by a supervisor. Candidates can be encouraged to engage more fully with the writing process and to communicate more with the supervisor by agreeing on a detailed timetable with internal deadlines for various stages of the research process. This will also help to avoid time being wasted on unsuitable or overambitious investigations.

It is disappointing to see that a significant number of supervisors still made no comment on the cover sheet, and in some cases candidates had clearly not been adequately guided on how to address the criteria. Other points from previous reports remain valid. Candidates continue to be in need of guidance on the following:

- establishing, refining and using the research question
- providing a clear academic context for the research
- sustaining an effective argument
- displaying a command of the language of the topic
- bibliographic entries and in-text references
- structuring the essay (headings and sub headings)
- incorporating and integrating diagrams and illustrations
- selecting material for inclusion in an appendix.
- writing an abstract

Finally it must be emphasised that candidates submitting work which has been conducted in collaboration with a research team at a university or research institute must ensure that they have a sufficient level of input into the research approach and selection of methodology and sources. Above all it is essential that each candidate has a supervisor at the school who will take ultimate responsibility for the supervision process.