Student Guide: Extended Essays in Biology

Overview

An extended essay in biology provides you the student with an opportunity to apply a range of skills while researching a topic of personal interest in the field of biology. The nature of an extended essay in biology is characterized by a particular biological emphasis within the more general context of a scientific investigation.

Choice of topic

1. Your choice of essay must emphasis the Biology of a topic even if it is an interdisciplinary topic area.

    i. e.g. an essay which is based on Biochemistry must emphasis the Biology not the Chemistry.
    ii. e.g. essay which looks at human disease must emphasis the Biology not with the diagnostic or treatment of a disease.

2. Do not carry out unethical investigations

    You should ask your teacher for a copy of the **Animal experiment and ethics policy.**

3. Do not carry out dangerous investigations

4. Do not carry out investigations where the outcome is already documented in the standard textbooks.'

Using this Guide:

Overview of the guide:

Section 1: criteria for skills and presentation	**Section 2: criteria of the written parts of the essay**
(D) Knowledge and understanding of the topic studied [4]	Title page
(E) Reasoned argument [4]	Abstract (J) [2]
(G) Use of language appropriate to the subject [4]	Contents Page
(I) Formal Presentation [4]	Research Question (A) [2]
(K) Holistic Judgment [4]	Introduction (B) [2]
	Investigation (C)[4]
	Analysis (F) [4]
	Conclusion (H) [2]
	References / Bibliography
	Appendices

[ ] marks in square brackets refer the assessment criteria listed in the detail of all group 4 essays 'Assessment criteria pg 25-31

Section 1: covers those assessment criteria which cover the whole essay (synoptic). To meet the standards of the highest criteria you need to be considering section 1 criteria as your extended essay. As an example 'Use of language appropriate to the subject' (G), evidence to meet the highest levels of this criteria need to be shown in the introduction (B), Investigation(C), Analysis (F), Conclusion (H) and Abstract (J). Evidence for all section 1 criteria need to be demonstrated in this way throughout the essay.

Section 2: The suggested structure is based on the extended essay guides and the examination reports from 2009. Stages such as the Investigation (C) will probably require further sub division to guide the examiner through the stages of your essay. There is a 4000 word limit for the essay not including the 300 word abstract, acknowledgments, contents page, illustrations, equations, formula, calculations, citations, references, footnotes, endnotes, bibliography, appendices.

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Section 1: criteria for skills, knowledge and presentation

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. They can do this for example by:

Be prepared to explain why you have chosen one line of enquiry rather than another:

- When you are researching what's already written on research topic, explain why you choose particular texts or authors rather than others.
- Explain how your research topic fits into the bigger picture of research and theory in Biology.
- Show some evaluation of your sources; how you know that the author is a credible source of information
- Explain your choice of experimental methods rather than other techniques.
- Explain your choice of statistical tests (justify your choice).
- Quote sources that support the direction of your research topic.

DON'T:

- Write long technical regurgitations of known theory.
- Leave out citations and references.

Assessment statement:

The essay demonstrates a **very good knowledge and understanding** of the topic studied. Where appropriate, the essay clearly and precisely locates the investigation in an academic context.

[4]

E: Reasoned argument

In general terms:

- you are looking for the essay to contain 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?"

If you want to get top marks for this section:

- Keep explaining why you are doing things (logic) or making choices in your writing.
- Keep referring to the research question.
- Always refer the outcomes of the investigation to the research question, hypothesis and the established known Biological theory.

Don't:

- Carry out investigations that attempt to deal with a large number of variables.

Assessment statement

Ideas are presented **clearly and in a logical and coherent** manner. The essay succeeds in developing a reasoned and convincing argument in relation to the research question and hypothesis.'

[4]

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G: use of language appropriate to the subject

This aspect of assessment is key to you developing a good essay. There are two parts to consider:

- the use of clear and precise language avoiding excessive use of jargon.
- the use of terminology appropriate to the topic and where technical terms are explain.

You need to keep this style running throughout the essay, using (and understanding) the language of Biology. You can write in the first person singular active voice ("I") and you do not need to use the 'passive voice'.

Your examiner will be looking at how well you use language particularly particular biological, language.

Assessment Statement:

The language used communicates **clearly and precisely.** Terminology appropriate to the subject is used accurately, with skill and understanding. **All** technical terms explained.

[4]

I: formal presentation

Bibliography:

- All of your sources must be included in the bibliography.
- Nearly all of these sources will have a citation in your essay.
- If you have used general reference books but not used a citation in the text, then you need to explain how you used the source
- URL's should also have the name of the author or organisation, last update, publication date if possible.
- More detail are in section 2, Bibliography

Contents Page:

- You need to number the pages of your essay.
- Table of contents headings need to be the same as those used in the sub sections of the essay
- Check the page numbers given in the table of contents matches the pages number of the headings.

Illustrations:

- Images, diagrams, drawing and photographs need labels and must have a reference to their source.
- Use images that illustrate a point you are making, and make sure you refer to the image in your writing saying which explains why the image is provided.
- Only use the image to explain otherwise complex structure or processes, not just for decoration.

Appendix:

- Biological investigations often result in large quantities of raw data. Large tables of raw data are best included in an appendix.
- Processed data that is central to the argument of the essay should be included in the body of the essay, as close as possible to its first reference.
- Statistical analysis should be in the body of the essay along with the result of that test.
- The details of calculations associated with statistical tests can be in the appendix (if it is a lot of material).
- Anything in a appendix will not be marked, it is not part of the essay (not included in the word count).

Assessment statements

a. The formal presentation is excellent.

b. Full citation and bibliography. Appendices [4]

K: holistic judgment

Much of this is based on the idea of creative thinking. This type of intellectual initiative comes from having built up a knowledge of a subject area and then applying it to find new ways of

- Thinking about a problem
- Finding solutions to the problem
- Understanding the problem

Assessment Statement The essay shows **considerable evidence** of such qualities. Intellectual initiative, insight and depth of understanding Originality and creativity [4]

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Section 2: criteria of the written parts of the essay

This sub sections that follow are in the same order as would be expected in the essay

Title Page:

The title should provide a clear indication of the focus of the essay. It should be precise and not necessarily phrased in the form of a question.

The title is the first thing that the examiner will see when the essay arrives for marking. Make sure that the title makes an immediate and positive impact. I suggest that:

- There is no more than one sentence.
- It is based on the working hypothesis.
- Don't use language which is 'jargon-based' and where there are terms you do not fully understand.
- It should be possible for the examiner to understand immediately (at a glance) what the essay is about.
- Try out your title on other people for their immediate impressions. An intelligent reader will be able to understand what your essay is about simply from the title. Ask someone whose opinion you respect but better not ask friends as they are less likely to provide positive critical feedback.

Examples of title writing:

- "The effect of disinfectant toxicity on soil bacteria" **is better than** "Disinfectants in the environment".
- "A study of malnourished children in Cambodia and the extent of their recovery after a period of supervised nutritional supplements" **is better than** "Malnutrition in children of the World".
- "A study of the effect of differing pH levels on the growth of *Caluna vulgaris*" **is better than** "The effect of acidity on plant growth".
- "The effect of orange peel on seed germination" **is better than** "Factors that affect the germination of seeds".
- "Gel electrophoresis: The construction of an apparatus and the separation of proteins in heat-treated goats milk" **is better than** "Uses of the gel electrophoresis technique".

Section J: Abstract [2]

You have never met your examiner and they have no personal knowledge of you or your essay prior to its arrival for marking. They are not aware of the hard work and difficulties you have encountered and overcome in this work. In just 300 works you have to bring the examiner right up to date with a broad yet accurate understanding of your essay. More than any other section this part of the essay must be very carefully crafted for maximum impact. First impressions count a great deal when it comes to abstracts. Again I would suggest you ask your 'critical friend' to give you feedback on early drafts.

- This is the last part of the essay that you should write but of course it is placed at the front of the essay after the title page but before the contents page.
- Try to work on being concise (get to the point) and precise (accurate) in your account.
- The word limit is 300.

The abstract should clearly contain:

1. The research question to which you seek an answer and its significance in Biology.
2. Methodology which in broad terms is the way you set out to test your hypothesis. Detail is not necessary but a clear overview of the scope of the essay is essential. In other words 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).
3. Conclusion: What was the overall outcome of the investigation and its impact on the research question?

[2]

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Contents Page:

- A contents page is placed at the beginning of the extended essay, after the title page and abstract but before the introduction.
- All pages in the essay must be numbered.
- The content table should list various sub sections of the essay along with the correct page number.
- An index is not required.

A: Research Question

In a Biology extended essay express the purpose of the essay as a question.

This is will take the form of a carefully composed question that the research will attempt to answer.

For example, a statement of the topic of an essay might be "Factors that affect moss growth on tree bark"; the research question based on this topic could be "How is the distribution of one species of epiphytic moss on tree trunks affected by moisture?"

- Try not to confuse the essay title with the research question.
- The title that reflects the scope of the essay leads to the research question.
- The research question should be also be stated clearly in the introduction.
- For reason outlined in section 1 it will be appropriate to refer to the research question throughout the essay.
- If you decide to introduce new ideas as the essay/ experiment develops then these should be explained and justified.

Hypothesis

- *A good research question will readily allow hypothesis to be formed.*
- *Written as statement that can be tested (not a question)*
- *A directional or non-directional hypothesis along with a Null hypothesis can be stated*
- *It will normally be a single sentence, no more than two.*
- *It must contain a reference to the effect of the independent variable on the dependant variable*
- *If possible this should be followed by a predictive graph with appropriate axis labels.*

Assessment statement

The research question is **clearly stated** in the introduction and **sharply focused,** making effective treatment possible within the word limit. An appropriate **hypothesis** has been formulated.

[2]

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B: Introduction

There are three parts to this assessment criterion:

- How did you arrive at the research focus
- How did you narrow down to the research question
- How does the research question fit into the background reading for the essay
- You must carefully reference the sources (reading) that you have accessed.
- What the results of the study might reveal about the question being investigated.

Remember:

1. This is the section that makes reference to published work such as textbooks, books, Journals, research papers and credible websites (don't forget to evaluate). Citations in this section are essential.
2. You should give a source for a direct quotation and when you are paraphrasing.
3. Good introductions continually cross reference the sources to the extended essay research topic
4. You should begin with your research question, move to the known published research and then back to the research focus.

Assessment statement:
The context of the research question is **clearly demonstrated**. The introduction clearly explains the significance of the topic and why it is worthy of investigation

It should place your research in context e.g. state of current knowledge or relevance of your research.

[2]

C: Investigation

You need **to justify your approach and not simply report a method.**

Data selection and reliability:

- If you are using secondary data then you need to comment on the on how you selected the data and its reliability.
- You need to describe , explain and justify your choice experimental work to collect primary data..
- You should state the sources of your experimental work.
- The Method should be detailed enough to allows someone else to repeat exactly what you did.
- Limitations and uncertainties stated

The following points would be covered in a systematic treatment of the investigation planning.

Independent Variables

- *State the independent variable.*
- *The variable that you are changing in the experiment (plotted on the x-axis)*
- *If you are sampling they may include the time or place of samples*
- *The independent variable causes the change in the dependent variable.*
- *Identify in detail and include SI units*

State the Dependent Variables

- *State the dependent variable.*
- *The variable that you are going to measure (plotted on the y-axis)*
- *Identify in detail and include SI units*

State the Control Variables

- *These are the background variables in your investigation that may have a significant effect on the dependent variable. These are the ones you will control.*
- *This must be presented in a table with three columns titled variable, effect, control*
- *You should also consider any variable you can't keep the same*

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Method

- *Write a set of 'bullet point' instructions which are a step by step guide to your method (like a cooking recipe). It should be possible for someone to pick up this method and repeat your method exactly without any assistance or clarification.*
- *Be prepared to explain and justify your choice of experimental technique. Give a citation for the source.*
- *State how the independent variable will be set up and controlled*
- *State how the dependent variable will be measured*
- *Detail how you will control each variable*
- *Give a detailed list of all equipment used*
- *Errors and uncertainties and limitations*

  A table listing the variables involved with the precision of the device and an uncertainty is a clear way to carry out this part. This should be arranged with the largest source of uncertainty at the top of the table.

Variable	*Unit of precision*	*Error / Uncertainty/limitations*

- *In the first instance you should use the published uncertainty as indicated by an instrument manufacturer.*
- *Alternatively you should state the error as half of the last measured unit. Method:*

When you record a quantity, the last digit is always an estimate and therefore introduces uncertainty. If you where using a burette with millilitre graduations, then you could make a reading of say 23 yet you notice that the actual measurement is *about* 0.7 ml more. The 3 is the last measured digit and the .7 is the estimate. The minimum uncertainty is half the place value of the last measured digit (the ones column) or 0.5 ml. Therefore the final reading would be 23 +/- 0.5 ml

If you use callipers to measure length, the student might measure at 23 mm and about another 0.4 mm. However 3 is the last measured digit and should accompanied by an uncertainty of 0.5 mm. Therefore the final reading would be 23 +/- 0.5ml

The standard ruler is a special case as it introduces an error at both ends, so mm rulers should have an uncertainty of 1 mm. So a careful student might record a value of 23.7 mm using a standard mm ruler, but should ultimately write 23 mm +/- 1 mm.

- *All data should conform to the same number of decimal places after the point.*
- *Note qualitative considerations such as parallax problems in reading a thermometer scale, reaction time in starting and stopping a timer, or random fluctuation in an electronic balance read-out.*
- *Students should do their best to quantify these observations into the estimated uncertainty.*
- *Provided a foot note/ citation for any method found in a textbook or reference book.*

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Sufficiency of data:

- It's not enough to just state number of samples on the independent variable and the number of repetitions of each. The design of the experimental method must make it possible to actually collect the data you have specified.

- The sample should be representative of the range a very small sample is between 5-10, small sample is 20-30, and a big sample 30+.

- Where sufficient replicates have been carried out, then the calculation of:

    - the standard deviation of the mean is expected. But proposed calculation of the standard deviation based on a sample repetitions of less than 5 is wrong
    - the standard error of the mean to derive confidence limits, may also be calculated (The standard error is not expected, but it would be an acceptable alternative to the standard deviation).
    - Where fewer than five repeat on an independent variable are made then all point could be plotted or a range shown. Two repeats does not allow anomalies to be identified, three is a minimum of repeats on any independent variable point. As an example consider an investigation of the effect of temperature on the rate of an enzyme reaction. We would expect 5 different temperatures to be investigated as the independent variables. Each temperature should have a minimum of three repeats to allow anomalies to be identified.

- "I will repeat the measurements.....times at any given point in the range to make sure of the reliability of the data"
- Biological experiments may include a 'control repeat' in which everything is kept constant except that the 'treatment' independent variable is removed.

Assessment statement

Sufficient data has been gathered, and relevant material has been carefully selected. The investigation has been **well planned**. Method is detailed and the techniques fully explained. Limitations and uncertainties identified and effects **quantified**

[4]

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

Results – Raw Data

- Table titles should include reference to the independent and dependent variable and be understood at a glance.
- Draw a table of **all** raw data
    - Raw data is the first data recorded as a result of your experiment

- The table must be fully ruled:
    - It is normal practice to put in the independent variable in the first column and the measured dependent variable in the second.

    - **Units and degrees of precision are in the column or row headings.**

    - Always record data to the same number of decimal places.

    - If large amounts of data are collected using a data logger this may be presented as a graph, with a sample of the raw figures given and the settings on the data logger explained)

    - Numerical data should be centre justified

- Include any observations on sources of error or uncontrollable factors (**qualitative data**)

- It is important to include non-quantitative observations about your experiment. This is just as true for Biochemistry experiments as it is for Ecology or Behaviour experiments

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Data Logging Experiments:

- When data logging is used, raw data is defined as any data produced by software and extracted by the student from tables or graphs to be subsequently processed by the student.)
- Students may present raw data collected using data logging as long as they are responsible for the majority of software settings. (**need to show evidence of this action**). A screen shot of the data logging setting is useful
- The numerical raw data may be presented as a table, or, where a large amount of data has been generated, by graphical means.
- For example, the student should set the duration and rate of the sampling, and the generated data in the form of lists of measurements from the calculator or computer could be downloaded by the student into a computer spreadsheet.
- Students must organize the data correctly, for example, by means of table or graph titles, columns or graph axes labelled with units, indications of uncertainties, associated qualitative observations, and so on.
- The number of decimal places used in recorded data should not exceed that expressed by the sensitivity of the instrument used. In the case of electronic probes used in data logging, students will be expected to record the sensitivity of the instrument.

Processing

- You may lay out the processed data in a table format
- You may choose to add additional columns to the raw data table
- You must explain and justify why you carry out any calculations
- Provide a formula for all calculations
- The pathway of a calculation must be shown with an example.
- If you use the spreadsheet show a screen shot of your calculation
- You need to provided at least one worked example
- Make sure that processed data has the correct units
- Averages should be chosen with care and given the correct name i.e. mean, median or mode.
- Ranges or standard deviations can be used to compare averages. The standard deviation can be used to assess the reliability of a measurement.
- Suitable statistical tests can be carried out such as Spearmen's, T-Tests or Chi squared but justifies your choice on the basis of the hypothesis and on the types of data.
- Make sure you have a copy of Neil Millers guide to choosing a statistical test or the download called Merlin
- Where these statistics are calculated from a preset menu on a calculator or computer, a worked example will not be expected, but the data should be presented in such a way that the steps in the processing can be clearly followed
- Lines or curves of best fit can be fitted to raw data graphs, gradients can be calculated. These graphs must be drawn by hand unless the student can produce a high quality computer generated graph. (Again please consult Merlin).
- If a reading is particularly different from the others, it may be left out of the processing and analysis. However, students must **always** justify why they have chosen to do this.

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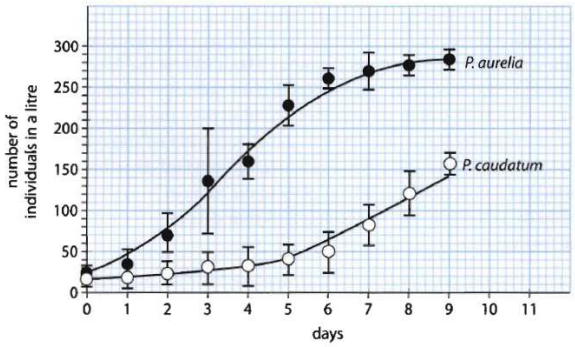
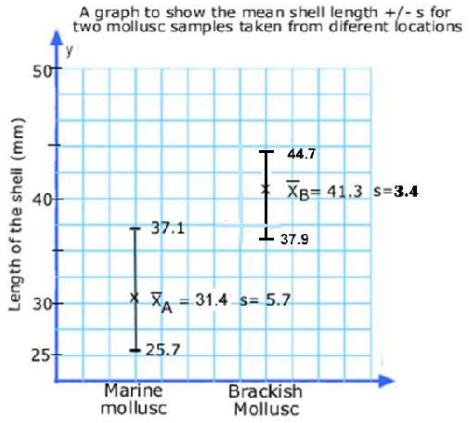
Presentation of processed data

- A graph should be drawn by hand unless you can produce a high quality computer generated version. Again the Add-in for Excel called Merlin is recommended.
- Present your processed data clearly using a graph, credit **will not** be given here for graphs of raw data.
- The choice of graph is important as is the choice of fitting lines as curves or straight lines through the data.
- Graph choice:
  - If your hypothesis is about a relationship between two variables use a scatter graph
  - If your hypothesis is about a difference between two variables use a Mean +/- SD/range
  - Do not use basic bar graphs.
- A graph should contain:
  - A title: a Graph to show….(include reference to the indep and dep variables)
  - Maximum use of the graph paper
  - Independent variable on the x –axis + Label + Units + Uncertainties
  - Dependent variable on the y-axis + Label + Units + Uncertainties
  - Plot points with a 'cross x'
- Scatter graphs (see the example below)
  - Notice that we have plotted the mean with a range (which could be SD if you have more than 5 repeats) or just a range. If you only have 3 repeats for a given independent value then plot them all to identify anomalies (which can then be ignored).
- Comparative Mean +/- range graphs

  Comparing two or more categories plot the calculated mean+/- range (which could be standard deviation if you have enough data).
- Lines and Curves on scatter graphs:
  - **DO NOT** join dot to dot.
  - Look at the plotted points and try to imagine either a straight line or a curve, draw the one that best fits the plotted points. Preferably passing through the mean and /or range
  - If there is one point that looks different from the rest of the pattern you may choose to treat this as an anomaly and miss it off your line or curve



Mean +/- Range graphs:
Plot the mean (notice this is shown as an X with a bar over the top.
Add the range (max/ min values)
Alternatively you can add +/- one standard deviation (68% data around the mean)



Sometimes rather than a bar chart it may be appropriate to represent data by plotting the mean of a sample plus a range (see below).

Assessment statement **sophisticated** application of appropriate analytical and evaluative skills. **Errors and uncertainties factored into analysis**
The essay shows effective and sophisticated application of appropriate analytical and evaluative skills.
[4]

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H: conclusion

1. *If you have carried out a statistical test:*

- Statistical conclusion: if you have used statistics then state the outcome of the test quoting values e.g. T or Chi
- State the level of significance of the statistical test
- State the experimental conclusion based on the above stats test.
- Adopt or reject the experimental hypothesis (quoting it in the process).
- Reformulation of a new hypothesis may be possible
- Compare to secondary sources (perhaps those cited in the design)

2. *No statisitcal test but have drawn a graph of processed data:*

- *Look at the graph and state the pattern in the graph.*
    - *You MUST refer to the pattern in your own data to justify your answer*
    - *Your conclusion should include a reference to the independent variable and the dependent variable.*
    - *Your conclusion is the general pattern in the graph (don't worry about anomalies at this point)*
    - *Explain the conclusion you have drawn with a scientific interpretation (theory)*
    - *Compare the results to know theory and values form literature*
    - *Provide a reference or citation of the sources*
    - *Be careful not to add additional statements that contradict your initial conclusion*
- *Systematically mention the anomalies in data and be precise and concise*
- *Comment on the strength of the conclusion*
- *Say if the hypothesis is* ***supported*** *(****Not*** *proved right!!) or* ***rejected by the initial conclusion.***

3. The conclusion may not fully answered your research question. You should point out unresolved issues and make suggestions as to how these might be further investigated.
4. Try not to overstate your conclusion
5. Where possible the conclusions should be verified by reference to the literature.
6. The final conclusion should be directly related to the research question and point out the main findings of your research.
7. Biological investigations often have unexpected outcomes and these should be pointed out.

Evaluation and Improvements

- A table of errors, effects and improvements is often a good way to systematically address this section
- Clearly state all the forms of error in measurements
- Clearly state all forms of error and problems with experimental design
- Start with the biggest sources of error.
- Do not include hypothetical (may have…) your sources of error have to be specific (see qualitative observations)

Factor affecting	**Effect on data**	**Improvement**
Give a named specific example *e.g.*	*Try to quantify or give reference to anomalies within data.* *Did it make the values too high or low, by how much?*	*Realistic improvements are school laboratory equipment which can be found and cross referenced from the Philip Harris catalogues in class*

- ***Distinguish*** *between limitations and error.*

An effective conclusion is clearly stated; it is relevant to the research question and consistent with the evidence presented in the essay. It should **include unresolved questions** where appropriate to the subject concerned.

[2]

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Bibliography:

- If you use Word then the References ribbon is recommended as a means to keep track of your research and as a means to produce an acceptable citations and referenced bibliography.
- All of the sources you have used should be set out in alphabetical order.
- If you used a general source then this should not be in the bibliography but stated in the introduction or in an acknowledgment.
- The bibliography should list only those sources cited.
- Your bibliography is there to allow others to read the same sources not as a list expecting to impress the examiner.
- There are many different styles of referencing such as:
    - American Psychological Association (APA)
    - Chicago/Turabian
    - Council of Biology Editors (CBE)
    - Harvard citation and referencing guide
- However more importantly is that you learn how to use the system before beginning your essay and maintain this throughout the investigation.
- Apply the chosen system consistently and do not mix styles
- Internet source present additional problems particularly of authorship and publication date. Make sure that you include the URL, title of the work, date accessed, author if possible.
- All sources should have some kind of evaluation perhaps cross referencing to show that the information is of academic reliability.
- Interviews can be recorded with a date, location and the name of the interviewee, their status as it relates to the essay.
- Citations are a short hand method of indicating which text is being sourced in the essay.

Appendices, footnotes and endnotes

- These are not an essential component of the extended essay.
- The examiner is not required to read them.
- It is not necessary to provided complete list of raw data particularly where this has come from a datalogger.
- Try to avoid referencing information in the appendix as this breaks up the continuity of your essay.

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	Assessment Level				
Criteria	4	3	2	1	0
A:Research Question 1. *Research Topic* 2. *Research Question* **3.** *Hypothesis*			The research question is **clearly stated** in the introduction and **sharply focused,** making effective treatment possible within the word limit. An appropriate hypothesis has been formulated.	The research question is **stated** in the introduction but is **not clearly expressed or is too broad** in scope to be treated effectively within the word limit. A weak hypothesis has been formulated.	The research question is **not stated** in the introduction **or** does not lend itself to a systematic investigation in an extended essay in the subject in which it is registered. No hypothesis
B:Introduction 5. *Sets the content* **6.** *Outline background knowledge.*			The context of the research question is **clearly demonstrated**. The introduction clearly explains the significance of the topic and why it is worthy of investigation	**Some attempt** is made to set the research question into context. There is **some attempt** to explain the significance of the topic and why it is worthy of investigation.	Little or **no attempt** is made to set the research question into context. There is **little or no attempt** to explain the significance of the topic.
C: Investigation 1. Method detailed allows a repeat. 2. Techniques are explained. **3.** Limitations and uncertainties stated	**Sufficient data** has been gathered, and relevant material has been carefully selected. The investigation has been **well planned**. Method is detailed and the techniques fully explained. Limitations and uncertainties identified and effects **quantified**	An **adequate range data** has been gathered, and relevant material has been selected. The investigation has been **satisfactorily planned.** Method is clear and some explanation of technique. **Some attempt** to identify limitations and uncertainties.	A **limited range data** has been gathered, and some relevant material has been selected. There is evidence of **some planning** in the investigation. Passing attempt to quantify limitations and uncertainties	**Insufficient or inappropriate** data has been gathered, and there is little evidence that the investigation has been planned. Limitations or uncertainties not mentioned.	**There is little or no data** gathered, and little or no evidence of planning in the investigation. Limitations and uncertainties ignored.
D: knowledge and understanding of the topic studied 1. Knowledge = facts **2.** Understanding = explanation, interpretation, application, perspective, empathy,	The essay demonstrates a **very good knowledge and understanding** of the topic studied. Where appropriate, the essay clearly and precisely locates the investigation in an academic context.	The essay demonstrates a **good knowledge and understanding** of the topic studied. Where appropriate, the essay successfully outlines an academic context for the investigation.	The essay demonstrates an **adequate knowledge and some understanding** of the topic studied. The essay shows some awareness of an academic context for the investigation.	The essay demonstrates **some knowledge but little understanding** of the topic studied. The essay shows little awareness of an academic context for the investigation.	The essay demonstrates **no real knowledge or understanding** of the topic studied.
E: Reasoned argument 1. *Repeated reference to the research question.* **2.** *Relate to the 'big ideas'*	Ideas are presented **clearly and in a logical and coherent** manner. The essay succeeds in developing a reasoned and convincing argument in relation to the research question and hypothesis.	Ideas are presented in a **logical and coherent** manner, and a reasoned argument is developed in relation to the research question, but with **some weaknesses.**	There is **some attempt** to present ideas in a logical and coherent manner, and to develop a reasoned argument in relation to the research question**,** but this is only **partially successful.**	There is a **limited or superficial** attempt to present ideas in a logical and coherent manner, and to develop a reasoned argument in relation to the research question.	There is **no attempt** to develop a reasoned argument in relation to the research question.

Student Guide: Extended Essays in Biology

Page 2 Extended essay assessment rubric

	Assessment Level				
Criteria	4	3	2	1	0
F: application of analytical and evaluative skills appropriate to the subject	The essay shows **effective** and **sophisticated** application of appropriate analytical and evaluative skills. **Errors and uncertainties factored into analysis**	The essay shows **sound** application of appropriate analytical and evaluative skills. The effects of **errors and uncertainties mentioned but not quantified.**	The essay shows **some application** of appropriate analytical and evaluative skills, which may be only partially effective. **Some evaluation of technique but incomplete.**	The essay shows **little application** of appropriate analytical and evaluative skills. **Errors and uncertainties largely ignored. Techniques not critically evaluated**	The essay shows **no application** of appropriate analytical and evaluative skills. Presents **only raw data.** Errors and uncertainties/ techniques **not evaluated**.
G: use of language appropriate to the subject 1. Appropriate terminology 2. Avoid excessive use of jargon **3.** Explain technical terms	The language used communicates **clearly and precisely.** Terminology appropriate to the subject is used accurately, with skill and understanding. **All** technical terms explained.	The language used communicates **clearly**. The use of terminology appropriate to the subject is accurate, although there may be **occasional lapses**. **Some** technical terms explained.	The language used for **the most part** communicates clearly. The use of terminology appropriate to the subject is usually accurate. Technical terms used but **not** explained.	The language used sometimes communicates clearly but does **not do so consistently.** The use of terminology appropriate to the subject is only partly accurate and with explanations.	The language used is **inaccurate and unclear**. There is no effective use of terminology appropriate to the subject.
H: conclusion 1. Must be consistent with the evidence presented in the essay. 2. Unresolved questions stated and suggestions for their investigation			**An effective** conclusion is clearly stated; it is relevant to the research question and consistent with the evidence presented in the essay. It should **include unresolved questions** where appropriate to the subject concerned.	A conclusion is **attempted** that is relevant to the research question but may **not be entirely consistent** with the evidence presented in the essay.	**Little or no** attempt is made to provide a conclusion that is relevant to the research question.
I: formal presentation 1. Citations 2. Images must enhance	The formal presentation is excellent. **Full citation and bibliography. Appendices**	The formal presentation is good. **Some informal citations and minor omissions**.	The formal presentation is satisfactory. Citation or Bibliography not consistent. **A major omission in citations**.	The formal presentation is poor. **A number of citations omitted and a weak bibliography**.	The formal presentation is **unacceptable,** or the essay exceeds 4,000 words.
J: abstract 1. Research question 2. Methodology 3. Conclusion			The abstract clearly states all the elements listed above.	The abstract contains the elements listed above but they are not all clearly stated.	The abstract exceeds 300 words **or** one or more of the required elements of an abstract (listed above) is missing
K: holistic judgment 1. Intellectual initiative 2. Insight and depth 3. Originality and creativity	The essay shows **considerable evidence** of such qualities. Intellectual initiative, insight and depth of understanding Originality and creativity	The essay shows **clear evidence** of such qualities.	The essay shows **some evidence** of such qualities.	The essay shows **little evidence** of such qualities.	The essay shows **no evidence** of such qualities.