# Appendix 1: Instructions for candidates

This assessment applies to the project–report for Advanced Higher Biology.

This project–report is worth 30 marks out of the total of 120 marks. The Course will be graded A–D.

It assesses the following skills, knowledge and understanding:

* extending and applying knowledge of biology to new situations, interpreting and analysing information to solve complex problems
* planning and designing biological experiments/investigations, using reference material and including risk assessments, to test a hypothesis or to illustrate particular effects
* recording systematic detailed observations and collecting data
* selecting information from a variety of sources and presenting detailed information appropriately, in a variety of forms
* processing and analysing biological information (using calculations, significant figures and units, where appropriate)
* making reasoned predictions and generalisations from a range of evidence/information
* drawing valid conclusions and giving explanations supported by evidence/justification
* critically evaluating experimental procedures by identifying sources of error, suggesting and implementing improvements
* drawing on knowledge and understanding of biology to make accurate statements, describe complex information, provide detailed explanations and integrate knowledge
* communicating biological findings/information fully and effectively
* analysing and evaluating scientific publications and media reports

Your assessor will let you know how the assessment will be carried out and any required conditions for doing it.

In this assessment you will carry out an in-depth investigation of a biology topic. The topic will be chosen by you. You must discuss the selection of possible topics with your assessor to ensure that time is not wasted on researching topics that are unsuitable. You will work individually to investigate/research the underlying biology of the topic. This is an open-ended task which may involve a significant part of the work being carried out without supervision.

The following table shows how the 30 marks are allocated to each of the categories against which the evidence will be assessed.

|  |  |
| --- | --- |
| **Category** | **Mark allocation** |
| Abstract | 1 |
| Introduction | 5 |
| Procedures | 9 |
| Results | 6 |
| Discussion (conclusion(s) and evaluation) | 7 |
| Presentation | 2 |
| **Total** | **30** |

In this assessment, you will have to produce a project–report. This report is submitted to SQA for external marking.

The same project–report cannot be submitted for more than one subject.

An overview of the Marking Instructions for the project–report is on page 18.

Prior to starting this assessment you should have started a biology investigation. This would normally be as part of your *Investigative Biology* Unit. In that Unit, you are required to plan and carry out a biology investigation. You should keep a record of your work as this may form the basis of your project–report. This record should include details of your research, experiments and recorded data.

**Producing the project–report**

The project–report submitted to SQA must have a logical structure and should be clear, concise and easy to read. It should be written in the past tense and the impersonal voice should be used. This is particularly important when describing the procedure(s) used.

The project–report should be between 2000 and 3000 words in length excluding the title page, contents page, tables, graphs, diagrams, calculations, references, acknowledgements and any appendices. The word count should be submitted with the project–report. If the word count exceeds the maximum by 10%, a penalty will be applied.

The project–report must include the following sections:

* Title page
* Contents page
* Abstract
* Introduction
* Procedures
* Results
* Discussion (conclusion(s) and evaluation)
* List of references

**Title page**

This page should have a title that clearly indicates the subject matter of the project–report. It should indicate the dependent and independent variables. A working title chosen initially might be revised in the light of developments and as the project–report nears completion. The title page must also have your name and candidate number and the name and number of the centre you attend.

**Contents page**

This page must list the sections within the project–report along with their corresponding page numbers for the purposes of cross-referencing. It is essential that all pages throughout the project–report are numbered.

**Abstract (or Summary)**

In your ‘abstract’ you must state the aim(s) and overall finding(s)/conclusion(s) of the investigation. The ‘abstract’ must be brief and should immediately follow the contents page and be separate from the ‘introduction’. Although it appears early in the project–report, as the ‘abstract’ summarises the investigation, it may be one of the last things you write.

The overall finding(s) must be consistent with the conclusion(s) given in the ‘discussion’ and should relate to the aim(s).

**Introduction**

Your ‘introduction’ must include a clear statement of the aim(s) of the investigation (despite the fact that you have already stated these in the ‘abstract’) together with any relevant hypotheses or questions. The aim(s) need to be clear and explicit since these are key to the project–report.

In this section you must include a concise account of the relevant background theory to the investigation, ie the information must link clearly to the aim(s) at a level appropriate to Advanced Higher. You must explain why the investigation is worth doing. It could be one seeking to extend knowledge or to replicate and confirm other researchers’ findings. Take care to use terms accurately and explain ideas clearly. The references you use as sources for the background theory must be cited in the text of the ‘introduction’ and listed at the end of the project–report (see ‘references’).

The biological importance of your investigation must be explained/justified.

Diagrams, formulae and equations may be included, as appropriate, and their source acknowledged, although these cannot count as the cited references (see ‘references’).

Downloading directly from the internet or copying directly from books may suggest to the marker that you have not understood the biology involved and will be considered as plagiarism. It is always best to put things into your own words.

**Procedures**

The procedures you use must be appropriate to the aim(s) of the investigation. The procedures must be clearly described in sufficient detail to allow the investigation to be repeated.

Bulleted/numbered points are only acceptable if statements are in sentences and are meaningful and coherent, ie must make sense if numbers or bullet points were to be removed, but must not be a list of instructions.

Consideration of the following questions will help you to decide if your experimental designs are valid and reliable:

* Have you included appropriate controls in your plans?
* If no control is necessary, have you justified this in your project–report?
* Have you controlled variables that should be kept constant?
* Are your replicates adequate and carried out independently of each other?
* Are your sample sizes adequate?
* How complex is the design of your experiment(s)?
* Have you modified procedures when this was necessary and/or based further work on initial results?
* How creative and original have you been?
* How accurate are your measurements?

The procedures should be presented in a meaningful and coherent way and not as a set of instructions.

It would be appropriate in this section to include labelled diagrams or photographs of assembled apparatus. There must be evidence that you have been involved in the planning of the investigation and have not simply followed a given set of instructions.

**Results**

The results must be relevant to the aim(s) of your investigation.

Readings (raw data) must be recorded and be within the limits of accuracy of measurement. Ensure that average results do not have an excessive number of decimal places or a claimed degree of accuracy greater than that of the raw data. All your raw and processed results must be presented in a clear and concise manner with appropriate use of calculations, tables, graphs and diagrams. It is essential that you summarise results adequately. Extensive raw data may be presented in an appendix.

Where results are presented graphically, a table containing the relevant processed data must support each graph. When drawing a graph you must ensure that:

* scales are chosen so that the plotted points are widely spread
* each axis is labelled with the name of the quantity and the correct unit
* data are plotted accurately

Where Excel or other software packages are used to present graphs, it is important that axes are adapted to suit the data so that the results are presented in a scientific manner.

You must include a statement of results from tables and/or graphs to show the main trends and patterns (or their absence) observed.

**Discussion (conclusion(s) and evaluation)**

The ‘discussion’ section is the most important part of the project–report and it should contain a discussion of your findings in a critical and scientific manner. It provides you with an opportunity to demonstrate an appropriate depth of your knowledge and understanding relevant to the biology in your project–report. It would be appropriate in this section to include a discussion of experiments that you carried out and which did not produce results or for which results were not presented.

In your ‘discussion’ you must include a clear statement of the overall conclusion(s) and a critical evaluation of the investigation as a whole.

The overall conclusion(s) must relate to the aim(s) of the investigation and they must be valid for the results obtained.

The ‘discussion’ section requires you to review your work in a critical manner. Your evaluation of procedures should include the following where appropriate:

* accuracy of measurement
* sources of error in relation to measurements
* adequacy of replication
* adequacy of sampling
* adequacy of controls or recognition of the effects of confounding variables
* positive and/or negative aspects of investigation design
* the ways in which problems encountered in the investigation were resolved or procedures modified

In the evaluation of your procedures, you should also emphasise positive aspects relating to the procedures as well as commenting on any shortcomings.

Your evaluation of results must include as appropriate:

* analysis of the accuracy and variation of the results
* interpretation of the validity, reliability and significance of the results
* critical and scientific discussion of the significance of the findings

The analysis and interpretation of results should include a statement of the results obtained, any trends or patterns observed and a discussion of the relationship between the results of different experiments in the investigation.

In discussing the findings as a whole, reference should be made to relevant background theory where appropriate.

**References**

A reference is any piece of material to which a writer ‘refers’ in the text. Each reference must be listed at the end of the project–report to provide information about the source of the material ‘referred to’. This allows the reader of the project–report to consult the original work if necessary and it is also an acknowledgement of the work of other authors.

Downloading directly from the internet or copying directly from books without acknowledgement is plagiarism. It is also plagiarism to present others’ ideas as your own. The purpose of referencing is to show clearly which ideas or words are not your own, to provide enough information for someone else to find the source of those ideas or words, and to present that information consistently. You should use an established approach (eg, Harvard, as illustrated in the examples below).

Within the project–report, there must be a minimum of three references from different sources. Different pages from the same book counts as one reference only. Similarly, if you refer to the same website several times, this too counts as one reference only. You should also be careful when using a website such as *Wikipedia* since the information it holds may not always be accurate.

Each reference must also be cited in the appropriate part of the text as illustrated in the example below:

*‘There are many different starches whose different properties make them suitable for different uses. Recently, transgenic plants have been used to produce ‘designer starches’ for use in specific commercial applications’ (Bowsher, 2007).*

Where a source has more than one author, additional authors may be represented as, eg (Jones et al., 2006) in the citation but the full list of authors should be given in the reference list.

**Books**

Author(s) (surname followed by initials), (Year of publication), *Title*, Place of publication: Publisher, Page number(s).

For example:

Carson R. (1962), *Silent Spring*,Boston: Houghton Mifflin Company, p189.

This would be cited in the text as:

*‘These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and homes — non-selective chemicals that have the power to kill every insect, the “good” and the “bad”...’ (Carson, 1962).*

**Online books**

The reference and citation for an online book should be the same as a printed text, ie Author(s) (surname followed by initials), (Year of publication), *Title*, Place of publication, Publisher, Page number(s) should all be given, **not** the website title/address.

**Journals/periodicals**

Author(s) (surname followed by initials), (Year of publication), Title of article, *Name of Journal*, Volume number (Part number if appropriate), [Page number(s) if available]. For example:

# Daniels, J. W., Molé, P. A., Shaffrath, J. D. and  Stebbins, C. L. (1988) Effects of caffeine on blood pressure, heart rate, and forearm blood flow during dynamic leg exercise, *Journal of Applied Physiology,* 85(1), pp154–159.

This would be cited as:

*‘Before exercise, caffeine increased both systolic blood pressure (17%) and mean arterial pressure (MAP) (11%) without affecting forearm blood flow (FBF) or Forearm Vascular Conductance (FVC). During dynamic exercise, caffeine attenuated the increase in FBF (53%) and FVC (50%) and accentuated exercise-induced increases in ANG II (44%). Systolic blood pressure and MAP were also higher during exercise plus caffeine; however, these increases were secondary to the effects of caffeine on resting blood pressure.’ (Daniels et al., 1988)*

**Online journals**

Details of the Author(s) and Journal etc must be given, **not** the host website. For example: On the website ‘Springer Link’, the page with the URL: <http://link.springer.com/article/10.1007%2FBF02861686> leads to an abstract of the following article which should appear in the reference list as follows:

[Weaver](http://link.springer.com/search?facet-author=%22M.+L.+Weaver%22), M. L., [Hautala](http://link.springer.com/search?facet-author=%22E.+Hautala%22), E. and [Reeve](http://link.springer.com/search?facet-author=%22R.+M.+Reeve%22), R. M. (1971) Distribution of oxidase enzymes in potato tubers relative to blackspot susceptibility II. Peroxidase and Catalase, [*American Journal*](http://link.springer.com/journal/12230) *of Potato Research*, [48(1), pp16-20](http://link.springer.com/journal/12230/48/1/page/1).

It should be cited in the text as follows:

*‘Peroxidase and catalase activities in selected potato tuber tissue were studied for differences and possible association with resistance or susceptibility to blackspot. Unbruised stem-end tissue had significantly greater peroxidase activity than did unbruised bud-end tissue. However, there was no significant difference between catalase activity at either end of the tuber [and] between blackspot susceptibility and peroxidase or catalase activity...’ (Weaver et al., 1971)*

**Websites**

As many of the following items as are available must be given: Author/organisation, Date, Title, Publisher, the URL and the date you accessed the material (because the ‘site’ may be updated between the time the writer uses it and the point at which a reader refers to it). If web source is dated, include date. If not use ‘n.d.’.

For example: The Mammal Society (2006) Position statement: badgers and bovine tuberculosis. URL: <http://www.abdn.ac.uk/mammal/badgers_tb.shtml>

(Visited: August, 2007)

This would be cited as (The Mammal Society, 2006) in the text.

When you are citing websites, it is sometimes difficult to attribute the information used to specific authors; in such cases, the citation should use the organisation responsible for the output published on the web pages consulted.

Where no clear author or organisation can be attributed, simply list the full URL in the reference list and cite the URL as far as the first ‘/’ in the text and the date visited, eg:

<http://www.abdn.ac.uk/mammal/badgers_tb.shtml>(Visited: August, 2007)

The above example would be cited in the text as (www.abdn.ac.uk, 2007)

The URL and the date visited must be listed, but should not be cited in the text. The date visited must be cited at the back for each website reference and must not be given as a blanket statement such as ‘all websites visited November 2014’.

Care should be taken when using information from websites such as *Wikipedia* or those created by private authors, since they may not have been ‘peer reviewed’ and, as a consequence, may not always be accurate. It is important to identify sources of information that are based on genuine scientific research or knowledge.

**Overview of Marking Instructions**

|  |  |
| --- | --- |
| **Assessment category and criteria** | **Mark** |
| **Abstract**   * a brief abstract (summary) stating the overall aim(s) and finding(s) of the investigation | **1**  **(1)** |
| **Introduction**   * clear statement of aim(s) together with relevant hypotheses/questions * account of underlying biology is coherent and relevant to aim(s) * biological terms/ideas are clear and accurate * biological terms/ideas are at an appropriate depth * biological importance is explained/justified | **1**  **4**  **(5)** |
| **Procedures**   * appropriate to aim(s) * procedures described clearly in sufficient detail to allow the investigation to be repeated * appropriate controls * control of variables * sample size * independent replicates * complexity, creativity and modification | **1**  **2**  **1**  **1**  **1**  **1**  **2**  **(9)** |
| **Results**   * relevant to aim(s) of the investigation * raw data recorded and within limits of accuracy of measurement * appropriate presentation * quality of presentation * presentation summarises overall results * a clear statement of any trends (or the absence of any trend), shown by the data, is given | **1**  **1**  **1**  **1**  **1**  **1**  **(6)** |
| **Discussion (conclusion(s) and evaluation)**   * conclusion(s) relate to aim(s) of the investigation * conclusion(s) is/are valid * evaluation of procedures includes comment as appropriate on: * accuracy/sources of error in measurement * adequacy of replication/sampling * adequacy of controls * positive and/or negative aspects of investigation design * solutions to problems and modifications to procedures * evaluation of results includes as appropriate: * analysis of results * interpretation of results * critical and scientific discussion of significance of finding(s) | **1**  **1**  **2**  **3**  **(7)** |
| **Presentation**   * appropriate structure, including informative title, contents page and page numbers * references cited in the text and references listed in standard form, acknowledgements, where appropriate | **1**  **1**  **(2)** |
| **Total marks** | **30** |