Method Sheet 35

Advice for writing up - Biochemistry projects

Overview

Congratulations on the completion of your data collection phase! Now comes the writing up. Giving as much care and attention to this process as your experimental phase is essential to help you score the highest possible mark for your final report or dissertation.

The following is some generic advice on how to begin writing up your project report or dissertation. Please check with your university supervisor if this advice is suitable for your own, specific project.

Structuring your final report

Different universities may have sligthly different requirements for the structure of a BSc or MSc project dissertation. You should follow the guidelines of your own institution. However, a final report at this level typically comprises the following major elements, in the following order:

(i) Title page
(ii) Abstract
(iii) Acknowlegements
(iv) Table of Contents
(v) Abbreviations
(vi) Introduction
(vii) Materials and methods
(viii) Results
(ix) Discussion
(x) References
(xi) (Appendices - optional extra section)

Advice on word count

The overall word limit for your final project writeup varies greatly between institutions. However, regardless of the overall length, you will still have to decide how much space to give to each section of your report. Suggestions for word counts for each section that might work for this type of project are shown in the table below, broken down by common total word count limits for typical BSc and MSc research projects. These suggestions assume that your word count limit does not include the references list at the end of the document, or the data contained within tables of the results section.

Please note that these figures are just a guide - they are very flexible. Feel free to alter the lengths of each section to meet your own instiution's requirements and project-specific needs. Please check with your supervisor if they will be appropriate for your project.

Section	4,000 word limit	8,000 word limit	12,000 word limit
Abstract	200	250	250
1. Introduction	1,600	3,750	6,000
2. Methods	700	1,000	1,500
3. Results	700	1,500	2,000
4. Discussion	800	1,500	2,250

Advice for the Title page

This will be the front page of your dissertation. Here you should give the title to your project, your name (in most institutions) and your student identification number. Keep your title concise (perhaps up to 15 words), and be sure to include both the name of the micro-organism and plant extract you have studied. Insert a 'page break' just after the text of this page so that the text from the rest of your document does not overlap onto this front page.

Advice for the Acknowledgements section

This can be a short section of several sentences to offer your thanks to those who have helped you in your project. Unlike the rest of the document, it can be quite personal. For example, you can thank your supervisor, friends and family here. Make sure to use 'Page breaks' to present this section on a separate page from the rest of the report.

Advice for the Table of contents

This adds a layer of professionalism to your report that may help win marks. Method sheet 28 shows how to easily insert a table of contents for your report using a Microsoft Word automated function.

We recommend that you number your major sections as follows: 1. Introduction, 2. Materials and Methods, 3. Results, 4, Discussion, 5. References. You should split each of these major sections into smaller subsections, each covering a specific topic and with their own subheading with appropriate second level numbering. For example: 1.1 Background to antimicrobial resistance, 1.2 Mechanisms of antibiotic resistance, etc.

Advice for the abstract

The abstract is a standalone summary of your project, typically between 200 and 300 words (check your institution's guidelines for your specific word limit). It must explain *why* you did the work, *how* you did it, *what* you found, and *why* it matters. The following is a suggested structure for your abstract, we advise you to give one to two sentences for each of the following:

- **Context**: Introduce the "Big Picture", mentioning the threat of Antimicrobial Resistance (AMR) and the scale of the problem.
- **The gap in knowledge**: Explain why your specific project is necessary. For example, you could mention that the requirement to discover new antibiotic scaffolds, and that natural products could represent a useful resource for this.
- **The aim**: State the objective clearly and concisely, in no more than one sentence.
- **Key results**: Give space only to the most relevant findings, and no space to minutiae. Be concise and quantitative. For example, instead of saying "some extracts worked", say instead, "Three extracts inhibited bacterial growth by more than 50% at 256 µg/ml, and the most potent extract (#102, *Cinnamomum verum*) yielded an IC50 of 25 µg/ml."
- **Conclusion/Impact**: Try to summarise the benefits your findings bring to the field in a single sentence, and perhaps (very briefly) where to go next with the work.

<u>How to improve your abstract</u>:

- **Do** remember to write in the past tense and the passive voice. For example, instead of saying "I will screen 400 samples for antimicrobial properties", say instead, "400 samples were screened for capacity to inhibit growth of *Micrococcus luteus*".
- **Don't** write the abstract first. You should only write the abstract after you have completed the rest of your report, so you can summarise it accurately.
- **Don't** make conclusions beyond what is clearly supported by your data. For example, do not "over-reach" by claiming that you have discovered a new antibiotic, or that it will work well in human studies.

Advice for the introduction

A high-scoring introduction for a BSc or MSc dissertation is not just a summary of facts; it is a persuasive argument that explains to the reader a key knowledge gap in the field, and why your project is necessary to address it. Examiners of project reports give the highest marks for the "Inverted Pyramid" structure in an introduction. This is where you begin with a broad overview of the field, and progressively narrow down the focus to eventually reach your specific research area.

We recommend giving space to at least the following topics in your introduction, in the following order:

1.1 Background to antibiotic resistance

Explain why AMR is a challenge in our hospitals today. Support these statements by refering to studies and statistics from reputable sources (e.g. UN or NHS studies). Explain how AMR arises, and why it has become increasingly common in our hospitals over the last century. Give some examples of human behaviours that have increased the prevalence of AMR in recent years.

1.2 Mechanisms of action of existing antibiotics

Explain how the major classes of antibiotic work. You don't have to cover every single antibiotic, but do give at least one example for each of the major mechanisms of action.

1.3 Mechanisms of antibiotic resistance in (Gram-negative or Gram-positive) bacteria

Explain how Gram-negative or Gram-positive bacteria (select one to match the type of bacteria you chose to study in your own project) resist existing antibiotics. Explain how resistance is spread between bacteria and in which environmental niches this most commonly occurs.

1.4 Reasons for the recent slowdown in antibiotic discovery

Explain how we used to discover antibiotics in the past, the golden age of antibiotic discovery, and why that source has dried up recently. Give some examples of approaches currently being explored by researchers to get past the present bottleneck in discovery.

1.5 Natural products as structural leads for the development of new drugs

Give a brief overview of the historical successes of natural products in drugs used today, including examples of some drugs in use today that derive from a natural origin.

1.6 Pros and cons of natural product screening in drug discovery

Explain that natural product screening typically offers a higher hit rate than synthetic compound screening, and often yields molecules with better toxicity / ADMET profiles. Discuss also the disadvantages of natural product screening, such as confounding from pigments or viscosity of extracts, and the requirement for activity guided separation to isolate the active compound. Mention that more work is necessary to figure out how to synthesise natural products and that they are therefore more difficult and time-consuming to patent. Discuss why big pharma moved away from natural products to synthetic compound discovery in the early 1990s, and the impact that had on drug discovery. Explain here also the key principles of the Nagoya Protocol.

1.7 Hypothesis and aims

Keep this section very short and simple. The hypothesis and each of the aims (maximum 3-4) should be one sentence only. The aims should match the overarching objective of each of the experimental approaches you took.

How to improve your introduction:

- **Do** start simple, and then introduce more complex concepts one at a time
- **Do** cite key articles in the field which support the major points of your introduction, inserting these at the end of the sentence where you make the point
- **Do** give preference to citation of more recent articles, and those which report primary research rather than review articles
- **Do** give space to discussing the pros and cons of various schools of thought if there is controversy in the area you aim to study
- **Do** steer the narrative towards key questions that remain unanswered in the field, specifically those that could be addressed by your project
- **Do** include diagrams which explain the key cellular or molecular mechanisms of the areas you intend to study; we suggest ~1 figure per 500 words of introductory text
- **Do** draw your own diagrams for the introduction - copying an image from the internet will score less marks than if you draw something yourself in powerpoint or Biorender. (If you do copy an image from elsewhere, remember you must cite the source of the image in the figure legend).

Advice for the methods section

The goal of the Materials and Methods section is to enable another scientist reading your report to repeat the experiments you have performed and replicate your findings exactly. High scoring methods sections will be precise, technical and free of minutiae.

We recommend structuring your methods section using subsection titles similar to the following:

2.1. Materials and Reagents

Here you should briefly list the main chemicals and consumables you used and the manufacturer of each. Include at least the microbiological media you used, and also the DMSO negative control, the antibiotics used as positive controls, and the 96-well microplates.

2.2 Preparation of Bacterial Inoculum

Give the strain number and supplier of the organism you studied. Explain how you grew a pure colony on an agar plate and set up an overnight culture, including the growth medium, temperature, shaking speed and make and model of the shaking incubator. Then explain how you set up the plate with the working concentration of bacteria before challenge with natural extracts.

2.3 Primary Screening Protocol (HTS)

Give the name and manufacturer of the library (Caithness Biotechnologies Ltd., Leicester, UK), the number of extracts and their concentration. Explain how you diluted the stock extracts into the bacterial cultures, indicating clearly the final concentration used. Mention both the positive and negative controls used, and their final concentrations. Give the growth time and temperature, explaining any approaches to minimise evaporation and edge effect. Give the name and manufacturer of the microplate reader, as well as the wavelength used to estimate bacterial growth. Explain the criteria which you used to define a “hit” in the primary screen.

2.4 Hit Validation and Dose-Response Assays

Mention how many hit extracts were taken forward for validation. Explain how the dose-response assays were performed, giving the range of final concentrations tested and any positive or negative controls used.

2.5 Disk diffusion assays

Explain how you set up and inoculated the agar plates for disk diffusion assays, and how much antibiotic or extract was added to each disk.

2.6 Data Analysis and Statistical Methods

It is essential to include a section on how you performed your data analysis and statistical approaches - missing this out or explaining it poorly greatly hurts the mark. Mention analytical techniques in the order you performed them. Start with background subtraction and normalisation, explaining briefly why you did these. Give the equation you used for Z’ factor calculation and explain why these were necessary. For the dose response data, explain how you calculated IC50 values. Mention which software you used for each different step of the analysis (e.g. Excel, GraphPad Prism or R). State what type of statistical test you used to analyse each different type of data (i.e. for the primary screening data, dose curve data and disk diffusion data). State the p-value cutoff chosen for statistical significance.

How to improve your Methods section:

- **Do** remember to write in the past tense and the passive voice (e.g. do not say “I grew the culture at 37^{o}C”, say instead, “The culture was grown at 37^{o}C”).
- **Do** be precise with quantities and concentrations (e.g. do not say “A small amount of extract was added to each well”, say instead, “1 µl of extract was added to 99 µl of culture in each well to yield a final extract concentration of 100 µg/ml.”
- **Do** give the the make, model, and manufacturer for all major equipment used.
- **Do** be very clear on how you did your statistical analyses.
- **Don’t** give space to the minutiae, which means content that is either not directly relevant to your project, or would be obvious to someone with basic competence in the field. For example, there is no requirement to explain how a pipette works or how to prepare a dilution series - just give the final concentration achieved.
- **Don’t** repeat the same content more than once.

Advice for the results section

The results section is where you present summaries of the data you collected in your experiments, presented in the most appropriate way for the reader to understand them. This section will include all of your charts, tables and images from experimental observations. You should only describe what you saw in your experiments here, highlighting only the most relevant findings in the text. In this section you should not give any space to interpretation of what the findings mean in terms of the bigger picture, relevance to the field or future work, limitations or comparisons to earlier studies in this section. Those comments are necessary, but they belong in the following discussion section and must be put there.

A high scoring results section will present high quality charts and tables with appropriate description of the summary statistics in the main body of the text between each figure and table.

Results to report in this type of project

For our basic Microbiology project, you should present the following results in the order shown:

Results of the primary screen

After completing background correction, normalisation and mapping extract IDs to the plate maps, sort your data to establish which extract inhibits bacterial growth the most (see Method sheet 21). Chart the data as a bar chart using the extract ID number as the x-axis value, and the corresponding %max growth as the y-axis value. Ensure these two columns in your Excel file are sorted in order of %max growth (not numerically by compound ID). Plot one column per extract, with all 400 extracts on the chart. Add SD or SEM error bars to the chart (see Method sheet 17).

Table of Z' factors for each plate you measured

Calculate the Z' factor for all of the plates you assayed during your project (see Method sheet 21). Present these values in your report in a table with 4 columns and 6 rows. The top row should begin with an empty cell then Exp 1, Exp 2 and Exp 3. The left column should begin with an empty cell at the top, then Plate 1, Plate 2, Plate 3, Plate 4, Plate 5. Type the Z' factor for each of the 15 plates you measured (assuming you screened all 5 plates three times each) to two decimal places in the respective remaining boxes. Remember to give a table number, title and footnote. Increase the size of the table if you have completed more than three replicates.

Replication dose curves of top hits

Plot these as scatter plots in Excel. Plot the mean of at three independent experiments for each concentration tested, plus the SD or SEM error bar. Use a log scale with base 2 on the x-axis. If you performed dose curve replication on more than one hit, show them on separate charts. Add a 4-PL curve fit to the chart to indicate where the IC50 lies. Place asterisks (*) above any data point that is significantly lower than the control growth condition (see Method sheet 17).

IC50 calculation for top hits

Use the equation for the 4-PL curve fitted to each extract dose curve experiment to calculate an IC50. Compare it to that of a standard antibiotic (e.g. tetracycline). Report these values in the main text of the results.

Table of disk diffusion assay results

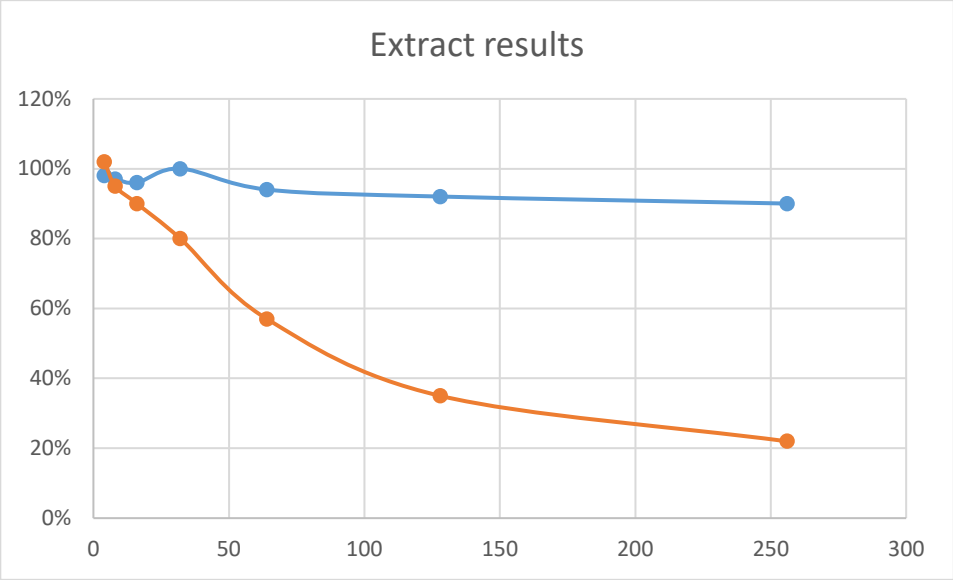
Insert a table with 6 columns and at least 2 rows. The top row should have headings of an empty first cell, then no treatment, DMSO, antibiotic, extract and p-value. The left hand column should have one heading per row with the name of each extract you tested. Insert the mean diameter of zone of inhibition ± SD in each respective cell. In the sixth column, insert the p-value for the comparison between DMSO and extract. Explain these in the table footnote and remember to give a table number and title. Increase the size of the table if you have studied more conditions than these.

In addition to the table, insert an image (from a photo if available) of an example plate showing zones of inhibition around the various disks. This should be presented as a separate figure with its own number, title and legend. Make clear that this is a representative example of one experiment and how many experiments were actually performed.

What makes a good chart?

The hallmark of a well-presented chart is one that is clear, uncluttered, and shows the information necessary for easy comprehension of the data. Journals have specific guidelines for chart formatting to meet their requirements for quality. Following these rules in the preparation of your own charts should help lift the mark for your own dissertation.

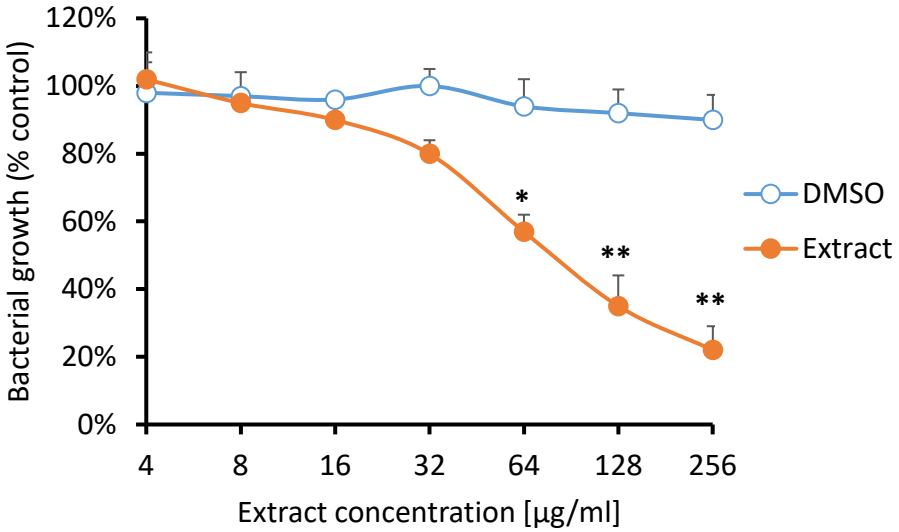
Let's examine what a poorly formatted chart looks like, using a chart prepared with the default settings Microsoft Excel applies to a scatter-plot chart before correct formatting (see below).



Reasons why the above example is a **poorly formatted chart**:

- There are no x-axis or y-axis labels
- There is a title at the top of the chart (Excel inserts these by default)
- There are no error bars to indicate the variability between experiments
- The x-axis is on a linear scale, when it should be on a log scale for dilution curves
- There is no legend on the chart to explain what the different colours of line represent
- There are horizontal and vertical gridlines
- There is a border around the outer perimeter of the chart area
- The font is light grey, a little too small, and difficult to read clearly
- The axis lines are light grey and too thin (insufficient line weight)
- There are no tickmarks on the axes
- No asterisks are present to indicate values significantly different from control

Now let's have a look at a well formatted chart plotted from the same data (see example below).



Reasons why the above example is a **well-formatted chart**:

- X-axis and y-axis labels are both present and indicate the correct units
- There is no title at the top of the chart (this will go in the text below your chart)
- Error bars indicating the standard deviation are present
- The x-axis is on a log scale in base 2, which is correct for doubling dilutions
- A legend is present on the chart to explain what the different colours of line represent
- The horizontal and vertical gridlines have been removed
- The border around the outer perimeter has been removed
- The font is solid black, a little larger, and now easier to read
- The axis lines are solid black and 1.5 line weight
- Tickmarks are present on both axes
- Asterisks are present to indicate p-values on values significantly different from control

Use the above as a checklist to ensure your charts meet the same level of quality. Your examiners will be looking for all of these things in charts of a high scoring Results section.

What to include in your figure titles and legends

Every figure in your report must have a number, a title and a legend. These must also be formatted correctly to score well. The figure title and legend will appear directly below the chart in your report, not above. They should be in a font or style that is slightly different from the main text to help distinguish the title and legend text from the rest of the document. An example of a poor figure title and legend is shown below:

> Figure: Antibiotic effects of extract
> The results are shown in the above chart.

Reasons why this is a poor title and legend:

- There is no figure number
- The title is vague and non-descriptive
- There is no clear explanation of how the experiment was performed
- The legend lacks essential information on experimental replicates ('n'), statistical tests, error bars and p-value thresholds

Now let's look at an example of a good figure title and legend:

> Figure 3.2: Dose-dependent inhibition of growth of *Micrococcus luteus* by *Cinnamomum verum* extract
> *M. luteus* cultures were grown for 18 h in the presence of indicated concentrations of *C. verum* extract or equivalent content of vehicle control (DMSO). Growth was measured by absorbance at 600 nm. Means of 3 independent experiments ± SD are shown. Statistical significance was determined using a two-way ANOVA followed by Sidak's post-hoc test, comparing each extract dose to the corresponding vehicle control (* $p < 0.05$, ** $p < 0.01$).

Reasons why this is a good title and legend:

- There is a figure number (3.1) and a descriptive but concise title that explains clearly what is shown
- The legend gives sufficient explanation of what was done in the experiment so a reader can understand the basics of what is shown without having to refer to the main text
- The identity of the control is made clear
- The number of independent experiments performed to collect the data is shown clearly (it is essential to always report this 'n' value in your legends)
- The fact that error bars represent standard deviation is explained
- The type of statistical test used, and the comparator condition, is clearly explained (this too, is essential)
- The meaning of the one star and two star marking on the chart is explained in terms of the p-value thresholds they represent

How to improve your Results section:

- **Do** make sure every figure is numbered and cited in the main text by its number
- **Do** check whether your data are parametric or non-parametric before choosing a statistical test to apply
- **Do** explain clearly which statistical test you chose for analysis of each type of data and why
- **Do** present the results in an order that follows a logical progression and tells a story beginning with your hypothesis and following your thought process through each experiment
- **Do** prepare your figures to a high standard as explained in the section above
- **Do** mention any problems you may have seen in your experiments if they may affect the results (e.g. unusual cell morphology, low reproducibility, unexpected results, edge effect etc.), but leave discussion of those issue to the next section of the report
- **Do** show evidence of good reproducibility of experimental work (e.g. small error bars)
- **Do** include appropriate controls in all your experiments (e.g vehicle alone etc)
- **Do** remember to insert a space between number and unit every time (e.g. 1 µg/ml, not 1µg/ml)
- **Don't** show the raw data - only show the summary data after processing and analysis of data from all experiments of the same type combined
- **Don't** give a chart for each individual experiment - give only a single chart combining all the data from all experiments of the same type combined
- **Don't** show the results from individual experiments - only show the means of multiple repeat experiments post analysis (the exception to this is where you show an image of an agar plate or a microscope field or similar, in which case you should clearly indicate in the figure legend that the image shown is "a representative result from 'n' independent experiments")
- **Don't** give space to description of the minutiae - stick to the main findings and key observations

Advice for the discussion section

Here, the examiner will be assessing your understanding of the project, how it fits in with past work in the field and your understanding of what the results show and mean more broadly. Your results section is where you **describe** the findings. The discussion section is where you **interpret** the findings. You should structure your discussion section in the following order:

1) **Brief recap**: Why was your project necessary for the field?
2) **Interpretation**: What do your results mean?
3) **Context**: How do your findings compare to previous studies?
4) **Limitations**: What were the weaknesses of your study?
5) **Future Work**: What should be done to take this work forward?
6) **Conclusion**: What is the final "take-home" message?

For the brief recap, these should be at most 1-3 sentences, explaining why your project was necessary. Make sure you link back to your original hypothesis here.

Then try to explain what factors may be responsible for the main findings of your project. Give space particularly to why you think any extracts did, or did not, inhibit the growth of your bacterial strain of interest. If you saw any unusual results that are difficult to explain, this is where you will raise the point and offer some possible explanations.

Next, you should discuss what others have reported in terms of the effects of the same herb in previous studies, particularly if those studies look at the same phenotype you did. Give space to discussion of the likely toxicity of the plant - has it been trialled in human or animal studies? Mention any active compounds that others have previously reported to be present in the extract, and if these compounds have activity similar to what you have seen.

Then you should discuss the advantages and limitations of your own study. Give space to the pros and cons of natural extract screening. Then to any specific issues you found in your own project (e.g. the edge effect, contamination events, etc.).

Insert a paragraph or two on future work. This is where you suggest what direction you would like to take the work forward if you had sufficient funding. Focus specifically on which types of follow-on experiments or development programmes you think would be most valuable.

Finish with a clearly defined ‘Conclusion’ section. This should sum up the broad picture of what your work found and how it contributes to the field. Also mention the potential value to society if you have found some potentially useful bioactivity. But do not over-reach - make sure your claims are entirely supported by your own data. If you speculate that your extract could have therapeutic potential in future, make clear that this is a speculative point and will require further work to validate. Do not introduce any new information or discussion into this closing section - it should be quite brief and mainly a summary of what you have said previously. Some institutions prefer this to be a standalone section after the discussion (e.g. 5. Conclusions) - follow their guidelines if that is the case.

<u>How to improve your Discussion section</u>:

- **Do** cite a wide range of relevant references
- **Do** explain how your work addresses an unanswered problem in the field, and how your approach relates to studies of previous workers
- **Do** give space to discussion of both the advantages and limitations of the experimental approaches you have taken
- **Do** mention the key limitation that your work is *in vitro* only, and that the results may not be applicable to an infection *in vivo*
- **Do** give space to discussion of evidence from earlier studies which support or refute your own observations
- **Do** mention the possibility of activity guided separation as the next step in identifying any active compounds of interest that may be present in your hit extracts
- **Do** explain that progressing to isolation of a natural compound and developing it as a candidate drug in future work will require careful consideration of the Nagoya Protocol
- **Don’t** simply repeat the minutiae of the results again, a brief summary of a key finding is fine, but leave most of the numerical results in the results section
- **Don’t** be afraid to express your view if your findings challenge existing thought in the field - just be sure to explain clearly why you think you are right and they are wrong
- **Don’t** simply ignore any unusual results, or those that are difficult to explain - offering plausible explanations for these can actually win extra marks

- **Don't** be afraid of "negative results" - remember that two projects will score exactly the same mark if they are performed and written up to the same standard, regardless of whether one makes an amazing discovery and the other does not - this is not what you are being assessed on

Advice for the references section

Here, your examiner will assess your grasp of the literature in the field relevant to your project, and your ability to cite previous works correctly. Different institutions prefer different referencing styles. However, most UK universities require you to use either the **Harvard** or **Vancouver** styles. These styles have some key differences you should be aware of. Harvard style involves giving the first author surname and year of publication in the in-text citations (e.g. Smith et al., 2019). Vancouver style replaces this with a simple number, often in square brackets (e.g. [1]). Make sure you format your own references in the main text and in the reference list according to the style favoured by your own institution. These can be inserted and sorted by hand, but using a software application to manage your references will save a lot of time and effort in this process.

Examples of the Harvard and Vancouver referencing styles:

	In-text citation	Reference list
Harvard	(Wilson et al., 2020)	Wilson, B.A.P., Thornburg, C.C., Henrich, C.J., Grkovic, T. and O'Keefe, B.R. (2020) 'Creating and screening natural product libraries', Natural Product Reports, 37(7), pp. 893–918.
Vancouver	[1]	Wilson BAP, Thornburg CC, Henrich CJ, Grkovic T, O'Keefe BR. Creating and screening natural product libraries. Nat Prod Rep. 2020;37(7):893-918.

What references should I include?

Cite articles that support the major claims you are making, primarily in the introduction and discussion sections. It is better, where possible, to cite peer-reviewed journals over websites, and primary research articles over review articles. Here are some examples of journal articles that you could read to help you get started with this specific project:

1) Wilson BAP, Thornburg CC, Henrich CJ, Grkovic T, O'Keefe BR. Creating and screening natural product libraries. Nat Prod Rep 37:893-918 (2020)
2) Martínez-Fructuoso L, Arends SJR, Freire VF, Evans JR, DeVries S, Peyser BD, Akee RK, Thornburg CC, Kumar R, Ensel S, Morgan GM, McConachie GD, Veeder N, Duncan LR, Grkovic T, O'Keefe BR. Screen for new antimicrobial natural products from the nci program for natural product discovery prefractionated extract library. ACS Infect Dis 9:1245-1256 (2023)
3) Atanasov AG, Zotchev SB, Dirsch VM; International Natural Product Sciences Taskforce; Supuran CT. Natural products in drug discovery: advances and opportunities. Nat Rev Drug Discov 20:200-216 (2021)

How to improve your referencing:

- **Do** cite previous works that are most relevant to the area of interest, the methods you have chosen, and the overall aim of your project
- **Do** cite studies in reputable, peer-reviewed journals
- **Do** cite mostly primary research articles, with only a handful of review articles
- **Do** place your in text citations at the end of the same sentence where you make a claim or statement, don't save them up to the end of the paragraph or section
- **Do** favour citation of journal articles over textbooks
- **Don't** cite studies that report results that are far beyond the scope of your own project
- **Don't** cite studies from disreputable sources (e.g. unofficial websites, wiki pages etc.)
- **Don't** forget to order your reference list alphabetically if you choose to use Harvard referencing

General advice for your dissertation write-up

- Your writing should be clear, well organised and with excellent grammar and spelling
- Present your work to a high standard in terms of the formatting and presentation of the report (e.g. consistent font style and size for each level of heading, consistent formatting of charts and legends, etc.)
- Use hierarchical numbering for sections and subsection headings (e.g. 1. for Introduction, then 1.1 for the first subheading in your introduction, etc.)
- Use the Microsoft Word headings function to prepare a table of contents page just after your acknowlegements section
- Where possible, draw your own diagrams for explanatory figures in the introduction (e.g. using PowerPoint or BioRender)
- If you do copy an image from elsewhere to use it in your thesis, make sure to cite the source of the image clearly in the figure legend
- Introduce your facts in a logical order that makes sense for the reader
- Sections which jump about randomly between topics without a clear thread score low marks
- Use italics for all genus and species names (e.g. *Escherichia coli*)
- Remember to also use italics for all other Latin terms, such as *et al*., *in vitro* and *in vivo*
- For abbreviations, give the full term at first use explaining the acronym in brackets straight after, then use the acronym on every occasion thereafter (e.g. polymerase chain reaction (PCR) at first use, then simply PCR at every point in the document after that)
- Remember to include the abbreviations you have used in the list near the start of your report
- Unlike the Introduction, Methods, Resuls and Discussion sections, which are all numbered (1-4), the Abstract, Acknowlegements and References sections do not receive a number
- Use the ‘Page break’ function to ensure every figure is on the same page as its title and legend (which should be placed just beneath it)
- Also insert a ‘Page break’ just before each of the major sections to prevent cluttering