Report Writing: Scientific (Detailed)

A basic laboratory report structure should consist of the following sections:

- Title
- Introduction: concludes with an Aim/Hypothesis
- Materials & Methods: includes subjects/sample details, equipment, and a procedure
- Results
- Discussion: final paragraph should consist of a Conclusion

Title

Reports should have a clear and concise title that relates to the project. If there are multiple projects combined in the report, then construct a title that encompasses all the projects.
Example: "Determination of Protein Content in Breakfast Cereals"

Introduction

The *Introduction* should present all background necessary to put the experiment into context and make it understandable. Any important concepts and definitions should be presented in this section. For example, if you are writing a report about the protein content of breakfast cereal, you will need to detail why protein is important and why we want to analyse this food component. You will also need to write about the techniques that can be used to analyse protein.

Finding information and references: The *Introduction* section should be based on current knowledge from books and journal articles and needs to be referenced appropriately. This is not the place to discuss your own ideas or draw your own conclusions (this will be completed in the *Discussion* section), so as a rule, reference every statement you make.

Writing style and grammar: The *Introduction* section should be written in past tense using objective language and a passive voice. For example, instead of writing "We wanted to investigate the protein in breakfast cereal" write "The protein content in breakfast cereal was investigated".

Aim/Hypothesis

The aim is a short statement that describes the reason you are undertaking your practical experiment. In academic journal articles, the aim is usually the last paragraph of the introduction. Because the aim is your own idea, you do not need to include any references in this section. The aim is usually placed in the last paragraph of the introduction. However, you can present the aim as a separate section before the introduction if required - check your assessment instructions and requirements for the preferred format.

If your aim is included as a last paragraph in your *Introduction*, it needs to be written in past tense using objective language and a passive voice. However, if you write the aim as a separate section before the Introduction, it should be written in future tense, as this is something you are planning to do. For example, if you are investigating the caffeine content of Coca-Cola and other soft drinks, your aims could look like these examples:

- The aim of this study was to investigate the caffeine content of commercial soft drink samples.

OR

- Aim: To determine the caffeine content of commercial soft drink samples.

Materials & Methods

The *Materials & Methods* (sometimes referred to simply as *Methods*) should contain enough information that someone else could replicate your experiment exactly. Therefore, it needs an accurate description of all the subject or sample details, all the equipment used, as well as a detailed description of the method used.

Using a pre-existing method: If you used a method that is not your own design, reference the original method instead of writing out the whole method again. In this case, you will need to write

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down any changes that you have made to the original method. Because you will never use the exact sample as written in the original method, sample details must always be displayed. Samples, materials or equipment used in the experiment must be described in detail enough for someone to find that exact sample/reagent/piece of equipment.

Writing style and grammar: The *Method* should be written in past tense using objective language and a passive voice and be written as a cohesive piece of text about what you did, rather than a list of steps or instructions on how to do it. If your method contains a lot of samples and materials, these can be listed with separate subheadings (see example below). However, sample details and materials can also be integrated into the *Method*.

Example:

- "500g of Granny Smith apples (1kg bag, mild bruising of skin, sourced from Apple Delicious Farms, NSW on 8/3/2015) were peeled and pureed in a Vitamix 3000 blender, high setting, until homogenous. The sample was then transferred to a beaker, and 100mL of Ethanol (100%, Sigma Aldrich) was added." This way, both the materials and sample details are displayed at the same time as the method.

Subject/Sample details: A sample description must include type (what it is), description, name, brand, source (e.g. location) and purchase/use by date.

- For apples this could be: Granny Smith apples, 1kg bag, mild bruising of skin, sourced from Apple Delicious Farms, NSW on 8/3/2030.
- For breakfast cereal this could be: Weetbix, 1kg, Sanitarium, best before: 3/5/2029

Materials: All equipment used in the experiment, which must be described in detail enough for someone to find that exact reagent/piece of equipment. For example, you would need to include:

- The concentration, manufacturing date (if relevant), and brand of any reagents.
  Example: Ethanol, 100%, Sigma Aldrich.
- The name, model number and specific settings on any analytical instrument used.
  Example: UV-1800, Shimadzu UV Spectrophotometer at λ=750.

Results

The *Results* section should contain all the information about what happened in the experiment. This includes the data obtained and any relevant observations. This section should include charts, diagrams, tables, graphs and could also include images.

Key results should be emphasised in the body of the results section text, with references to the data in the tables and diagrams. Tables and diagrams should not be presented in a stand-alone format. When you refer to your own results, you need to indicate which table or figure you are getting the information from. You can do this by putting the table/figure number in brackets after the statement you make.

Writing style and grammar: The Results should be written in **past tense** using objective language and a passive voice.

References: The *Results* should contain only your own findings. Therefore, the results section should never include any references.
Example: The Total Antioxidant Capacity was found to be the highest in Tahitian Noni Juice (Table 2).

Tables

Table titles: A clear title should describe the data present. The titles should be displayed on top of the figures and should be descriptive enough for the reader to be able to read the title and look at the data and understand what it means, without referring to the text.

Table contents: In addition to your data, tables should also always contain the units of measurement and contain the correct significant figures if your data is numerical. Footnotes can be used as appropriate.

Numbering: Tables are numbered according to the order in which they appear. They can be numbered simply 'Table 1, Table 2' etc., or if you have a large report with different chapters, they can be labelled after the chapter number such as 'Table 2.1, Table 2.2.'. Your table should be numbered even if you only have one table in your report.

Table 1: Total antioxidant capacity of Noni Juice samples, using the CUPRAC method

Sample	Average Absorbance λ=734	Standard Deviation	Coefficient of Variation (%)	Total Antioxidant Capacity (mg/100mL)
Hawaiian Noni Juice	0.408	0.014	3.47	291.79
Tahitian Noni Juice	0.445	0.015	3.35	318.54
Fijian Noni Juice	0.345	0.013	3.63	247.11

Table 2: Type, concentration and order of elution of parabens found in unknown sample

Paraben Found	Concentration	Order of Elution
Methylparaben	1.90 g/L	1st
Ethylparaben	2.21 g/L	2nd
Propylparaben	4.14 g/L	3rd

Figures

Figures can be illustrations, photographs, images or graphs that help you present your information. Usually, figures are included in your results, however you may also want to include figures in the Introduction or *Discussion* sections to help you illustrate concepts.

Figure titles: A clear title describes the figure and is placed below the figure. It is descriptive enough to allow the reader to look at the figure and its subheading and understand what it means, without referring to the main body of text. Figures that are sourced from somewhere else need to be referenced in brackets in the figure title.

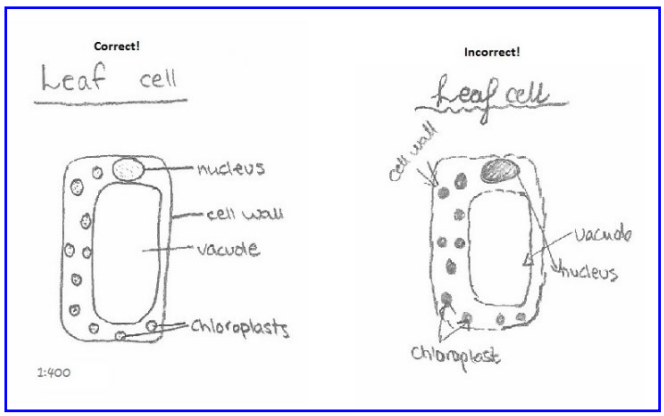
Figure numbering: Number figures in sequence, like numbering tables. Note that figures and tables are numbered independently from each other, so you can have a 'Figure 1' as well as a 'Table 1' in your report.

Figures: Illustrations
You may need to or want to include illustrations of observations you have made in the laboratory. This could include something you have seen using a microscope or in a petri dish.

Generally, hand drawn illustrations should:

- have a clear underlined title
- be simple line drawings (2D format, no shading or colouring, but exceptions exist, e.g. botany)
- have solid lines (i.e., not be sketches)
- include a scale for size
- have labelling on all objects in it, with a solid, straight, horizontal or vertical line touching the object (without arrowheads)
- have clear, neat, texted writing that is grammatically correct (i.e., no cursive).

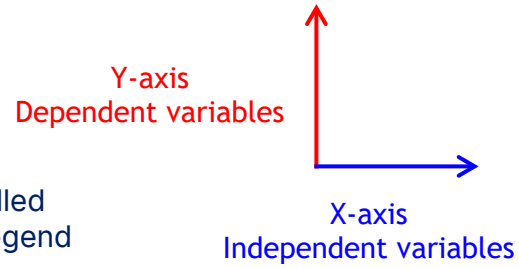
Figure 1: How to illustrate a leaf cell



Figures: Graphs

Graphs are figures that display data in a graphical form. This could be a bar, pie or line diagram. Graphs can be either hand drawn or generated on a computer with appropriate software. If hand drawn, using graph paper is ideal.

Graph components: In the graph, each axis must be labelled and units of measurement given. Variables that do not change, for example time, are called independent variables, and are placed on the x-axis. Variables that do change, such as concentrations, amounts or volumes, are called dependent variables, and these are placed on the y-axis. A legend should also be included.



Example 1: Bar graph

- On this bar graph, the y-axis states the dependent value, *Total Antioxidant Capacity*, and the unit, *mg/100mL Trolox Equivalent*, in brackets.
- On the x-axis is the independent value, which is the type of juice sample.
- Underneath each column, the values from the y-axis are also displayed.
- The legend is beneath the x-axis values, indicating which column (red or blue) refers to what - the TEAC or the CUPTRAC technique.

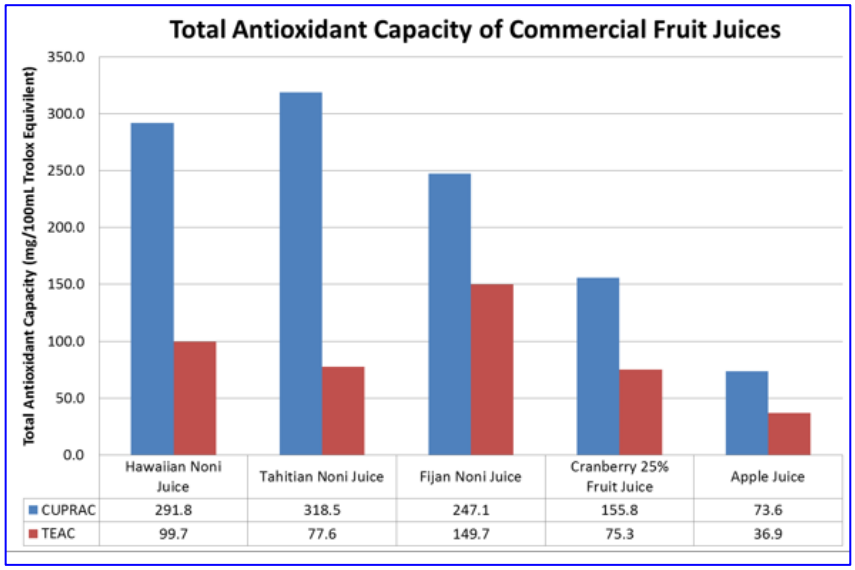


Figure 1: Comparison of the Antioxidant Capacity of different juice samples using two different analytical techniques: The CUPRAC and the TEAC

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Example 2: Line graph

- On the y-axis is the dependent value, which is *Average absorbance* at a wavelength of 450nm.
- On the x-axis we have the independent value mg of *Trolox* reagent/mL.

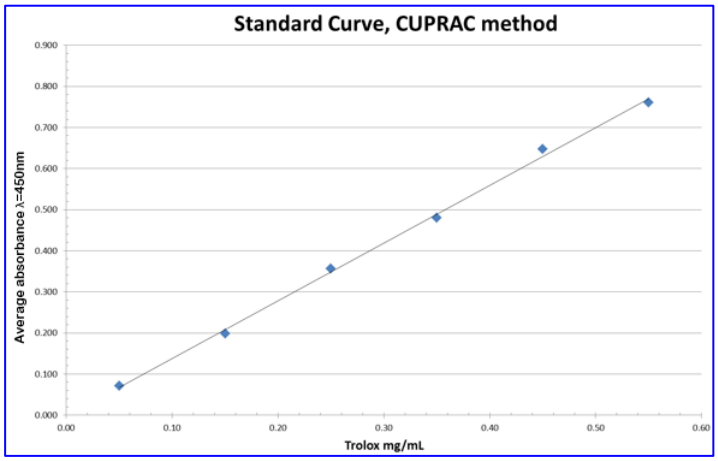

Figure 2: Standard curve of the Trolox vitamin E analogue vs. the average absorbance using the CUPRAC method for Total Antioxidant Capacity.

Discussion

To write a good discussion, you need to have researched previous knowledge on the topic and then compare and contrast this with your own results.

Discussion questions: Sometimes your lecturer provides you with additional questions to answer in your discussion. Include these where they best fit and creates the most natural flow. Try answering the following questions in your results:

- **Do your results agree with or dispute previous research?** Make sure you reference previous research and previous research values!
- **What might be some reasons for your results agreeing/disputing previous research?** Here you have to consider any limitations both in your own methods, and the methods previous research that you are comparing your results with.
- **Were there any limitations to your method?** Include any difficulties you encountered and any errors/potential errors in your experimentation or technique.
- **What do your findings mean?** What conclusions can you draw from your results, also considering what you already know of the topic?

Writing style and grammar: The Discussion can include a number of different tenses. You can use past tense in summarising your findings, then present tense to discuss the significance or relevance of your results. Use objective language and a passive voice for this section.

References: The Discussion should contain references where you discuss any previous knowledge or compare your results to those found in other studies.

Example: The results found that average blood pressure measurements were higher in participants who drank energy drinks regularly compared to those who did not. This supports the conclusion that regular consumption of energy drinks increases the risk for cardiovascular disease (Smith et al., 2003).

Conclusion

The *Conclusion* is a final paragraph of your discussion, where you summarise key findings from your *Discussion* and relate them back to your aim. The *Conclusion* should be short and concise. It is not a place to discuss your results. For example, if your aim was to find out how much dietary fibre was in breakfast cereal, your conclusion should include your value of the fibre content of said breakfast cereal.

The conclusion will vary depending on what type of report you are writing. It can be written as the last paragraph of the *Discussion* (without a separate heading), or with a separate heading following the *Discussion*. Confirm with your lecturer what style is preferred.

A conclusion should be a paragraph of two to five sentences, depending on the size of your research question.

Writing style: Write the *Conclusion* in past tense using impersonal language. Do not include any references in the Conclusion as you are not presenting any new information.

References

A list of *References* must be included at the end of your report, listing all the sources you refer to in the body of your report. Check your unit description for your disciplines

preferred referencing style.

Appendices

An *Appendix* is a section at the very end of your report that includes any relevant information that you did not include in the main body of your report. This could include raw data, calculations, drawings or photographs. The important thing to remember is to **keep it relevant**. If it does not add value to your report, you should *not* include it in the appendix.

If you have a lot of information to include at the end of your report, you can add several appendices. With multiple appendices, label them accordingly (Appendix A, Appendix B etc.), and refer to them where appropriate in the main body of your report. Any tables included in your *Appendices* should follow the same format as in the *Results* section.

Related helpsheets

- Report Writing - Tenses in Science
- Report Writing - Scientific (Brief)
- Writing in an Academic Style
- Paragraph Structure

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