Writing scientific reports

In this post we explore how scientific reports differ from general report writing, including structure, conventions and other key elements.

# Introduction

Scientific reports follow a specific structured format and includes a comprehensive description of technical or scientific research or experiment(s), including recommendations and a conclusion. A scientific reports purpose is to communicate information to other scientists.

“It is a specialized type of report that adheres to the scientific method characterized by attention to detail, reliance on test procedures, objective analysis, documented research, careful report and observations based on evidence”. (Smith-Worthington & Jefferson, 2011)

Scientific reports should provide the reader with clear instructions on how to replicate an experiment and ensure that the methodology can be examined, and the results validated whilst also using and reflecting upon existing literature.

# Conventions

Conventions in scientific writing are a strict set of rules which must be followed; however, the exact conventions can vary depending on the piece of work you are carrying out.

💡 **Tip:** Always check your assignment brief for the conventions you need to follow.

Scientific writing should always be straightforward, clear, concise and to the point. It’s very important with this type of writing to:

* Avoid ambiguous or misleading statements.
* Ensure the report is about the research and not the researcher.

We will go on to look at how to achieve this in the next section.

# Key elements of scientific writing

Let’s look at the important aspects of scientific writing:

## Your Audience

The purpose of your writing is to communicate your ideas to the reader who may be your supervisor or another scientist. It is essential that each part of your writing contributes towards your purpose and stays on topic.

Considering your audience (who will read your writing) is a useful step in the process of writing your report. What does your audience need to know? Who are they?

## Writing style

Objectivity is an essential part of scientific writing. Remember the aim of a report is to **clearly state the facts and the conclusions** that have been reached from the observation of an experiment. It is based on quantitative and or qualitative evidence. Any conclusion that you reach must be supported by the data you present in the report and linked to established research in the relevant scientific field.

Scientific writing is about detail so make sure you are precise in what you write and avoid ambiguous language that may be open to a different interpretation.

Scientific writing is also very concise in style. To achieve this, make sure you are focussing on communicating as efficiently as possible, avoiding elaboration where it isn’t necessary. There are a number of different strategies that you can use to write concisely including ‘**Short, relevant, critical**’ which are described in more detail in the ‘[Writing your main body](https://medium.com/my-learning-essentials/writing-the-main-body-6a14805bcdf7)’ resource.

## Using an active or passive voice

Scientific writing generally uses an active voice as this supports a clear, precise writing style. However, both the active and passive voices are useful tools with their own strengths which can be employed in your writing. Passive voice also has a role to play and can be used to help your writing flow more naturally.

Examples of active vs passive voice:

**Active: “We arranged the experiments.”**

This sentence emphasises the group carrying out the action.

**Passive: “The experiments were arranged.”**

This emphasises the person/group or object that is receiving the action.

Unlike non-scientific writing, a scientific report uses differing tenses across the various sections of the same report.

**Past tense** is used in the introduction, methodology and results sections of your report. It helps to indicate the experiment has already occurred. Here’s an example sentence:

“The aim of the experiment was to assess the effectiveness of a single covid vaccine on those aged 60 and above.”

**Present tense**is used in your report where you are writing about already established knowledge, referring to figures or within your discussions and conclusion sections. Here’s an example sentence:

“The graph below demonstrates the results that occurred over the specific time period of 1st May 2020 until 15th June 2020.”

💡 **Tip:** You may find in some subjects a small amount of future tense is used at the end of the introduction to show what is going to be done.

## Technical language

Definitions and abbreviations are used when referring to technical terms in your writing. The first time you refer to a word or phrase, its important to write it out in full followed by the abbreviated form or definition after it. This is also placed inside brackets as shown in the example below:

“Adenosine 5'-diphosphate (**ADP**)…”.

Once you have established an abbreviation you should then continue to use it throughout the rest of your report.

## Referencing

As with any piece of academic writing it is essential that you reference the sources you include in your report. References include a citation within the text of the report and a full reference at the end of the report following the conclusion and before the appendix. Sources that you reference set your work within the context of other published work.

Check your unit information for the referencing style that is required for the report.

Citations are generally located in the Introduction section to highlight the evidence for current theories or topics. They will also be found in the discussion section where they can be used to demonstrate how the findings from the experiment/research relate to the published literature. Links to further support on referencing can be found at the end of this post.

# Structuring your report

“Organization is essential for a well-written scientific document. The readers must know where to quickly find the information they seek, from the cover page to the reference list.” (Schulz, 2009)

There are different formats for a scientific report and IMRaD is one of the most recognised ones. It takes a rigid, structured approach to the format and is used extensively in the sciences including 4 distinct stages, the **I**ntroduction, **M**ethods, **R**esults**a**nd **D**iscussion. In this section we will discuss a slightly expanded **IMRaD** structure as shown below:

1. [Abstract](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#ae2a)
2. [Introduction](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#ab60)
3. [Methodology](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#b6ba)
4. [Results](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#e57c)
5. [Analysis and Discussion](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#77c8)
6. [Conclusion](https://medium.com/my-learning-essentials/writing-scientific-reports-e4083a918a63#bc2b)

💡 **Tip:** The requirements for a report can vary so ensure that you check your assignment brief and are aware of exactly what you have been asked to include. Some scientific reports assignments may also ask you to include a [literature review](https://www.escholar.manchester.ac.uk/learning-objects/mle/lit-review/).

## 1. Abstract

An abstract is a summary of your report. It tells the reader what you did, how you did it and what you found out in a quick glance. It’s best to write the abstract last, since you will be summarising each section of your report into a single paragraph.

### **Purpose of your abstract**

An abstract is often the first thing someone will read in your report. They will use it to become familiar with what’s in the report to help make a decision if it’s something they want to read in more detail (you can use abstracts in the same way when reading and researching for your own assessments!). Your abstract should tell the reader everything they need to know about your experiment.

If you are asked to write an abstract, remember they are an essential part of the report and are not something that can or should be rushed.

When writing your abstract, imagine you are describing your report to someone else, then consider what the key pieces of information they would need to know to understand the report as a whole.

If you are struggling to identify/decide the main point from each of your report’s sections, this may indicate you have not made this clear enough in the full report.

**Structuring your abstract**

Abstracts need to contain a lot of information **within a small word-count**. Having a set structure to follow can be really helpful in ensuring you include the information you need.

There are many different approaches to structuring abstracts and different approaches may work for different people and different types of work. We have included two different structures here that you may find useful. Try to experiment and find what works for you.

Structure 1:

1. The big picture of your report
2. Gap(s) in the literature
3. How your work fills this gap
4. Your original argument and strong concluding statement

Structure 2:

1. Introduction (Your main objectives and hypothesis)
2. Methods (what you did)
3. Results (what you found out)
4. Discussions (what you think it means)
5. Conclusion (what you learned)

An abstract is normally one paragraph in length and roughly around 200–300 words. Therefore, each point should be no more than 1–2 sentences.

## 2. Introduction

The introduction section of the report should inform the reader why the paper has been written. It should include sufficient background information so that the reader can understand, evaluate and potentially replicate the experiment.

Before you start writing the introduction, reflect on these two questions:

* What is significant or interesting about your experiment?
* What was the reason that the investigation was carried out?

The introduction will:

* Introduce the research problem and why it is important.
* State the question being asked and the hypothesis e.g. what you expect the results to be from the experiment.
* Cite the scientific literature relevant to the problem.
* Identifies research gaps.

💡 **Tip:** the introduction to your report is not the section for detailed explanation: the detail will be included in the later sections.

## 3. Methodology

The methodology tells the reader **how you conducted your experiment** or study in enough detail to allow the reader to recreate it. Your methodology also needs to include a **discussion** of **why**you conducted it in that way.

💡 **Tip:** The Academic Phrasebank has a useful section on words and phrases to help you [describe and discuss your methods](https://www.phrasebank.manchester.ac.uk/describing-methods/). As you have already conducted the experiment, the methodology section should be written in **past tense**.

To explain **how**you conducted and analysed your experiment, you should include appropriate details which may include:

* When and where the experiment or study was conducted.
* Description of the study site (if you did field work), including: physical or biological features.
* The materials and equipment you used, including the number of materials and technical specifications of your equipment.
* Experimental or sampling design, including how the experiment was structured, the constants and variables.
* How you handled the materials.
* How you collected data and the type of data you collected i.e., qualitative, quantitative, mixed.
* How you analysed the data (qualitative analysis, statistical procedures, mixed methods and details of any software used)

To explain **why** you conducted and analysed your experiment in the way you did you should include:

* References to appropriate literature that supports your decisions.
* Discussion of the benefits and limitations of your methodology.
* Where relevant, explanations of why you **did not** take certain decisions or actions.

**Structuring your methodology**

The methodology is usually structured chronologically or sequentially in order of when you performed each step of your experiment.

💡 **Tip:** [Transition phrases](https://www.phrasebank.manchester.ac.uk/signalling-transition/) are particularly helpful in this section of your report.

Using subtitles to help guide the reader through the different stages of your experiment may also be useful in this section of your report.

## 4. Results

The results section (sometimes called data or findings) details the data you collected and answers the question: ‘what did you find out?’

Your results section should give an impartial outline of the data. In this section, you will usually present the reader with:

* **A concise and accurate description of the results**written in the **past tense.**
* A **combination of text and visual elements** such as diagrams or charts or drawings. Visual elements showcase your data making it easier for you and your reader to see patterns or other key findings in your data. Avoid repeating the same information in both your text and your visuals. They should complement one another, not repeat each other.
* **Negative results** or data you didn’t expect or that seems to disprove your hypothesis and any **unusual correlations** you noticed in your data.

Your results section **should not include any discussion or explanation** of results or present your interpretations of the data. The analysis and conclusion sections gives you a chance to explain what you think your findings mean.

💡 **Tip:** The [‘Reporting Results’](https://www.phrasebank.manchester.ac.uk/reporting-results/) section of the [Academic Phrasebank](https://www.phrasebank.manchester.ac.uk/) has lots of useful sentences and phrases to help you describe your data.

The structure for your results section may look like this:

1. Short introduction.
2. Summarise the main finding from your study.
3. Summarise the general findings / trends from each of your visuals / figures in separate paragraphs.

💡 **Tip:** It is better to present your results in order of importance, rather than in order you conducted experiments in. Remember to pay close attention to detail when presenting numerical data.

## 5. Analysis and discussion

The analysis and discussion section is where you will provide critical analysis of your results, written in the present tense. In this section you will tell the reader what you think the results mean and why you think they are important including:

* Explanations of what your results mean and why they matter. Including discussions of evidence that both supports and rejects your original hypothesis.
* Possible alternative explanations for your results and discussion as to why you feel your interpretations are more credible and/or reliable.
* Discuss any inconclusive results and their significance.
* Comparison of your results to other relevant studies/research. Including references to and discussions of appropriate literature which how where/how your experiment and results agree or disagree.
* Ideas and suggestions for future pieces of work; some report structures may ask you to put these into a specific ‘further work /future directions’ section.
* Discussion of any limitations in your overall study which may have effected or impacted upon your findings and conclusions. For example, discuss what your results can’t tell us.
* Suggestions for how your findings can be applied.

However it is important your analysis and discussion section does not present the reader with new pieces of data not included in your results section. You should also try to avoid simply repeating your results without analysis and overusing jargon.

**Structuring your analysis and discussion:**

There is no definitive structure for an analysis section. It is important to consider about what works best for your own study and the findings you wish to discuss. However you may want to consider:

* Structuring your analysis and discussion in order of **most to least important conclusions.**
* Using subheadings to help structure your analysis and discussion around your different conclusions.
* An inverted pyramid structure where your discussion section progresses from the general to the specific analysis.

## 6. Conclusion

The conclusion is a paragraph that summarises the results and discussion sections of the report and its where you highlight what you think your research has demonstrated and what you have learnt from it.

💡 **Tip:** The conclusion can be included within the discussion section or as a separate section depending on the guidance you have been given for the report.

Your conclusion is a brief section at the end of your report, not a long piece of writing so remember to write clearly and concisely. Considering the following questions may help you structure your conclusion:

* Why did your carry out your experiment/study? What was the question being asked?
* What was your main finding and why is it significant?
* Where they any limitations of the study?
* How have the results of the experiment improved your understanding of the problem? What have you learnt from the process?

It’s not a prerequisite for the conclusion but you can refer to further experiments that would be useful in relation to your experiment. However your conclusion should not:

* Duplicate your abstract.
* Lists results from your experiment.
* Introduce new arguments or evidence.
* Repeat the analysis from the discussion section.

# Summary

In this post we explored the conventions, key elements and structure of scientific reports. This post is written as a guide to support you with your assignments; it is important you refer to guidance provided by your school or academic for specific referencing styles and possible standard report structures you may be required to follow in your work.

We have collated the key information you need to include in each section of your report as a downloadable checklist, you can find this and other related resources in the further support section below.

## Reference list

* Smith-Worthington, D. and Jefferson, S., 2010. Technical writing for success. Cengage Learning.