Flinders University

SLSS

WRITING AN ARGUMENT

PURPOSE

The purpose of a report is to interpret, explain, and disseminate knowledge through the investigation of a hypothesis. A report is an argumentative piece and the discussion of results serves to justify your conclusions. For a university assignment, this generally requires you to demonstrate your understanding of the results you have obtained and how they relate to a theory you are learning or a research question you have been given.

Those reading reports also have their own goals: to gather information and gain satisfaction that the findings are legitimate – that they are well supported by the evidence presented. Therefore, the way you explain the interpretation and significance of your results is key to helping your reader understand the data or conclusions you are presenting, as well as where you are in your learning journey.

When discussing your results, there are three main questions to consider:

1. Does the data support your hypothesis?
2. What are the implications of your findings?
3. What are the potential limitations of the experimental design and conclusions drawn?

ADDRESSING & EVALUATING THE HYPOTHESIS

Often, a clear way to begin the discussion is to explain whether the data supports the hypothesis. Using this as a starting point helps to create a logical progression of ideas in your discussion. Ask yourself: what happened? Why? What does it mean?

When speaking directly to the hypothesis, remember that experiments, especially those that are done over a limited amount of time with few replicates, are used to *support* or *indicate* a truth, not to *prove* a truth. Therefore, use words like **supported** or **indicated** and avoid the use of **proved**/**disproved** or **correct**/**incorrect**.

When making these claims, remember that they must be based on evidence (data) and be defensible. Explain **how** and **why** you have reached the conclusion: the clearer you make the connection between the data and the claims you are making, the stronger your argument will be.

HOW TO DISCUSS DATA (FIGURES AND TABLES)

When discussing your results, think about how you can help your reader understand the data you are presenting. Think about the data in the context of the experiment or trial you have conducted, the process or theory you are studying, and previous work in the field.

HOW TO REFER TO DATA

- Refer to tables as tables and all other images (graphs, photos, schematics) as figures
- Refer to all figures, tables, equations and calculations in-text when discussing them (e.g. Figure 1 shows that…)
- Place figures, tables and equations immediately when they are first mentioned in the text (unless instructed otherwise)
- The figures should stand alone (this means they can be easily interpreted and understood by reading the figure caption), but the discussion should **explain** the interpretation and significance of these results as they relate to the aims outlined in the introduction

SEE THE GUIDE ON USING TABLES AND FIGURES

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EXPLAIN THE TRENDS OBSERVED

Here is where you discuss what the data is showing. Rather than simply describing a graph or figure, look at the big picture: explain what you want your reader to see when they look at the figure and what the takeaway message should be. You will have already provided a figure caption with the description, so avoid the temptation to repeat yourself.

For example, if you are monitoring weight increase over a weeklong period, rather than stating the specific weight gain for each day, look at the overall trend: is it linear, exponential, or oscillating?

> 'Despite an overall increase in weight, there was no discernible trend in weight gain across the week measured (Figure 2).'

RELATE RESULTS TO THEORY

In the academic community, results are reported to create conversation and build on existing knowledge, and are therefore clearly linked to the literature. You need to do the same in your assignments. Use theory to reason about the trends and results observed and demonstrate your understanding of the big picture.

DISCUSS THE IMPLICATIONS OF THE RESULTS

It is important to explain why your results are significant. This is often a great way to end your discussion of the data, whether that be the discussion of a single figure or the entire section, as well as link your findings back to the hypothesis or aims. Discuss the consequences your findings have for the field or phenomenon you are investigating and link it to the literature.

The ending of the report can be based on further theoretical understanding. For example:

> 'Understanding how this mechanism works on a molecular level will allow a deeper understanding of the collective behaviour at play.'

Or, discuss further practical applications:

> 'This system can now be scaled up to successfully manage incoming student admissions at a faculty level.'

WHEN THINGS DON'T GO TO PLAN

SUGGESTING IMPORVEMENTS TO THE EXPERIMENTAL PROCEDURE

Suggesting improvements to the experimental design demonstrates your understanding of the experiment and the data you have collected. However, avoid outlandish or unlikely reasons for the weaknesses in your experiment and avoid blaming others such as lab partners. Consider:

- If you had an opportunity to conduct the experiment again, what would you do differently?
- Is there anything you have learnt that would help you to collect accurate or effective data next time?

HOW TO DISCUSS UNEXPECTED DATA OR OUTLIERS

There is a temptation to simply label unexpected data as 'outliers' and ignore them in both your interpretation and discussion. However, you must acknowledge any anomalous data or unexpected results and explain why/if you have chosen to omit them from your analysis. Remember that any time you deliberately ignore data that doesn't fit into your narrative, you are altering and skewing your results.

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THE STRUCTURE OF DATA DISCUSSION

The following examples demonstrate how to describe trends or results observed in the data, as well as the reasoning for this (theory), and the implication(s) of the result.

EXAMPLE ONE: LINKING TO PRACTICAL IMPLICATIONS

Trends or results observed

Reasoning for this (theory)

Implications of the results

The growth rate of plants with increased Azospirilla and Pseudomonas concentrations at the rhizosphere can be seen in figure 2 to be up to three-times higher than those with lower bacterial concentrations over the 2 months measured. This may be due to the crucial role nitrogen fixing and root-disease supressing bacteria play in plant health, with increased bacterial presence working as a natural fertiliser (Flinders University, 2021). While the results of this study are limited to the growth of a single plant species, understanding the role of bacteria in the rhizosphere may lead to more efficient use of Plant Growth-Promoting Rhizobacteria across a broader range of flora, and a reduction in the need for artificial fertilisers or pesticides.

EXAMPLE TWO: LINKING TO THEORETICAL IMPLICATIONS

Trends or results observed

Reasoning for this (theory)

Implications of the results

As shown in figure 7, the addition of NaOH to HCl increased the temperature of the solution from 20°C to 40°C over 1 minute. This is due to the exothermic reaction of a strong aqueous acid and a strong aqueous base to create the neutralised solution of NaCl, water and energy (as heat) (Flinders University, 2021), represented by Equation 1,

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H2O_{(l)} + heat$$

Equation 1

Potential energy in the breaking and creation of chemical bonds as well as the transfer of kinetic energy from newly formed water molecules to existing water molecules, demonstrates a conservation of energy (Silberberg & Amateis, 2020); energy which cannot be created or destroyed but was exchanged and released as heat (Brown et al., 2013).

Take note of the use of references in the discussion of results above. These are used as evidence to support the conclusions and implications made.

You'll note that the above examples use the third-person passive voice in the past tense. Scientific writing should be **clear, concise,** and **specific.**

SEE THE GUIDE ON WRITING STYLE

REFERENCES

Brown, T. L., LeMay, E., Bursten, B. E., Murphy, C., & Woodward, P. (2013). *Chemisty: The Central Science* (Vol. 3). Pearson Education Australia.

Flinders University. (2021). *CHEM1234 EXAMPLE Essential Chemistry Course Book*. Flinders University.

Silberberg, M. S., & Amateis, P. (2020). *Chemistry: The Molecular Nature of Matter and Change* (Vol. 9). McGraw-Hill Education

The term 'argument' is used in everyday language to describe a dispute or disagreement between two or more people. However, within written academic work, the presence of an argument does not always indicate a disagreement. An argument can be used to:

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- Support something we think has merit – a position, a point of view, a program, an object.
- Persuade someone that something would be beneficial to do (or not to do) – a course of action.
- Convince someone that something is true, likely to be true or probable – a fact, an outcome.
- Show someone the problems or difficulties with something – a theory, an approach, a course of action.
- Reason with someone to get them to change their mind or their practice.

In its most basic form, an argument is **a claim (or conclusion) that is supported or justified** by at least one **reason.** The supporting statements of an argument are called **premises.**

An argument is NOT:

- a statement of fact (i.e. 26.7% of Australians prefer dark chocolate.)
- an assertion or claim (i.e. Wearing a seatbelt reduces the risk of injury.)
- a prescriptive statement (i.e. The Government should spend more money on healthcare.)
- a conditional statement (i.e. If you drink too much alcohol, you will damage your brain.)
- a series of statements about the same thing.

An argument IS:

- a group of statements of which one is a proposition or claim that is supported by at least one of the other statements

For example:

CLAIM PREMISE PREMISE

Drinking water daily is good for your health as it cleanses out your liver and reduces the level of toxins in your blood.

THESIS STATEMENT

These elements come together in your thesis statement. A thesis statement tells your reader your position and how you will argue it. It acts as a roadmap for your writing, showing the reader **the structure of your argument.**

For example: The death penalty should not be restored in Australia due to the discriminatory nature of capital punishment, the fallibility of proving guilt in criminal cases, and the violation of the most fundamental human right – the right to life.

SEE THE GUIDE ON INTRODUCTIONS FOR MORE

WHAT MAKES A GOOD ARGUMENT?

The **purpose** of an argument is to convince others of whatever you are asserting or claiming. You do not need an argument to simply describe something, list items, explain how something works or identify key points or factors. However, you do need to use an argument when the point you are making may be not well

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known or not well accepted (not obviously true), or where you know there is some disagreement or alternative perspective. In these cases, we need to provide reasons to support our position.

A good argument should be convincing. You should find yourself believing the claim, or at least finding the conclusion reasonable. This entails several things:

- acceptable or reasonable premises (likely to be true)
- evidence or reasons that are relevant to the claim
- reasons which provide sufficient grounds to lead us to accept the claim.

These are called the acceptability, relevance, and grounds of an argument. If an argument satisfies these three conditions, it is likely to be a good argument.

HOW DO I WRITE AN ARGUMENT?

1. Ensure you **understand the question**. What do you have to do? What issues do you need to cover?
2. Do your **research**. What do we know about this issue? What do the researchers say? What are the debates, the problems?
3. Go back to the question and consider your answer, given your research and what you have learnt. This will be your **claim**. Make it very clear what position or point of view you are taking.
4. How will the evidence from your research support your case?
   - Integrate supporting evidence by **quoting** and/or **paraphrasing**.
   - Acknowledge counter arguments/counter evidence.
   - Use linking words and discourse markers to draw connections between your argument and the evidence and/or counter evidence.
5. Argue for this position in an academic context. Consider your claim and supporting premises and draw out the implications:
   - Why am I saying this here?
   - What point am I trying to make?
   - What does this evidence show?
6. Make sure your essay has **a clear, logical structure** with relevant points which lead to the conclusion. It should be easy for your readers to follow where you are heading and why.

You will need to decide how to put forward your point of view in a reasoned and objective way. What made you come to this conclusion? What did you find convincing? What did you find problematic? These will be the reasons that justify your conclusion. If you found the reasons convincing, so should your readers.

! *Remember to acknowledge all the sources of your information throughout your paper and in your reference list.*

SEE THE GUIDE ON USING THE RIGHT LANGUAGE FOR MORE

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SAMPLE ARGUMENT

The Smart Pill – a critique

(adapted from Super-Pill To Get Students' Brains Into Gear, Jeremy Laurance, London)

Debilitating mental diseases like Alzheimer's and other forms of dementia have a huge social and financial impact. [background issue/broad context] As a consequence, scientists have been trying to find a cure by developing drugs that slow mental deterioration and enhance memory retention. According to researchers (MacNally 1998; Jones 2001) more than 200 chemical compounds that will boost memory and learning ability are currently being developed by pharmaceutical companies. [current state of research] If successful, the application of the drugs could be much broader than just the treatment of dementia. Professor McGaugh (2001) claims that the new drugs will have a wide appeal to students sitting exams and 'ambitious workers wanting an edge over their rivals' (p. 74). [implications]

There seems to be some evidence that a 'smart pill' is a possibility. Experimental trials of a new class of cognitive enhancers, called ampakines, have supposedly had positive results without the severe side effects. [positive case] Current research (McGaugh 2001) indicates that rats taught to avoid one part of a maze by electric shock treatment remembered the information up to a month afterwards when given the drug, compared to the control group which forgot within 24 hours. Ampakines have also had 'remarkable effects in humans' (McGaugh 2001, p. 75). [supporting evidence]

However, these claims need to be treated with caution. [negative case] The Chair of CIBA Foundation says that of the 140 'smart pills' already being sold in California, none were effective and some were actually hazardous. One cognitive enhancer, Tacrine, has produced only modest effects – slowing mental deterioration by just six months – while its side effects, such as liver damage, have been very severe. [supporting evidence] While ampakines are supposed to have reduced side effects, there is little information on what these are and as yet no confirmation on the supposed remarkable effects in humans. [counter-argument]

While the idea of a 'smart pill' is likely to be popular with students and high achievers, there is little evidence that such a pill exists, and especially one without risk. [summarising reasons against] At the same time, all the current research is focused on enhancing memory retention. While this would be beneficial for dementia sufferers and those with Alzheimer's, it will only be of limited use to the normal person, i.e. enhancing short-term memory during a specific task. [implication] Being smart entails more than just retaining information. The benefits of a smart pill, should it be developed, will be very limited and unlikely to be worth the risk. [conclusion, claim]