**SCIENTIFIC REPORT GENRE**

**How to write a science report**

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**INTRODUCTION: *What is the theory behind the investigation? What question do we want to answer?***

In some ways the introduction is the most important part of the report – if you do this well, the rest of the report will be much easier to do - because you understand what is happening. The opposite is also true, if you do a poor introduction the rest of the report will also be poor because you can’t see the big picture.

There are two main parts to an introduction.

The **first** part explains the theory behind the investigation. Your first sentence should be a general statement of a scientific theory. Then you should explain or elaborate the theory - sometimes in order to keep the first sentence quite simple you can’t explain yourself fully, so do this in the next few sentences. Then link this theory to your investigation – that is - explain exactly what aspect of this theory you will be investigating.

The **second** part of the introduction describes what you will be doing. This will include which a paragraph briefly describing how you will perform the investigation (not a list of steps, do that later in your method). Explain what variable you will be deliberately changing (the *independent variable*) and how you will be changing it. Also describe the variable you will be measuring (*dependant variable*), as well as the variable which you will be controlling, or keeping constant (*controlled variable*).You could put the information about the variables in a table at the end of the introduction

**TITLE: *What do we want to investigate? What question do we want to answer?***

The title should only be a few words.

**AIM: *What is being investigated?***

An aim is usually one short sentence that directly states the objective of the experiment – it tells you exactly what you are trying to prove by doing the experiment. An example would be:

*To investigate (or measure) the effects of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

**HYPOTHESIS: *What do we think might happen?***

The hypothesis is connected to the question you are trying to find an answer to. The hypothesis is a *testable prediction*. In scientific language this means that a hypothesis will predict some sort of relationship/connection between what we change (independent variable) and what we measure (dependent variable) – it tries to predict an answer to the AIM. A very good hypothesis might provide a reason for the prediction.

A simple hypothesis could be:

*The change in \_\_\_\_\_\_\_\_\_\_\_\_\_ will cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This should happen because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

**PROCEDURE: *How will we conduct the experiment? What equipment will we need?***

A procedure is a series of number steps someone else can follow to replicate your experiment. The steps must be very clear but not too basic (for example - don’t say collect the equipment). Before you write a procedure you must have seriously thought about the following three questions:

* What variable are we going to deliberately change *(independent variable)* – how will we do this?
* What variable are we going to measure *(dependent variable)*, how will we do this?
* What variables are we going to try to keep the same *(controlled variables)* each time?

Once you have answered the three key questions above you should have a bit of an idea of what you have to do and what equipment you will need.

Write out a step-by-step guide to what has to be done to complete your experiment – this is your procedure. You must number the steps so that they form a list of instructions. Use present tense (picture yourself doing each step) and avoid using “we” or “I”. This is called passive tense.

Write a list of equipment you will need (use a subheading – Equipment or Materials).

A diagram is a good idea as you can refer to it in your procedure and save yourself a lot of writing.

A good simple diagram is an easy way to show a complicated set-up of equipment and can make it easier for the reader to understand what to follow. Diagrams of science equipment are drawn in two dimensions **(**i.e. no depth) and are called line drawings. Some rules to remember are:

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| * Diagrams drawn in black pen/pencil.
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| * Straight lines should be drawn with a ruler.
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| * Labels should be printed horizontally.
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| * No colour or shading.
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**RESULTS: *What data has to be written down? How do I organise it?***

This section is where you record what you have observed and/or measured in the experiment. It must be organised and usually the data that is collected is put into tables (there could be more than one table). Almost all data will fit into a table, even observations can be organised this way.

**Table 1** – Extension of a spring when mass is added



Each table should have a title – such as Table 1, etc. Each column in the table should have a heading - if the data in the column are numbers then the units should be written with the heading – eg, if you measure the length of a shadow – the units would centimetres (or cm).

If the data are numbers (we call this quantitative data), then you may be able to show them on a graph. Many graphs are really just a nice picture of the actual numbers (eg bar graphs or pie graphs – so we do not use these a lot in Science). The main type of graph used in Science is a Trend line graph – a line graph where the trend is shown as a smooth straight or curved line (the data is NOT joined dot to dot). A lot more detail about graphs is given in “Graphing Analysing, and Concluding”.



**ANALYSIS: *What does the data tell us? Did we make any errors?***

An analysis is where you interpret the data you have collected. There are two main reasons for this, so there are **two** main parts to an analysis.

The **first** is to identify and interpret the overall patterns evident in the data.

* This part starts with a simple statement which describes a trend you see in the data. Describing a trend is as simple as stating a pattern you observe in the data – you do not explain what this trend means (that’s a conclusion).
* You should then quote specific data from the table or graph which are evidence of your trend.

If there is more than one trend in the data you have more than one paragraph here.

The **second** part of the analysis is to identify errors in the data. There are many ways to do this – but the main ones are outlined below in a table.

* This part of the analysis starts with a statement about the amount of error you found. Some examples are - The data appears to contain… “very little”; “insignificant”, “minor”, “significant”, “considerable”, “ a single instant of major”, ‘excessive’…error.
* Once you have made this statement you need to explain why you think this, using one of the three methods explained in the table below.
* At the end of this paragraph you will need to make a statement about whether the amount of error affects the validity of the results or conclusion you reach from the results. This is a pretty easy decision if you have claimed “very little” or “insignificant” amounts or error – you can say your results appear valid along with any correctly drawn conclusions. It is also easy if you have claimed “significant”, “considerable”, or ‘excessive” error – you can say the results are NOT valid and the conclusion based these results are not likely to be correct. If you have claimed “minor”, “a single instant of major” error – you will have to make a judgement on the overall validity of the results.

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| Type of Data | How to decide on error |
| **Observations** (words, not numbers) | * Does the data make sense? Does it agree with what you expected? If your observations seem a little weird then you could say you have error. How much error depends on how “odd” or “unexpected” your observations are.
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| **Numbers**(but not on a trend line graph) | * Same as above but ALSO…
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| * If you know what the numbers are supposed to be, you could calculate the amount of percentage error by comparing the numbers you measured with the value the numbers were supposed to be.
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| **Numbers**(and put on a trend line graph) | * How close are your data points from the trend line? If a lot of the data points are away from the trend line your data is “inconsistent”, and your experiment has a ‘significant’ degree of error. If the data points are quite close to the trend line you have “insignificant” error. Any data points that are a long way from the trend line are examples of “major error” - but if there is only one then you can redraw the trend line while ignoring this point. Mention you have done this in your analysis section about error.

If you do the trend line graph on excel, the excel program will calculate an R2 value which measures the “closeness” of the points to the trend line. An R2 value of greater than 0.95 is acceptable as insignificant error. |
| * Interpret the trend line direction and shape - does the trend line make sense? Does it agree with what you expected? If it does not then you have either discovered something new or you have error. Like above, the amount of error depends on the “oddness’ of the trend line.
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**CONCLUSION: *What does the experiment prove? Can we explain the errors?***

The main reason for a conclusion is to sum up your major findings, relate them to the theory you were investigating, and to explain errors. The conclusion is generally not very long and uses a lot of the same ideas you have already outlined in the analysis.

There are three main sections to the Conclusion.

The **first** section of the Conclusion explains what you have discovered in the investigation.

* To start this section you write a simple statement concluding what you have discovered (your conclusion) in the investigation. This statement will be based in the trend you wrote about in your analysis (in the analysis you described the trend whereas in the Conclusion you tell us what the trend means).
* In the next sentence(s) you should explain or elaborate if you need to (sometimes in order to keep the first sentence quite simple you can’t explain yourself fully, so do this in the second or third sentences).
* In the sentences after that, quote data (from the results table or the trend line graph) which supports the conclusion you have made. To finish this section explain how your conclusion relates to, or agrees with the theory behind the investigation (you have written about this in the introduction).

If you have more than one conclusion to make, you may need more than one paragraph for this section of the Conclusion.

The **second** section of the Conclusion concerns the errors in the experiment.

* You have already identified how much error there is in the analysis, so use this to write a simple statement about how much error is in the experiment.
* After this you have to explain how this error occurred. Generally your argument will depend on whether your error is systemic, or episodic (see the table below). Once you have explained how the error occurred, make recommendations to improve the procedure.

The **third** section of the conclusion sums up the investigation.

* State the main conclusion you found.
* State the degree of error you had and the main reason for it.
* State if the conclusion you made was consistent with the theory behind the experiment.
* State whether the conclusion is valid (little error) or if further investigation with a modified procedure is required (lots of error).

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| Type of error | What is it? How do you tell? |
| Systemic error | Systemic error is built into your procedure - an error which occurred again and again. If you have systemic error the trend line does not agree with what you expected to find, BUT your data points on the graph will generally be close to the trend line. In other words, your main conclusion is not correct, but the data looks fine. To figure out what caused your systemic error you have to examine the logic behind your procedure – this is the hardest type of error to explain. |
| Episodic error | Episodic error is easy to identify. The word episodic refers to “a single episode” of error – you did something wrong once, but did it correctly other times. This causes data points to be “not close” to the trend line. Any data point which is not close to the trend line is an instance of episodic error. If quite a few of your points are not close to the trend line, then you have a lot of episodic error – your laboratory technique is quite bad. To figure out what caused the episodic error you need to look at the data and reflect back on the techniques you used to measure it. |