7.5 Introductions

The introduction to your research paper sets the tone for the rest of the work. It does an important job. It tells the reader, marker or reviewer the motivation, rationale and any information they need to understand your study. If you do it well, the introduction will make your readers eager to read the whole paper. Hopefully, the introduction will also establish a favourable opinion, this will be advantageous as they continue to read the rest of the document.

Paper vs Thesis

Most of this section of the book refers directly to introductions to short format writing (i.e. research papers). The major difference between the different types of writing is, obviously, length. However, the core concepts hold true in either format. The single biggest point is that an introduction should have focus, it should prepare and lead the reader into your work. Anything that isn't relevant to your study should not be in there, even in long format writing.

Big Tip

This is the introduction to your story, not a general recap of the whole field.

Objectives of an Introduction

Whenever I ask a new writer what the purpose of the introduction to their research paper is, they say that it's to tell the reader all the information needed to be able to understand your work. This is partly true, but it is better to think about your introduction as fulfilling the following four objectives:

1. **Motivation:** establishing the wider context of your work and why it matters to the world. This should be framed such that the reader will care.
2. **Mapping the Gap:** Define the specific area that *your* work contributes to, what *wasn't* known before you begin. You should define the problem your work addressed and where your work *adds value* to the established literature.
3. **The rationale for your hypothesis:** provide enough of the detail from previous studies to make it clear why you formed the hypothesis that you went on to test. Ideally, presented in a way that a reader would also form the same hypothesis.
4. **Basis for discussion:** your introduction needs to lay the foundation for any points that you will bring up again in your discussion. This final point is why you should write and plan the introduction and discussion together.

The biggest difference between a good introduction and an OK one is that the OK introduction just tells the reader things that are known but doesn't really tell them why they need that information. In contrast, a good introduction frames all the information being delivered in a way that connects it to the study, highlights what *wasn't known* and establishes why knowing the answers would be valuable. It helps the reader to clearly see where they are going. If you write your introduction well, your readers will want to know

the answers to your study questions.

Plan your story before you start

One point before you begin: before you can write an effective introduction, you need to have a clear idea what the main story of your manuscript will be. In essence; what is it that you are introducing? Without a clear direction, it is very likely that you will write an unfocused and overly long introduction. For this reason, it is usually best to write the introduction after you have drafted the results. In addition, you should always be thinking about your introduction alongside the discussion.

While the advice of writing the introduction near the end is undoubtably good, I have supervised enough students to realise that everybody wants to get started as soon as possible. So, what should you do? Well, you will have a good idea of the broad topic area from early on in your work. This means you can do the required background reading and take notes of the important things you want to introduce or that you think you will discuss. In your introduction you will not need to cover the entire literature, everything needs to be connected to your work. Therefore, while reading and note taking, identify how each paper connects to your study question or data interpretation.

Make sure everything in your introduction is directly relevant to the studies that you have performed

Once you have read everything, your next step is to sketch out a framework for what you think the contents of your introduction will be. Later you can come back to fleshing out the text once the rest of the pieces of the story are in place.

Introduction Structure

Recommendations

If you are writing for a specific journal or assignment, check the instructions. If there are not definitive guidelines, then I recommend the following for a research paper:

~1 single-spaced page = ~400-900 words
3-5 paragraphs
No subheadings

The standard way to organise an introduction is to start wide and become more and more focused and specific as you move through. When deciding exactly how wide to

start, think about the journal target audience; the introduction for a multi-discipline journal will need to start wider than a manuscript for a more specialised area. Note that the biggest problem new writers tend to have is that they make the introduction too long by either starting too wide or going into too much detail in areas in non-essential areas. Make sure you stay relevant by asking yourself "would it matter if I didn't include this sentence" and delete anything you don't need.

Think about who you are writing for and how they will absorb your work. Writing in an accessible way is good for everybody, so although you will focus on your target audience and use language that they are comfortable with, you shouldn't be aiming to make your work dense just to sound clever.

Be aware that established researchers in the field will already know most, if not all, of the content in your introduction. These readers are likely to skim read your intro and progress rapidly to the main story. Skim readers often only read the first and last line of each paragraph, absorb that point then move on. Make sure these "topic" and "wrap" sentences in each paragraph work to advance the story and are sufficient to set the scene.

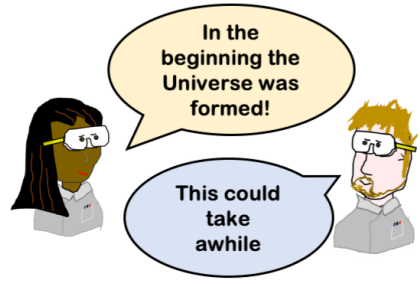
Big Tip

Include a keyword from your title in the first sentence.

Paragraph One- Motivation and Big Question

Opening Sentence

By the end of the first paragraph your readers should have a good idea what the big question is, why they should care, and why they should keep reading. You need to be on message right from the start or your work will feel unfocused. If you have not written a draft of your title yet then jot one down now, it will help everything else fall into place. The **first sentence** of your first paragraph should include one of the keywords from the title.



Don't start your introduction too wide. Use a keyword from your title in your first sentence to help you focus

Open your introduction with a big impact statement. If your study is *directly* related to a specific disease or tissue function, then these are the easiest to write in a way that will connect with the reader very rapidly. However, if the work you have done is not directly related to the disease but instead is focused on the function of a specific protein family or providing mechanistic insight, then your opening should introduce the protein family in the first sentence then come back to the disease-relevance later.

If you follow this first sentence rule, you will be on message right from the start and thereby avoid adding an extra paragraph of unnecessary super wide information.

Real example first sentences

Paper on tendon stem cells.
Tendon is prone to injury and degeneration, and this is often seen in occupational and sporting environments.
Lee, K.J., Clegg, P.D., Comerford, E.J. et al. BMC Musculoskelet Disord (2018) 19: 116.

Paper on a basement membrane protein.
The alveolar compartment of the lung contains a unique basement membrane, which is shared between epithelial and endothelial cells.
Urich, D., Eisenberg, J.L., Hamill, K.J. et al. J Cell Sci (2011)124(17): 2927-2937.

Paper on genetic causes of atopic dermatitis.
Atopic dermatitis (eczema) is a common inflammatory skin disease affecting 15-30% of children and 5-10% of adults.
Paternoster L., Standl, M., Waage, J., et al. Nat Genet (2015) 47(12) 149-1456

Have a look at some opening sentences in papers in your discipline and you should see a similar trend.

Sentences 2-5

The next two or three sentences of the first paragraph should expand on the opening point to establish the motivation behind the work by making big picture comments about where the problem or lack of knowledge lies. For example, most introductions about a disease will mention the effect it has on people's quality of life, how many people are affected, and what it costs to treat. They will then close by pointing out where there are challenges, such as a lack of effective therapy or an area where there is incomplete understanding.

In terms of references, many of the statements in these sentences will be quite general so it will be appropriate to cite a few good review articles. Reference work from different authors, both competitors and collaborators to give a broader coverage of the existing literature. Of course, any very specific comments will need the appropriate primary data reference and you should not cite a review if the point you are making comes from a single original source.

Paragraph 1 wrap sentence

The end of the first paragraph should tell the reader where you are going to take them. The last sentence should say something like "In this study, we attempted to answer ...". You don't need to use those exact words, but the last line should capture that sentiment.

Big Tip

In the last sentence of first paragraph point out a problem or hole in the knowledge that your research paper will address.

Paragraphs Two, Three and Four

Now that you've established the big picture, the overarching goal of the project, you can start to go deeper, moving toward the specific questions your study addressed.

Before you begin, write down what you need the reader to know. This is not a list of *everything* that you know, but rather on the information that is relevant to your current story. Put your list in order of importance then take the most important points and turn them into the topic sentences. Remember topic sentences are generally accessible and won't rely too heavily on specific pieces of information. Do this so that you don't lose focus. You don't want to go off track here if something is just an interesting aside it probably has no place in your introduction.

Next, order your topic sentences from broad to narrow. You should be constantly building toward the goal of establishing your specific, narrow research question. These middle paragraphs are also where you drop in the details that will refer to again in the discussion. Once you have ordered the topics, all you need to do is use this framework to assemble the rest of the story. Most of the citeable material, the info that has come from preceding studies, will appear in the body of the paragraphs and should presented and ordered that connects them to the topic sentence.

Throughout the second, third and fourth paragraphs continue to "map the gaps" in the literature addressed by your work. As you progress through the introduction the statements should become more focused and should emphasise the value of the specific questions you addressed.

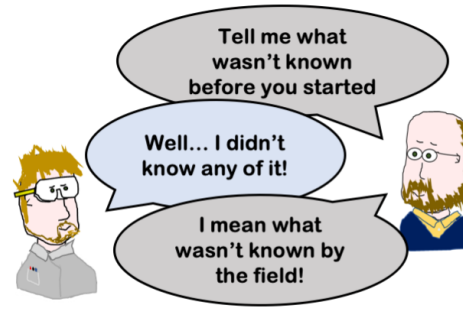
Example phrasing to "Map the Gap."

- "Previously it has been reported that X affects Y, *but the molecular mechanism is unknown."*
- "An increase in Y has been correlated with disease progression, *but the pathogenic consequences have never been established."*
- "Protein Y has been established as important for cell type B function Z, but its role in cell type C *has not been evaluated."*

The phrases in italics are examples of how you can draw attention to where your research is going. These sorts of phrases are most effective in the topic or wrap sentences of a paragraph.

By the end of this section, your research question should be obvious. In fact, you want to go further. You want your readers to want to know the answer to the questions you have asked. If you have not yet reached that point, then you need to tidy up, rephrase, reorder and possibly cut out non-relevant material. I tend to overwrite my first draft of my introduction section then cut out or contract lots of the sentences during the editing phases until I get to a stage where I am happy.

You will need numerous primary references throughout the middle paragraphs, usually more than one citation per sentence. Again, make sure to cite your competitors not just your boss, and mention any area where there is controversy. The controversy point is especially important if the data you are about to present supports or contradicts previous findings. Your reviewers will know the field, so do not ignore some previous work because it doesn't fit your model!



Frame your introduction so that it focuses on what *wasn't* known rather than just saying the current thinking

Final paragraph

By the end of your set up paragraphs, the research question should be implicit. In the final paragraph, you should now make it explicit. Clearly state the question, the hypothesis or aim that you have been working towards (only use one of these options). Simple phrasing like; "The purpose of this study was to determine….", or "here we tested…", can be very effective here.

Big Tip

Shorter introductions are usually better.
Make sure everything is relevant and on message.

Follow this opening statement with a few sentences explaining your experimental model system or an overview of your approach "…. using X, Y and Z". You may want to say why this approach was used if it is a new approach. It is quite common to end the introduction with a **one-sentence** overview of the results and what they mean in relation to the big picture question you posed in the first paragraph of the intro.

And that's it. You have written your first draft. Later in the writing process, you'll come back and edit to make sure every sentence is helping your story and to cut out everything that doesn't add value. Introductions do end up being one of the easier parts of a paper to write but like, all things, it will take practice. Don't worry if your first draft comes back with lots of comments from your co-authors.

What to check when editing

Check your paragraph structure

Look at each of your paragraphs and make sure that they are complete and structured appropriately with all the required elements; topic, token, links, and wraps. Pay special attention to any paragraph that is below 100 or over 200 words in length as they are usually the ones with problems.

Big Tip

If someone were to read only the topic sentences, they should be able to grasp the basis of the whole story.

Read the first sentence of each paragraph, they should be enough to set up the main points of the story. Each paragraph's topic sentence should also look *forward* toward the contents of the current paragraph rather than backward.

You should next pay attention to the last sentence of each paragraph (the wrap), make sure that they have one, and that each wrap effectively advances the story on to the next paragraph. If you ever receive comments about a draft "lacking flow" then usually it is a sign that your wrap sentences aren't pushing the story forward.

It can be hard to delete work that you spent a long time reading and writing to prepare, but, if it isn't relevant, it has to go.

Remove any off-topic material

Being self-critical is one of the hardest parts of writing, but the key to writing well is to cut out anything that should not be there, irrespective of how much time you spent writing a section. For every "fact" you are delivering, ask yourself what value it adds to the story, if it isn't adding anything then delete it.

The parts of your text where the answer is clear, where the work is either definitively useful or not useful are easiest to fix. It gets harder when you think everything is needed. In these cases, look at the relative value to the story of each part and then devote space proportionate to their importance. In some situations, you will be able to bring in further detail in your discussion, which is why it is always a good idea to edit the introduction and discussion at the same time.

Referencing

Make sure every piece of information, which is not common knowledge or an original thought, is cited. Over citing is better than under citing.

7.6 Materials and Methods

The "Materials and Methods" or "Experimental Procedures" section should be the easiest part to write of any scientific report, manuscript, thesis, or dissertation; after all, you know what you did! Having said that, there are a lot of common mistakes that you should be aware of. The good news is most of these mistakes are easy to fix with some simple improvements.

Keep a good lab book

When it comes to writing up your methods having a clear, understandable, and complete lab book makes everything easier. Remember that your lab book should not leave the lab, so scan or copy pages as required if you will be writing at home. Your lab book should have all the details including manufacturer information, product codes, lot numbers etc. The more details you have recorded, the easier and quicker this section will be to write.

Write as you work

When writing the rest of the report or paper, you need to have a solid idea of what your main story will be before you can get going. However, the methods sections are different. Here you can and should be writing everything as and when you are doing the actual experiments. There are two simple reasons for this:

The best time to write your methods section is as soon as possible!!

1. **You will find it easier.** You will still remember exactly what you have done and will not have to rely solely on the quality of the records in your lab book.
2. **You need the details**. If you have forgotten to record the batch or clone number of some key reagent it is much easier to just have a look in the fridge, or wherever, than try to work it out later.

Use published examples as a guide

For most experiments, your protocol is likely to be very similar and based upon published work. Use these publications to help you. This is especially true when your supervisor has published the same technique before. Do not copy directly; carefully check all the details and be sure to update anything where you made changes. Pay extra attention to any experimental details required to *interpret* the data. As always, do not forget to provide the reference to your source material.

As the next generation of scientist, you should be aiming to do things better than the generation before. Wherever you can improve clarity or specificity in your methods, you should do so. Remove any ambiguities, tighten up phrasing and add experimental specifics missing from the original. Generally, try to do a better job!