

# CHAPTER 10

## The Introduction

### 10.1 OVERALL

#### INTRODUCTION GUIDELINE 1:

Interest your audience and provide context.

The purpose of the Introduction is twofold: to interest your audience to read the paper and to provide sufficient context or background information for readers to understand your study independently of other previous publications on the topic. Often, the Introduction also gives an overview of what to expect in the paper. Note that the Introduction may repeat some parts of the Abstract, which is ok.

### 10.2 CONTENT AND ORGANIZATION

#### INTRODUCTION GUIDELINE 2:

Follow a "funnel" structure.

Include:

Background

Unknown/Problem

Question/Purpose of Study

Experimental Approach

Optional: Results/Conclusion

Significance

## 10.3 ELEMENTS OF THE INTRODUCTION

## Background

**INTRODUCTION GUIDELINE 4:**

Provide pertinent background information, but do not review the literature.

Start the Introduction by providing some background information. The amount of background information needed depends on how much the intended audience can be expected to know about the topic. You should start very broad to provide some general context of your work. Then write about the specific aspect of the topic that is of interest, mention the existing research in the area, and discuss current beliefs. A good partial introduction, in which the background starts very broad but then narrows down quickly to the research topic, is shown next (see also Example 10-7 and Revised Example 10-10):

**Example 10-1 A partial introduction showing good funneling of background**

In mammals, the auditory hair cells of the inner ear are the sensory receptors of the auditory system. Two functionally and anatomically distinct types of mammalian auditory hair cells exist: inner and outer hair cells. Outer hair cells do not send neural signals to the brain, but they mechanically amplify low-level sound that enters the inner ear (1). The amplification is powered by an electrically driven motility of their cell bodies (2).

The molecular basis of this mechanism is thought to be the motor protein prestin, which is embedded in the lateral membrane of the outer hair cells. Mammalian prestin is an 80 kDa, 744 amino acid membrane protein whose function appears to depend on chloride channel signaling (3,4). Although prestin has been researched intensively, its molecular function has not been fully established.

Broad background

Specific background

Unknown/  
Problem

Note that you should not review the topic when you are writing a research paper. A summary pertinent to the research you are presenting in the paper should suffice. In the following example, the Introduction of Example 10-1 is shown again; but in this version, the author has reviewed the topic. Too much irrelevant information (underlined) has been included. Consequently, the introduction does not clearly funnel down to the topic of interest (the molecular function of prestin), and readers get confused because they do not know what aspect of the background information to focus on.

**INTRODUCTION GUIDELINE 3:**

Keep the Introduction short.

Readers have relatively fixed expectations about where in a document they will encounter particular items. Based on the location of these items, they will interpret the text. If writers can become aware of these locations, they can better guide the reader through the document, highlighting and emphasizing various pieces of information depending on the degree of importance. Generally, readers expect the parts of the Introduction to be arranged in a standard structure: a “funnel,” starting broadly with background information and then narrowing to what is the question of the paper (see also Zeiger, 2000).

The Introduction should be as short as possible but contain all the information needed to lead into the work. Ideally, an introduction of a typical journal article should be one to two double-spaced pages (about 250–600 words). Check the *Instructions to Authors* of your target journal to ensure that you are within the set word limits for the Introduction.

Most research papers in basic science are investigative. That is, they are based on specific research questions you try to answer or on a particular hypothesis you try to test. Introductions for these papers should contain the following elements:

1. **Background**  
broad and specific background information and previous research in the area
2. **Unknown/Problem**  
problems of previous work and unknown factors in the area
3. **Question/Purpose of Study**  
addition made by your research
4. **Experimental Approach**  
approach taken toward this addition

The Introduction should funnel from broad general background, to knowledge on a specific aspect of the topic, to something unknown or problematic, and then to the research question of the paper and its experimental approach. Although not an absolute necessity, I recommend including your main results and conclusions as well as to state the overall significance of the paper to round up this section. If you include main results and conclusions, place them at the end of the Introduction. Including results and conclusion in the Introduction will let your readers know what to expect and will let them more easily follow the paper. If your paper deals with a controversial topic in your field, however, you may consider withholding main results and conclusions in your Introduction to encourage as many readers as possible to continue reading your paper and argumentation.

**Example 10-1 B Introduction that reads like a review**

In mammals, the auditory hair cells of the inner ear are the sensory receptors of the auditory system and the vestibular system. The auditory hair cells are located within the organ of Corti on a thin basilar membrane in the cochlea of the inner ear. Their name derives from a structure known as the hair bundle or stereocilia found on the apical surface of the cell, which extends into the scala media within the cochlea. Damage to the hair cells results in sensorineural hearing loss.

Two functionally and anatomically distinct types of mammalian auditory hair cells exist: inner and outer hair cells. In inner hair cells, the stereocilia are deflected mechanically, thus opening gated ion channels and allowing positively charged potassium and calcium to enter the cell. The influx of these ions depolarizes the cell, resulting in a receptor potential that subsequently triggers the release of neurotransmitters at the basal end of the cell. The neurotransmitters in turn trigger action potentials in the nerve, converting the mechanical sound signal into an electrical nerve signal.

Outer hair cells, which have evolved only in mammals, do not send neural signals to the brain, but they mechanically amplify low-level sound that enters the inner ear (1). The amplification is powered by an electrically driven motility of their cell bodies (2). This so-called somatic electromotility consists of oscillations of the cell's length, which occur at the frequency of the incoming sound and in a stable phase relation. Outer hair cells have not improved hearing sensitivity of mammals, but have extended the hearing range from about 11 kHz (maximum in some birds) to about 200 kHz (maximum in some marine mammals). They have also improved frequency selectivity (frequency discrimination), enabling sophisticated human speech.

The molecular basis of the electrically driven motility of outer hair cells is thought to be the motor protein prestin, which is embedded in the lateral membrane of the outer hair cells. Mammalian prestin is an 80 kDa, 744 amino acid membrane protein whose function depends on chloride channel signaling (3,4). Prestin is compromised by the common marine pesticide tributyltin (TBT) as has been shown by high concentrations of prestin in Orcas and toothed whales. Although prestin has been researched intensively, its molecular function has not been fully established.

Background starts broad, but then goes into irrelevant details that are not important for the research topic

The specific background also contains some irrelevant information

**The Unknown/Problem****INTRODUCTION GUIDELINE 5:**

State the unknown or problem.

After discussing general background and specific aspects of existing research, describe what the problems with the existing research are or what is unknown. The unknown is clearest if you signal it by stating it directly, for example, "The unknown is the 'Y' in molecule." You can also use other phrases

to state the unknown outright: "has not been established," "or" "has not been determined." Alternatively, you can imply rather than state the unknown by using a suggestion or a possibility ("Previous findings suggest that ..."; see also Table 10-1 in the section on "Signals for the Reader.")

Use an objective tone when criticizing previous work. Avoid antagonistic phrases:

**Not appropriate**

- ... does not seem to understand ...
- ... failed to ...
- ... made the mistake of ...
- ... used improper methods ...



Better

- The results of study X have been questioned.
- One study found A, another study found B.
- Findings on X are controversial.
- Although A showed X, our results do not agree ...

Also, do not blame individual authors or teams. You may end up creating your own enemies who one day may be reviewers of one of your papers or grant proposals.

**The Question/Purpose****INTRODUCTION GUIDELINE 6:**

State the central point (question/purpose) precisely.

The most important element in a research paper is the research question or purpose of the work. The question/purpose is the "central point" of your Introduction and of the paper as a whole. It therefore needs to be worded very carefully. If the central point is stated precisely, the reader immediately has an idea of what to expect in the paper. Furthermore, the reader can read the paper in a directed way rather than blindly, and the experiments make more sense.

Because the question/purpose provides an overview of the entire paper, and every paragraph and sentence in your paper relates to it, I recommend for you to write your research question/purpose onto a Post-it note before you start composing your manuscript. Place this note on the side or top of your computer screen where it cannot be overlooked. It will remind you to keep your writing focused on the question/purpose of the paper.

The research question/purpose of a research paper should name the variables studied as well as the main features of the study. Note that the question/purpose is usually not written in the form of a question but as an infinitive phrase or as a sentence, using a present tense verb, as in the next examples:

**Example 10-2 Phrasing of question/purpose**

- a To determine if the triggered cellular processes affect the rRNA structure and folding dynamic *in vivo*, ...
- b Here we asked how rheumatic fever influences heart rate.



- c In this study, we show that a sequential scheme of phosphorylation and dephosphorylation can generate circadian oscillations.
- d Here we examine the effects of total carbonate concentration on U(VI) adsorption.

The research question should follow logically from the previous statements of what is known or believed and what is still unknown or problematic. Thus, the topic of the research question should be the same as the one found in what is known. Equally important, the research question should be the question the reader would expect after reading about what is unknown or problematic.

### Experimental Approach

#### INTRODUCTION GUIDELINE 7:

State the experimental approach briefly.

In the Introduction of your research paper, you should also briefly indicate your experimental approach. In general, the experimental approach is short—usually one sentence, at most, two or three sentences. The experimental approach should be signaled so readers can identify it immediately. Examples of how to signal the experimental approach are shown in Example 10-3 (see also Table 10-1 in the section on “Signals for the Reader”).

- Example 10-3** **Signals for the experimental approach**
- a We analyzed X by agarose gel electrophoresis.
- b We simulated Tropical Instability Waves using a constant coefficient Laplacian friction scheme.
- c The structures of the compounds were characterized by UV, IR,  $^1\text{H}$  NMR,  $^{19}\text{F}$  NMR spectra, and HRMS.

### Results and Conclusion

After the experimental approach, you may briefly state your main results and conclusion. Although their inclusion is not a must, know that readers like to read about the main results and conclusion of your work in the Introduction. Most readers dislike having to read the whole paper, waiting and searching for the answer to the research question. In some journals, results and conclusions are delayed until the Discussion section of the paper. If you have the chance to include results and conclusions in your Introduction, however, do so. Readers will be thankful for it. See also Table 10-1 in the section on “Signals for the Reader” for ways to signal results in the Introduction.

### Significance and Implication

Consider stating why your findings are important. Do so by stating what the significance or implication of the study is, as shown in the following

- Example 10-4** **Stating the significance or implication**
- a X is an important addition to...
- b ... which aids in the elucidation of...

If you state the significance or implication at the very end of your Introduction, it not only rounds up this section nicely, but also provides the overall perspective of your work for the reader. See also Table 10-1 in the section on “Signals for the Reader” for additional ideas on how to signal the significance or implication of your article.

## 10.4 SPECIAL CASE: INTRODUCTIONS FOR DESCRIPTIVE PAPERS

For descriptive papers, include

- Background
- Discovery statement
- Experimental approach—if appropriate
- Description
- Implication

State an implication at the end of the Introduction of a descriptive paper.

Some research papers are not written to answer specific questions or prove a hypothesis but rather to describe a new finding, such as a new organism, an unknown disease, or a novel apparatus. This category also includes methods papers. Introductions for these papers follow a slightly different “funnel” structure because elements that readers expect to find in the Introduction of a descriptive paper differ from those of an investigative paper. Elements that should be contained in the Introduction of a descriptive paper include:

1. **Background** background information and previous research in the area
2. **Discovery statement** new discovery made by your research
3. **Experimental approach (optional)** approach taken toward analyzing this discovery
4. **Description** description of the new element
5. **Implication** importance of the findings

In descriptive papers, the Introduction should funnel from the general background to the specific aspect (if it is known), to the discovery statement, and then to the description and implication. For some descriptive papers, the reason for the discovery or previous problems before discovery can also be included in the Introduction. Most descriptive papers do not