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Introductions and Conclusions for Scientific Papers

Introductions

What is the purpose of an introduction in the scientific field?

- An introduction sets up the question or issue to be resolved or studied. It provides the necessary background information for a reader to follow and understand the importance of the topic/study (i.e. why research should be done). An introduction orients the reader to the problem at hand.

An ideal scientific introduction will do these things:

- Provide the research context for the problem/question being addressed.
- State and explain the problem/issue in specific terms; how this part will fill in the missing brick in the wall of research already done.
- Give some sense of the paper's overall organization.
- Relate the problem to a theory.
- Described the facts that are already known that support or don't fit the theory (background information).
- Explain how and why this research is important.

How much information should you give up front? Ask yourself:

- What background information is necessary to understand the question/issue you will explore?
- How much information is necessary to understand the importance of this question/issue?
- Are you demonstrating an understanding of the issues?
- Have you clearly focused on one specific question/issue?
- Are you assimilating or synthesizing the background information as a frame for your own observations/ideas?

How do you know if you are doing too much or not enough?

- Are you taking too broad an approach?
  - You want to orient the reader to the specific question/issue the paper discusses, not the entire history of the field. Avoid the "Since the dawn of man" introduction.
- Are you taking too narrow an approach?
  - You want to assume the reader knows something about the field, but do not assume the reader is an expert. The reader/audience does not know everything the writer does.

Checklist for prewriting and revising introductions to scientific papers, Ask yourself:

- What am I trying to discover or prove?
- Which kind of problem am I working on? (define or measure, match facts and theory, evaluate and compare, or prove one thing over another)
- What, how, who, when, where, and why?
- Why is this problem new or distinctive?

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Sample Introduction (Hacker, Diana. *Rules for Writers.* 4th ed. Boston: Bedford/St Martins, 2001.)	**Explanation**
In most ecosystems, the supply of nitrogen is the most limiting factor to plant growth. Nitrogen is available to plants only after it has been fixed into NH_4^+ or NO_3^- compounds which make up a very small percentage of the total nitrogen pool in an environment. To combat this problem, leguminous plants have developed a symbiotic relationship with the nitrogen fixing bacteria, Rhizobium spp. Legumes form root nodules which house Rhizobium and provide the bacteria with carbon compounds, while the bacteria fix nitrogen for the plants' consumption (Adler, 1995). This relationship and its mechanisms have become the center of much study, both in the physiological mechanisms and population interactions.	It moves from the general to the specific and gives the context for the research. It sets up the literature review that will follow. **Note**: This background information is typically followed by a review of the research and the writer's hypothesis. Unlike in the Humanities, scientific papers are more concerned with the data or information than the way it is worded. Scientific papers use paraphrases and summaries often but not direct quotations.

Conclusions

What is the purpose of a conclusion in the scientific field?

- A conclusion is where the writer can summarize the paper's findings and generalize their importance. It is also where the writer can raise questions, discuss ambiguous data, and recommend places for further research. Conclusions often occur in a section titled "Discussion." This writing is an extension of a conversation(s) with colleagues.

An ideal conclusion will incorporate some or all of these goals:

Note: Always be mindful that different types of scientific papers will require different types of conclusions. For example, a conclusion in a lab report will not generally be speculative or provide practical applications. Always check with your professor about what type of information is appropriate.

- Interpret results, supporting conclusions with evidence.
- Recognize the importance of "negative" results.
- Move from the general to the specific.
- Restrict or expand results, including warning the reader how and why they should not generalize conclusions or suggesting ways to safely generalize.
- Point out implications and/or draw inferences (if appropriate to the type of paper).
- Mention practical applications, if any.
- Define unanswered questions.
- Give recommendations for further research.

Typical problems in conclusions:

- *Explanation overload*—don't overload the reader with unnecessary explanations unrelated to the topic.
- *The empty finding*—explain what the findings mean, don't let the reader jump to his/her own conclusions.
- *Ignoring "negative" results*—don't ignore results that do not fit your expectations; instead use them as a discussion point.
- *The broad statement*—don't make statements that are too broad; limit statements to what your data proves.
- *The expansive statement*—don't overstate the importance of your finding; be modest rather than expansive. Don't speculate beyond your results; speculation should be able to be proven in future experiments.
- *The digression*—stay focused on your research question. Do not digress or provide generalities.
- *The list of problems*—always provide thoughtful discussion of the "errors" in your conclusions; do not simply list them.

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Sample Conclusion (Hacker, Diana. *Rules for Writers.* 4th ed. Boston: Bedford/St Martins, 2001.)	**Explanation**
Recent research on cold-water immersion incidents has provided a more complete understanding of the physiological processes occurring during drowning and near-drowning accidents. Current findings suggest that the cooperative effect of the mammalian diving reflex and hypothermia plays a critical role in patient survival during a cold-water immersion incident. However, the relationship between the two processes is still unclear. Because it is impossible to provide an exact reproduction of a particular drowning incident within the laboratory, research is hampered by the lack of complete details surrounding drowning incidents. Consequently, it is difficult for comparisons to be drawn between published case studies. More complete and accurate documentation of cold-water immersion incidents-- including time of submersion; time of recovery; and a profile of the victim including age, sex, physical condition--will facilitate easier comparison of individual situations and lead to a more complete knowledge of the processes affecting long-term survival rates for drowning victims. Once we have a clearer understanding of the relationship between hypothermia and the mammalian diving reflex, and of the effect of such factors as the age of the victim, physicians and rescue personnel can take steps to improve patient care both at the scene and in the hospital.	It interprets the results, supporting conclusions with the research findings. It also recognizes and comments on the limitations of the experiment and then gives recommendations for future research and points out the practical applications.

Last updated 6/12/2014

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