

## 20.109 Scientific Writing



**Marilee P. Ogren PhD**

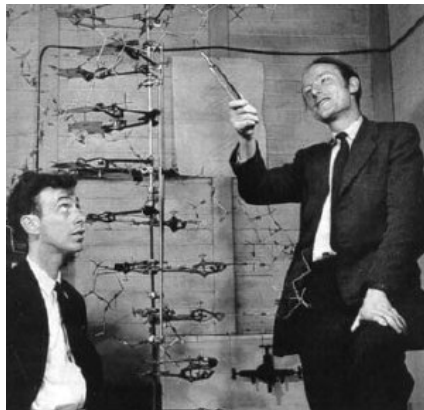
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The quality of writing can affect the  
impact of your work



## The goal of scientific writing is to communicate ideas

*“The purpose of a scientific paper is to communicate results and analysis to the wider scientific community.”*

*The better a paper is written, the more readers it will attract and the more citations it is likely to receive.”*

Bredan & van Roy (2006) EMBO 7:846-9

**QUESTION: Do scientists publish “truth?”**



## The IMRD structure helps you communicate effectively

- Introduction (*prologue*)
- Methods (*narrative*)
- Results (*evidence*)
- Discussion (*epilogue*)

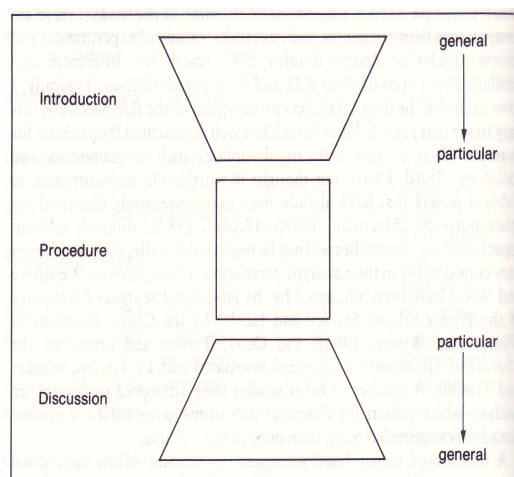
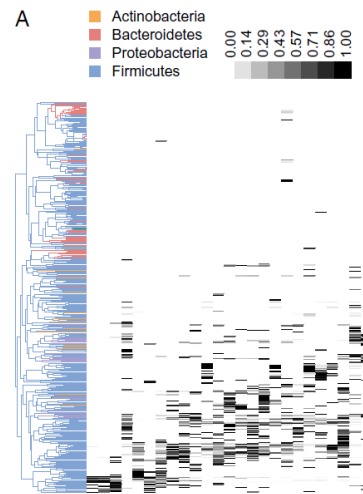


Figure 7 Overall organization of the research paper (Hill et al., 1982).

## Article scramble

### Identify the origin of each passage

- Introduction
- Methods
- Results
- Discussion
- Figure caption



The large functional and phylogenetic variation observed between infant gut microbiomes may be due to random colonization events, differences in immune responses to the colonizing microbes, changes in host behavior, or other aspects of host lifestyle (4, 6). How each of these factors contributes to shaping the infant microbiome remains unclear.

What features of this excerpt identify it as belonging to the Introduction?



**INTRODUCTION**

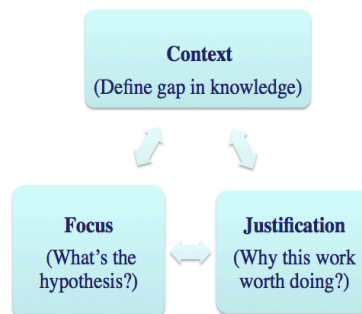
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What features of this excerpt identify it as belonging to the Introduction?



- The introduction provides a framework for the story...you must provide sufficient background information for a reader to understand the forthcoming results.
- Reveal the **importance** of the work through connections to both prior scientific accomplishments and interesting future applications...
  - You must also make the hypothesis explicit
- [M]ost introductions are "funnel" shaped in terms of content.
- (20.109 guidelines for scientific writing).

## Introductions have three elements



- **CONTEXT:** Start broadly, Identify what is and unknown
- **FOCUS:** Explain how you address the unknown
- **JUSTIFICATION:** Explain why it is important to do so

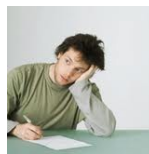
16S rRNA gene sequences were assigned to OTUs using the QIIME implementation of cd-hit (33) and a threshold of 97% pairwise identity. OTUs were classified taxonomically using the Ribosomal Database Project (RDP) classifier 2.0 (34). A single representative from each OTU was aligned using PyNast (35) to build the phylogenetic tree used to for measuring the PD of samples (7) and unweighted UniFrac (36).

What features of this excerpt identify it as belonging to the Materials & Methods?



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What features of this excerpt identify it as belonging to the Materials & Methods?



- The methods section should allow an independent investigator to repeat any of your experiments. Use sub-section headings to allow readers to quickly identify experiments of interest to them...
- The key to a good methods section is developing your judgment for what information is essential and what is extraneous.
- Note that the methods section should be written in the past tense... [and] in complete sentences and paragraphs, not in bullet point form.
- (20.109 guidelines for scientific writing)

## The M&M allows replication and interpretation of your work



- Provide the right level of detail
- List the methods in logical order
- Use proper grammar
- Use narrative prose (topic sentences and well focused paragraphs)

## Protocol vs. Methods section

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### **A Protocol is . . .**

- A series of steps to be carried out (think: **recipe**)
- Written in sequential or temporal order
- Intended for the reader to achieve a final result

The abundance of operational taxonomic units (OTUs) was assessed across all samples, and OTUs were clustered in a heat map according to their cooccurrence (Fig. 3A). This clustering analysis revealed a succession of bacterial communities that resolved four discrete phases (steps) initiated by life events.

What features of this excerpt identify it as belonging to the Results?



The abundance of operational taxonomic units (OTUs) was assessed across all samples, and OTUs were clustered in a heat map according to their cooccurrence (Fig. 3A). This clustering analysis revealed a succession of bacterial communities that resolved four discrete phases (steps) initiated by life events.

What features of this excerpt identify it as belonging to the Results?



The purpose of the results section is to **present your data in a relatively unbiased way**, but with some guiding framework.

**Begin with a short description of the goal and strategy** of your overall experiment, and then delve into specific sub-sections that describe each piece of the work.

Titled **sub-sections** help support your high-level narrative and make dense papers easier to read...

To write the results section, **use the figures and tables as a guide...**

Note that verbs in the results section are usually in **the past tense**.  
(20.109 guidelines for scientific writing)

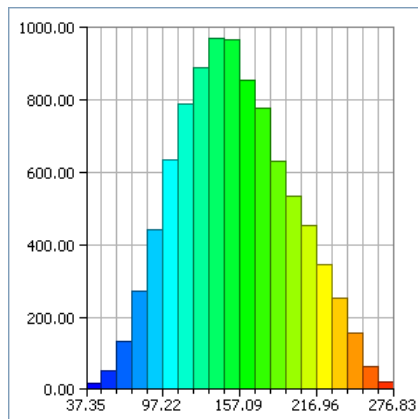
## The Results tells a story



- Select data carefully
- Provide context
- Describe data presented in illustrations

OTU-based community structure and composition in the gut microbiota. Each vertical lane corresponds to a sample day, and the gray-scale shaded rectangles represent the abundance of the different OTUs. The dendrogram on the left shows how the OTUs are clustered according to cooccurrence, and branches are colored to indicate the taxonomical assignment of the OTUs at the phylum level. Samples selected for metagenomic analyses are indicated with asterixes.

What features of this excerpt identify it as a Figure Caption?





OTU-based community structure and composition in the gut microbiota. Each vertical lane corresponds to a sample day, and the gray-scale shaded rectangles represent the abundance of the different OTUs. The dendrogram on the left shows how the OTUs are clustered according to cooccurrence, and branches are colored to indicate the taxonomical assignment of the OTUs at the phylum level. Samples selected for metagenomic analyses are indicated with asterixes.

What features of this excerpt identify it as a Figure Caption?



Captions to the figures and tables explain the elements that appear in the illustration.

Conclusions about the data are NOT included.

As you write your first draft, you might state in a short simple sentence what the point of the figure or table is.

In later drafts, make sure each element of the figure or table is explained.

Your figure captions should be written in the present tense because you are explaining elements that still exist at the time that you are writing the paper.

(20.109 guidelines for scientific writing)

## Captions allow illustrations to stand on their own

- Describe experiment
- Explain abbrev, symbols, point out arrows or boxed areas
- Do not interpret the data



This second observation is consistent with other metagenomic analyses of infant gut microbiomes, which reported microbial enzymes that degrade nondigestible polysaccharides of plant origin (2, 5). Together these studies suggest that the infant microbiome is metabolically ready for receiving simple plant-derived foods, such as rice cereal.

What features of this excerpt identify it as belonging to the Discussion?



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What features of this excerpt identify it as belonging to the Discussion?



The purpose of the discussion section is to interpret and contextualize your data.

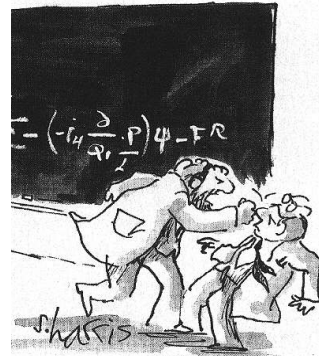
... begin by reiterating the purpose of your research and your major findings.

Then: ....connect your findings to other research; ... suggest specific experiments for extending your findings; describe limitations.

Finally, explain the importance of your findings  
(20.109 guidelines for scientific writing)

## The Discussion is an argument

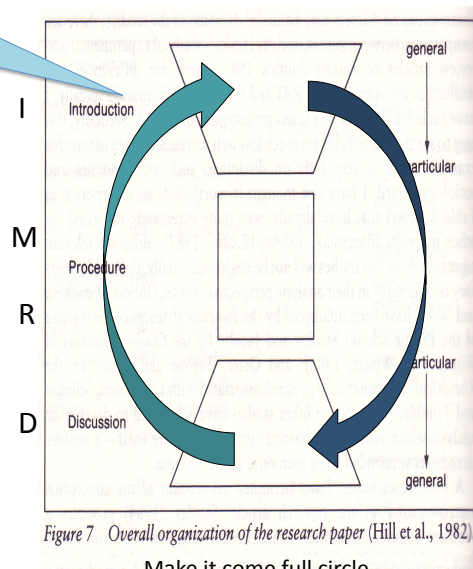
- Interpret data
- Connect to the literature
- Explain contribution to field
- Admit limitations and flaws



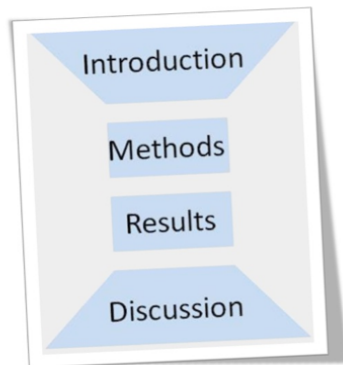
"YOU WANT PROOF? I'LL GIVE YOU PROOF!"

## Remember This?

Reread your  
Introduction  
WHY?



# IMRD Systematic Thinking



- **I** Introduction: What did you know?
- **M** M&M: What did you do?
- **R** Results: What did you see?
- **D** Discussion: What does it mean?