

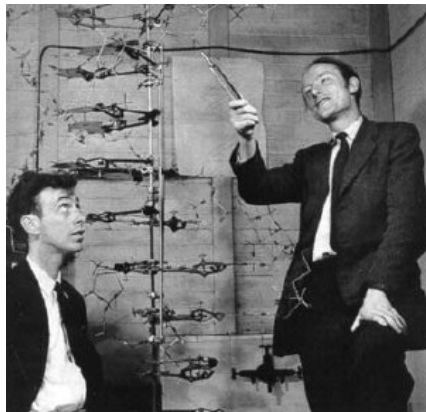
# Scientific Writing

20.109  
Spring 2012



The quality of writing can affect the impact of your work.

2



Watson & Crick, 1953



Avery, 1944

## 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.



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## The IMRaD structure helps you communicate effectively.

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

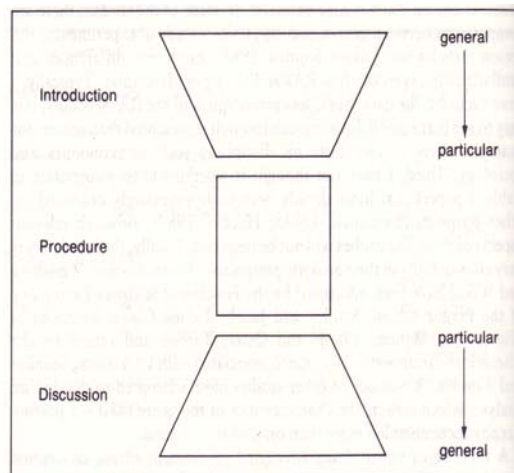


Figure 7 Overall organization of the research paper (Hill et al., 1982).

4

# Article scramble: Identify the section of each passage.

5

- Introduction
- Methods
- Results
- Discussion
- Figure legend



The following passages come from a different section of a paper that explore the suitability of RNA aptamers to probe a cellular process (Niles and Marletta. *ACS Chem Biol.* 1: 515 (2006)).

The randomized region of sequenced aptamer. The conserved motif identified using MEME is displayed as a sequence logo... G-rich regions within aptamer sequences are shown in italic boldface; two poly-G regions in the non-heme-binding control oligonucleotide **6-5** that do not conform to the G-rich consensus are underlined. The number of clones harboring a given sequence is shown in parentheses.

At the sixth and eighth selection rounds, the evolved library was blunt end cloned into pSTBlue-1 vector (Invitrogen) and used to transform competent NovaBlue *E. coli* cells (Invitrogen). Single colonies were used for mini-prep cultures from which plasmid encoding a single aptamer was isolated for sequencing and archiving.

The motif selected in our experiments...resembles those obtained during the selection of DNA and 2'-NH<sub>2</sub>-RNA aptamers to NMM and HPIX, respectively (32-34). This suggests that the PPIX scaffold is the predominant binding surface interacting with selected aptamers and that the electronic or steric changes upon metal coordination (heme), pyrrole N-methylation (NMM), and hydration of the vinyl side chains (HPIX) do not significantly alter this interaction.

Sequence data obtained for two and 28 aptamers from the round 6 and 8 pools, respectively, are summarized in Table 1. Analysis using the MEME algorithm (37) revealed the occurrence of a highly conserved G-rich motif in the majority of sequenced clones (Table 1). Interestingly, **6-5** and several round 8 aptamers do not contain this consensus sequence.

Recent advances in genomics and proteomics are increasing our understanding of transcriptional and post-transcriptional gene regulation and how various gene products integrate into networks (1-4)....While [several] strategies are facilitating the elucidation of protein function, less attention has been focused on the role biologically important small molecules play in modulating protein networks.

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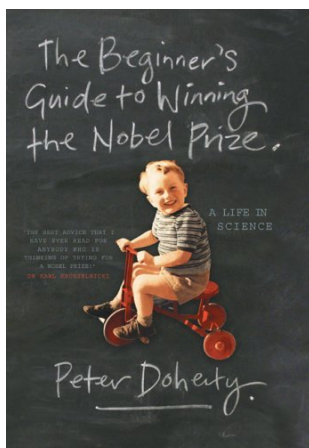
What features of this excerpt identify it as belonging to the Introduction?

- General, written like a textbook
- Identifies gap in research
- General -> specific (small molecules)
- Cites papers

The introduction provides a framework for the story you are about to tell, and thus serves two main purposes. For one, you must provide sufficient background information for a reader to understand the forthcoming results. Just as importantly, you must motivate the audience to keep reading! How? Reveal the significance of the work through connections to both prior scientific accomplishments and interesting future applications... [M]ost introductions are "funnel" shaped in terms of content. (20.109 guidelines for scientific writing)

**Introduction gives the context, focus, and justification.**

7



- Start broadly; end with your goal
- Identify what is (un)known
- Explain how you will address the unknown

**At the sixth and eighth selection rounds, the evolved library was blunt end cloned into pSTBlue-1 vector (Invitrogen) and used to transform competent NovaBlue *E. coli* cells (Invitrogen). Single colonies were used for mini-prep cultures from which plasmid encoding a single aptamer was isolated for sequencing and archiving.**

8

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

- Past tense: what you did
- Enables you to replicate experiment
- Very specific information, e.g. sources

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 judgement 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 or interpretation of your work.**

9



- Provide the right level of detail
- List the methods in logical order
- Use proper grammar

Sequence data obtained for two and 28 aptamers from the round 6 and 8 pools, respectively, are summarized in Table 1. Analysis using the MEME algorithm (37) revealed the occurrence of a highly conserved G-rich motif in the majority of sequenced clones (Table 1). Interestingly, 6-5 and several round 8 aptamers do not contain this consensus sequence.

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

- Describes data rather than interprets it
- Cites figure, or where results are summarized
- Use of terms like “revealed”

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 about your data.

11



- Select data carefully
- Provide context
- Describe illustrations

The randomized region of sequenced aptamer. The conserved motif identified using MEME is displayed as a sequence logo... G-rich regions within aptamer sequences are shown in italic boldface; two poly-G regions in the non-heme-binding control oligonucleotide 6-5 that do not conform to the G-rich consensus are underlined. The number of clones harboring a given sequence is shown in parentheses.

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

- First sentence: what you're seeing. The figure title.
- Explanation of format.

Legends to the figures and tables explain the elements that appear in the illustration. Conclusions about the data are NOT included in the legends. 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 legends should be written in the present tense since you are explaining elements that still exist at the time that you are writing the paper. (20.109 guidelines for scientific writing)

Legends allow illustrations to stand on their own.

13

- Describe experiment
- Explain abbrev, symbols
- Do not interpret or describe data



The motif selected in our experiments...resembles those obtained during the selection of DNA and 2'-NH<sub>2</sub>-RNA aptamers to NMM and HPIX, respectively (32-34). This suggests that the PPIX scaffold is the predominant binding surface interacting with selected aptamers and that the electronic or steric changes upon metal coordination (heme), pyrrole N-methylation (NMM), and hydration of the vinyl side chains (HPIX) do not significantly alter this interaction.

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

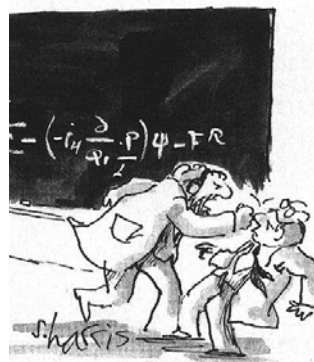
- Use of "suggests" -> data interpretation
- Gives authors' opinion
- Relates work to others, includes citations.

The purpose of the discussion section is to interpret and contextualize your data. You should begin by reiterating the purpose of your research and your major findings. Then you might do any or all of the following: connect your findings to other research (published or that of your peers); ... suggest specific experiments for extending your findings; describe any conceptual or technical limitations of the research. Finally, you should explain the significance of your findings to basic science and to engineering applications. (20.109 guidelines for scientific writing)

## The Discussion is an argument about your data.

15

- Interpret data
- Explain contribution to field
- Admit limitations and flaws



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



## In sum, understand IMRD to improve scientific writing.

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