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## How to write a scientific paper

Nicolas Fressengeas

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# How to write a scientific paper

N. Fressengeas

Laboratoire Matériaux Optiques, Photonique et Systèmes  
Unité de Recherche commune à l'Université de Lorraine et à CentraleSupélec

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4. **Write** the Discussion. Finalize the Results and Discussion before **writing** the introduction. ...
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# How to write a scientific paper

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Journal List > Int J Sports Phys Ther > v.7(5); 2012 Oct > PMC3474301

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PMCID: PMC3474301

PMID: [23091783](#)

## HOW TO WRITE A SCIENTIFIC ARTICLE

[Barbara J. Hoogenboom](#), PT, EdD, SCS, ATC<sup>1</sup> and [Robert C. Manske](#), PT, DPT, SCS, ATC<sup>2</sup>

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### Abstract

Go to: 

Successful production of a written product for submission to a peer-reviewed scientific journal requires substantial effort. Such an effort can be maximized by following a few simple suggestions when composing/creating the product for submission. By following some suggested guidelines and avoiding common errors, the process can be streamlined and success realized for even beginning/novice authors as they negotiate the publication process. The purpose of this invited commentary is to offer practical suggestions for achieving success when writing and submitting manuscripts to *The International Journal of*

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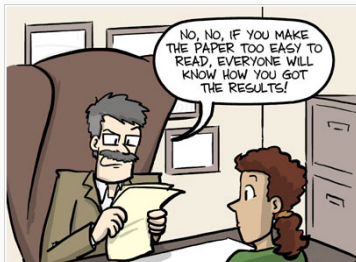
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## English Communication for Scientists

PROGRESS

### Unit 2: Writing Scientific Papers

As a scientist, you are expected to share your research work with others in various forms. Probably the most demanding of these forms is the paper published in a scientific journal. Such papers have high standards of quality, and they are formally disseminated and archived. Therefore, they constitute valuable, lasting references for other scientists — and for you, too. In fact, the number of papers you publish and their importance (as suggested by their impact factor) are often viewed as a reflection of your scientific achievements. Writing high-quality



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- Learn how to write scientific papers in under 4 minutes
- How to Write a Paper in a Weekend (By Prof. Pete Carr)
- Judy Swan, Scientific Writing: Beyond Tips and Tricks



# A reference work

Nicolae Al. Pop

360

ISSN 2071-789X

REVIEW

**ECONOMICS**

*Sociology*

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DOI: 10.14254/2071-  
789X.2016/9-4/23

## Introduction

Pop, N. Al. (2016), A Reference Work on the Science and Art of Writing a Scientific Paper, *Economics and Sociology*, Vol. 9, No 4, pp. 360-364. DOI: 10.14254/2071-789X.2016/9-4/23

## A REFERENCE WORK ON THE SCIENCE AND ART OF WRITING A SCIENTIFIC PAPER<sup>1</sup>

**Motto:**  
*„Some think but do not write, others write without thinking;  
many think after they write, few write after they think“*  
Theofil Simenschy

In the modern world, marked by hyper-competition



# Part I

## Tools for scientific writing



# I Tools for scientific writing

- 1** A scientific paper
  - Papers share the same structure
  - References, so important references
  
- 2** Separation of content and presentation
  - A concept to ease and enhance writing
  - $\text{\LaTeX}$ , a scientific writing tool
  - $\text{\LaTeX}$  How To through practice



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# The process of publishing a scientific paper

## Choose the right journal

- Get inspired by your university policy
- Choose a journal that is read by your targeted audience
- Choose Open Access journal
  - ▶ Pay never more 1000\$ and target far below
  - ▶ If you cannot : publish in free paywalled access journals AND in open archives such as <http://hal.univ-lorraine.fr>
- Read the editorial guidelines

## Write and publish

- Write your paper this class
- Send it to journal
- Wait for reviewing
- Make corrections if necessary
- Publication occurs if reviewers agree

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Keywords

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A good title will pop up in web searches



European Geriatric Medicine 6 (2015) 573–579



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Research paper

Writing a scientific article: A step-by-step guide for beginners

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Even today, the old adage "publish or perish" remains valid. Many young researchers find themselves under pressure to produce scientific publications, in order to enhance their career prospects, or to substantiate requests for funding, or to justify previous funding allocations, or as a requirement for university qualifications such as a Masters degree or doctoral thesis. Yet, often, young doctors do not have much training, if any, in the art of writing a scientific article. For clinicians, in particular, the clinical workload can be such that research and scientific writing are seen to be secondary activities that are not an immediate priority, and to

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A certain amount of preparatory work needs to be done before you ever write a word of your article. This background work should generally already have been accomplished by the time you are at the writing stage, because it also serves as background to the research project you are writing about. All the time you invest in preparing the protocol for your project is an advance on the writing

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Research paper

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Research paper

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Dates ! Who was the first ? How long was it reviewed ? Date of publication ?



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# The first page of a scientific paper

- Informative short title
- Ordered author list
- Affiliations
- Keywords
- Article history
- Abstract
- Contact information
- Article reference

The abstract is an ultra short summary of the paper emphasizing new findings

The screenshot shows the first page of a scientific paper. At the top, there are logos for ScienceDirect and Elsevier, and the journal title 'European Geriatric Medicine'. The article title is 'Writing a scientific article: A step-by-step guide for beginners'. Below the title is the author list: 'F. Ecarnot\*, M.-F. Seronde, R. Chopard, F. Schiele, N. Meneveau'. The authors' affiliation is 'EAPRD, Department of Cardiology, University Hospital Jean-Minjean, 3, Boulevard Fering, 22000 Brest, France'. The article history includes 'Received 22 June 2015', 'Accepted 16 August 2015', and 'Available online 19 September 2015'. The abstract begins with 'Many young researchers find it extremely difficult to write scientific articles, and few receive specific training in the art of presenting their research work in written format. Yet, publication is often vital for career advancement...'. The journal logo 'EUROPEAN GERIATRIC MEDICINE' is in the top right corner.

## 1. Background

Every researcher has been face to face with a blank page at some stage of their career, wondering where to start and what to write first. Describing one's research work in a format that is comprehensible to others, and acceptable for publication is no easy task. When you invest a lot of time, energy and often money in your research, you become intimately and emotionally involved. Naturally, you are convinced of the value of your research, and of its importance for the scientific community. However, the subjectivity that goes hand in hand with deep involvement can make it difficult to take a step back, and think clearly about how best to present the research in a clear and understandable fashion, so that others – likely, non experts in your field – can also appreciate the interest of your findings.

Even today, the old adage "publish or perish" remains valid. Many young researchers find themselves under pressure to produce scientific publications, in order to enhance their career prospects, or to substantiate requests for funding, or to justify previous funding allocations, or as a requirement for university qualifications such as a Masters degree or doctoral thesis. Yet, often, young doctors do not have much training, if any, in the art of writing a scientific article. For clinicians, in particular, the clinical workload can be such that research and scientific writing are seen to be secondary activities that are not an immediate priority, and to

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With this in mind, we present here a step-by-step guide to writing a scientific article, which is not specific to the discipline of geriatrics/gerontology, but rather, may be applied to the vast majority of medical disciplines. We will start by outlining the main sections of the article, and will then describe in greater detail the main elements that should feature in each section. Finally, we will also give a few pointers for the abstract and the title of the article. This guide aims to help young researchers with little experience of writing to create a good quality first draft of their work, which can then be circulated to their co-authors and senior mentors for further refinement, with the ultimate aim of achieving publication in a scientific journal. It is undoubtedly not exhaustive, and many excellent resources can be found in the existing literature [1–7] and online [8].

## 2. Getting started: things to do before you write an word

A certain amount of preparatory work needs to be done before you ever write a word of your article. This background work should generally already have been accomplished by the time you are at the writing stage, because it also serves as background to the research project you are writing about. All the time you invest in preparing the protocol for your project is an advance on the writing

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Research paper

Writing a scientific article: A step-by-step guide for beginners

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Every researcher has been face to face with a blank page at some stage of their career, wondering where to start and what to write first. Describing one's research work in a format that is comprehensible to others, and acceptable for publication is no easy task. When you invest a lot of time, energy and often money in your research, you become intimately and emotionally involved. Naturally, you are convinced of the value of your research, and of its importance for the scientific community. However, the subjectivity that goes hand in hand with deep involvement can make it difficult to take a step back, and think clearly about how best to present the research in a clear and understandable fashion, so that others – likely, non experts in your field – can also appreciate the interest of your findings.

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## Research paper

### Writing a scientific article: A step-by-step guide for beginners

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# The paper body

## Sections, subsections, figures & tables

- Introductory section
- Sections and subsections
- Self-consistent figures
- Self-consistent tables

The introductory section sets the paper background. It can, or not, have a title.

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of the article that will come out of your project. Thus, you probably already performed an extensive literature review to establish the current state of knowledge on the topic, and ensure the originality of your research when developing the protocol, and this can serve for your paper. It is helpful, when you are reviewing the literature, to take notes of important points or pleasures that you intend to include in your article, with the relevant references. A software program for managing references (either free versions or commercially available products) can be helpful for managing the large volume of references that you are likely to wade through before sifting out the most important points.

Usually, you will also have the final results of the statistical analysis of your data. This will form the basis of your results section. Some of the graphical representations of your results will serve as figures for the article, so it is helpful to highlight the most important findings as you read through the results so that you do not forget anything important.

Before starting to write, you should identify the target journal in which you intend to submit your research. This will have consequences for the formatting, but more importantly, for the orientation of your writing style, since the writing must be appropriate for the type of reader you are targeting. For example, are you targeting a specialist journal, where readers are expected to be experts in your field, or a general medicine journal, where readers may be experts from other disciplines? This will have implications for the amount and type of information that you must include. In addition, the editorial policy of the target journal should also be taken into account. For instance, in a given area of expertise, some journals favour papers reporting basic research, whereas other journals give precedence to more clinical work. The choice of the target journal depends on the objectives, which are beyond the scope of this article. However, at the very least, you should check that your paper falls within the scope of the journal you have chosen.

### 3. What are the main sections of a scientific article?

The vast majority of scientific journals follow the so-called "IMRAD" format, i.e. introduction, methods, results and discussion. Naturally, there are some exceptions to this rule, and you should always check the instructions for authors of the journal where you plan to submit your paper to ensure that this is indeed the recommended format. For the purposes of this guide, we will only discuss the IMRAD format, as the most widespread.

Your article should thus contain (in this order): an introduction, a methods section, a results section and a discussion. Added to this will be the abstract, which is more or less a summary of these main sections, and of course, the title. At the end, there must be a list of bibliographic references, the tables, and the legends to the figures. Finally, there may also be some other optional sections, such as acknowledgements, conflicts of interest or authors' contributions.

Below, we will discuss each of these sections in detail, outlining the main points to keep in mind when writing them.

#### 3.1. The introduction section

The introduction is of prime importance in grabbing the reader's attention (Table 1). It participates during the review process, the introduction must get the reviewer "hooked", wanting to read more, and thinking to themselves, "How come I never thought of this!". In this section, you will thus explain why you undertook your study, what you aimed to achieve with it, and how this constitutes a useful addition to the existing body of evidence on this topic.

In concrete terms, you should start by explaining briefly, using appropriate references, what is already known about this subject. You should then narrow the field down somewhat and identify the area where there is still some uncertainty, citing, where appropriate, any previous (and possibly conflicting) data. This will logically lead to a description of an explicit gap in the knowledge that your study hopes to fill. This is an essential element in justifying the utility of your work. Having now explained how your study is going to contribute something new and useful, you should clearly state your working hypothesis, followed by your objective(s), and very briefly, the strategy implemented to achieve these goals (Table 1).

In the background, the reasons that prompted you to undertake your research should be clear to the reader, and justified by the state of scientific knowledge with appropriate references. It is not necessary to cite every article in the literature on the topic; a careful selection of the most pertinent publications is sufficient. Similarly, it is not necessary to state numerous results that may seem over simplistic or eminently obvious. Yet you should try to achieve a suitable balance between relevant background information, and excessive detail. In this regard, you should keep in mind the target audience you are aiming for. This will depend on the profile of the readership of the journal in which you intend to submit your research, as mentioned above. If you are targeting a specialist journal, then your background can be more detailed and technical than if you are addressing an audience of non-specialists in your field.

The introduction should logically flow towards the identification of the gap in knowledge that you hope to fill. This is a good opportunity to state the added value of your study, or the new information that your study will yield. Will your results change clinical practice? Will they help the scientific community to large to move towards consensus on a previously controversial topic by providing hard evidence in one direction or the other? This is your chance to make a case for your article, in the appropriate terms, of course.

As far as possible, try to avoid diverging from the subject at hand. Every sentence should serve a purpose. Many journals have a limit on the length of the introduction, with a maximum number of

Table 1  
Outline of the main features of the introduction section, with examples.

Feature	Example
Background describing what is known on the subject	Peritoneal cavity intervention is the cornerstone of therapy for acute coronary syndromes, but may be associated with procedure-related complications
What is not known? What elements are still subject to controversy? What is the exact gap in the knowledge that your study hopes to fill? Use any existing data, especially conflicting data that indicate urgency	It remains unclear whether, to date, it has not been proven. The study data has investigated the effect of... There are few data to quantify the effect of... remain unclear
Objective (i.e. working hypothesis): On the most pertinent gap plan to measure	We hypothesized that the administration of... would reduce... in the context of...
On the type of patient population or clinical context	Through a prospective, single-blind, randomised, controlled study



# The paper body

## Sections, subsections, figures & tables

- Introductory section
- Sections and subsections
- Self-consistent figures
- Self-consistent tables

Sections are compulsory, except in letters. Subsections are not.

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In concrete terms, you should start by explaining briefly, using appropriate references, what is already known about this subject. You should then narrow the field down somewhat and identify the area where there is still some uncertainty, citing, where appropriate, any previous (and possibly conflicting) data. This will logically lead to a description of an explicit gap in the knowledge that your study hopes to fill. This is an essential element in justifying the utility of your work. Having now explained how your study is going to contribute something new and useful, you should clearly state your working hypothesis, followed by your objective(s), and very briefly, the strategy implemented to achieve these goals (Table 1).

In the background, the reasons that prompted you to undertake your research should be clear to the reader, and justified by the state of scientific knowledge with appropriate references. It is not necessary to cite every article on the literature on the specific research of the most pertinent publications is sufficient. Similarly, it is not necessary to state relevant results that may seem over simplistic or eminently obvious. Yet you should try to achieve a suitable balance between relevant background information, and excessive detail. In this regard, you should keep in mind the target audience you are aiming for. This will depend on the profile of the readership of the journal in which you intend to submit your research, as mentioned above. If you are targeting a specialist journal, then your background can be more detailed and technical than if you are addressing an audience of non-specialists in your field.

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Feature	Example
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What is not known? What elements are still subject to controversy? What is the exact gap in the knowledge that your study hopes to fill? Use any existing data, especially conflicting data that indicate urgency	It remains unclear whether, to date, it has not been proven. The study data has investigated the effect of ... There are few data to quantify the effect of ... remain unclear
Objective (i.e. working hypothesis): On the stated premises you plan to measure	We hypothesized that the administration of ... would reduce ... in the context of ...
On the type of patient population or clinical context	Through a prospective, single-blind, randomised controlled trial
On any secondary objectives	study





# The paper body

## Sections, subsections, figures & tables

- Introductory section
- Sections and subsections
- Self-consistent figures
- Self-consistent tables

Figures are self-consistent and have numbers and captions. They are placed above or below the text.



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**Table 1**

The main elements to be included in a successful title.

Feature	Example
Cite the main factors studied	State the name of the drug or intervention
Cite the population/context studied	In acute myocardial infarction/chronic risk primary prevention/early phase stroke check
Cite the design	Randomised, double-blind, controlled trial/registry/cohort study/care-cohort study
Cite the main finding	Incidence/odds/ratio/relative risk
Put the most important aspect first	If the focus is on the intervention, because this is what distinguishes your article from others, then state the title with the intervention name
Avoid imperative formulations that serve no specific purpose for international consensus nomenclatures for drug names	Avoid terms such as "a report of..." or "the effects of...". If there are effects, state what they are! (Etiological, therapeutic, prognostic)
	Concomitant names should be avoided. They reduce legibility (if the pharmaceutical company), and may be considered an indirect preference for a particular company. Also, they are not about the same across different countries
	Reverse subtitles for names of study groups. Specific recommendations may apply, depending on your target journal

examples of what constitutes an efficacious title. Bear in mind that your target journal may have a limit (in terms of number of words or characters) on the length of the title. Here again, keeping it short is harder than coming up with a 4-line title.

### 3.7. References

The reference section lists all the sources you have used as a basis to prepare your hypothesis, and build your research. It is your ethical and professional responsibility to document your work adequately, and provide full transparency in identifying your sources. It is also imperative to cite the sources on which your hypotheses are based, to prove that they are in fact sound. The references support your work and place it in the context of other studies on the same topic, while at the same time providing guidance for readers who would like to engage in further reading on the topic.

Many young researchers find it hard to judge when it is necessary to cite a reference. Basically, any idea or fact that emanates from another source (other than yourself) needs to be

supported by a reference. However, universal truths or facts that are widely established do not need to be referenced (e.g. cardiovascular disease is very common, or cancer is a major cause of death). However, ideas, or more particularly phrases or names that were coined by someone else do need to be referenced (e.g. patients with the "McCormell Sign" – The paper by McCormell describing the sign should be cited here. Or, patients were classified according to the RAIAC criteria – the paper describing the RAIAC criteria should be cited here).

When citing references, apart from specific papers that give their name to a sign or classification system as in the examples above, you should give precedence to articles published in English-language, peer-reviewed journals. Citing sections from published books is also acceptable, but you must be very specific and list the exact names and titles of the chapter concerned, with the page numbers, and the names of the authors and/or editors of the book, with its publication details.

Internet sites should be avoided where possible, as should personal communications and unpublished data. If you have several possible references, you may prefer to choose the most

Title citing Drug/Intervention, Context, Design & Main Finding: Use subtitles sparingly (for study group names)	
<b>Abstract:</b> Comprehensible by itself. Introduction, methods, results, conclusion.	
<b>Introduction</b>	Include current state of knowledge, with references. Identify the gap in knowledge that you wish to fill with your study. Outline objectives (primary and secondary).
<b>Methods</b>	Describe in detail what you did, and how. Detail selection criteria for study population. Describe all tests, interventions, and/or other exposures. Detail endpoints (primary and secondary). Detail considerations that led to methodological methods to be used in dedicated paragraph.
<b>Results</b>	Describe study results. Avoid commentary and take prediction. Does a result fit every method proposed in previous section. Use appropriate illustrations (Tables and Figures).
<b>Discussion</b>	Start with recap of your main finding. Put your results in perspective with other reports in the literature. Explain significance of results, and how they contribute to the expansion of knowledge, or to the state of the art. Outline strengths and limitations.
<b>References</b>	List all sources used as a basis for your work. Check accuracy of all references, even if copied from other papers.

Fig. 4. Summary of basic guidelines regarding the items to include in each section of a scientific manuscript.

# The paper body

## Sections, subsections, figures & tables

- Introductory section
- Sections and subsections
- Self-consistent figures
- Self-consistent tables

Tables are a special type of figure, with separate numbers.



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The main elements to be included in a successful title.

Feature	Example
Cite the main factors studied	State the name of the drug or intervention
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Cite the design	Randomised, double-blind, controlled trial/epidemiological study/care-cohort study
Cite the main finding	Incidence/prevalence
Put the most important aspect first	If the focus is on the intervention, because this is what distinguishes your article from others, then state the title with the intervention name
Avoid imprecise formulations that cover too specific purposes for international consensus nomenclatures for drug names	Avoid terms such as "a report of..." or "the effects of...". If there are effects, state what they are! (Qualitative, therapeutic, prognostic)
	Concomitant names should be avoided. They reduce legibility (if the pharmaceutical company), and may be considered an indirect preference for a particular company. Also, they are not about the same across different countries
	Reverse subtitles for names of study groups. Specific recommendations may apply, depending on your target journal

examples of what constitutes an efficacious title. Bear in mind that your target journal may have a limit (in terms of number of words or characters) on the length of the title. Here again, keeping it short is harder than coming up with a 4-line title.

### 3.7. References

The reference section lists all the sources you have used as a basis to prepare your hypothesis, and build your research. It is your ethical and professional responsibility to document your work adequately, and provide full transparency in identifying your sources. It is also important to cite the sources on which your hypothesis are based, to prove that they are in fact sound. The references support your work and place it in the context of other studies on the same topic, while at the same time providing guidance for readers who would like to engage in further reading on the topic.

Many young researchers find it hard to judge when it is necessary to cite a reference. Basically, any idea or fact that emanates from another source (other than yourself) needs to be

supported by a reference. However, universal truths or facts that are widely established do not need to be referenced (e.g. cardiovascular disease is very common, or cancer is a major cause of death). However, ideas, or more particularly phrases or names that were coined by someone else need to be referenced (e.g. patients with the "McCormell Sign" – The paper by McCormell describing the sign should be cited here. Or, patients were classified according to the RAKC criteria – the paper describing the RAKC criteria should be cited here).

When citing references, apart from specific papers that give their name to a sign or classification system as in the examples above, you should give precedence to articles published in English-language, peer-reviewed journals. Citings sections from published books is also acceptable, but you must be very specific and list the exact names and titles of the chapter concerned, with the page numbers, and the names of the authors and/or editors of the book, with its publication details.

Internet sites should be avoided where possible, as should personal communications and unpublished data. If you have several possible references, you may prefer to choose the most

Title Citing Drug/Intervention, Context, Design & Main Finding: Use subtitles sparingly (for study group names)	
<b>Abstract:</b> Comprehensible by itself. Introduction, methods, results, conclusion.	
<b>Introduction</b>	Include current state of knowledge, with references. Identify the gap in knowledge that you wish to fill with your study. Outline objectives (primary and secondary).
<b>Methods</b>	Describe in detail what you did, and how. Detail selection criteria for study population. Describe all tests, interventions, analyses, techniques... Detail endpoints (primary and secondary). Detail considerations that be used. Statistical methods to be described in dedicated paragraph.
<b>Results</b>	Describe study results. Avoid commentary and take prediction. Once a result is given, method proposed in previous section. Use appropriate notations (Tables and Figures).
<b>Discussion</b>	Start with scope of your main finding. Put your results in perspective with other reports in the literature. Explain significance of results, and how they contribute to the expansion of knowledge, or how they advance knowledge. Outline strengths and limitations.
<b>References</b>	List all sources used as a basis for your work. Check accuracy of all references, even if copied from other papers.

Fig. 4. Summary of basic guidelines regarding the items to include in each section of a scientific manuscript.

# The paper end

## Conclusion, acknowledgments and references

- Conclusion
- Acknowledgments
- Other mandatory sections
- References

The conclusion summarizes the main findings



recent one, or the one published in the most reliable and reputed source journal. Try to give priority to original research articles, rather than reviews. If you want to cite an idea from a paper where the authors already cite another source for the same idea, then you should return to the original article and verify the exactitude of what you are citing, then cite the original authors, not the intermediate paper. It is your responsibility to ensure the accuracy of all the references you cite, and it is up to you to provide sufficient detail so that a potential reader can find that paper. You should check the accuracy of every reference yourself, even those that you have taken from other published papers. It is not the job of your chosen target journal to format your references or verify their exactitude.

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# I Tools for scientific writing

- 1** A scientific paper
  - Papers share the same structure
  - References, so important references
  
- 2** Separation of content and presentation
  - A concept to ease and enhance writing
  - L<sup>A</sup>T<sub>E</sub>X, a scientific writing tool
  - L<sup>A</sup>T<sub>E</sub>X How To through practice



# The need for references

Standing on the shoulders of giants

## A scientific issue

In a scientific paper, *all sayings* must be

- either demonstrated,
- or taken from an identified **referenced** source.

## A network issue

The way papers are linked through proper referencing

- shows the links between scientific domains,
- shows how people work together,
- provides a world-wide basis for scientific knowledge<sup>a</sup>.

<sup>a</sup>See wikicite, crossref & the initiative for open citations



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# Do not forget the references

Researchers and advisors are touchy about references

## An acknowledgment issue

Using other people work without citing it properly is **BAD**.  
A good citation allows to find the way to the original work.

## An evaluation issue for researchers

The quality of a researcher's work is often evaluated on the  
number of times her/his papers are cited.  
Career and salary may depend on it.

## A reputation issue for institutions

International ranking is often based on papers citations rather than  
on papers themselves.  
Institutions issue affiliation rules to ensure proper automatic  
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# Reference management

Real time tracking of the papers you read to ease proper referencing upon writing

## Zotero

## UL favorite

- Keeps tracks of web searches as you read
- Keep references in collections
- Allow participative work on a reference collection
- Easy export for one click proper citations
- Allow to match most journals citation habits
- Full training courses available [here](#)

Many other reference managers exist

e.g. JabRef

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# Focus on content, not on presentation

All journals have different guidelines for presentation, though all articles share the same structure

## Journal articles share the same structure

- All journal articles have title, authors, affiliations, abstract, references. . .
- which are **typeset differently**, depending on the journal.

## Scientific writing is focusing on content

- OK for writing a short descriptive title, a meaningful abstract and properly referencing others work
- But who cares about character font or size and paper layout ?

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# Markup languages: a universal solution

XML, HTML, WikiML, SVG, PDF... and  $\LaTeX$

Specify what things are, not *how*

*This is a title*

```
\title{My really neat short and descriptive title}
```

Abstract example

```
\begin{abstract}
A good research paper can be hampered by a poor abstract.
  The students following this class should thus focus on
  paper content rather than on its layout, so that they
  can summarize it properly in an attractive abstract.
\end{abstract}
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# OK, I specify what things are

Who will specify how things are ?

The rendering job is done by a software, upon your directives

- The web browser renders the HTML language
- L<sup>A</sup>T<sub>E</sub>X renders this presentation as directed:

```
\documentclass{beamer}
\mode<presentation> {
  \usetheme{Warsaw}
  \usecolortheme{wolverine}
  \setbeamercovered{dynamic}
}
\usepackage[frenchb,english]{babel}
\usepackage[utf8]{inputenc}
\usepackage{xcolor}
\usepackage{listings}
\title{How to write a scientific paper}
\author{N. Fressengeas}
...
```

# OK, I specify what things are

Who will specify how things are ?

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- The web browser renders the HTML language
- $\LaTeX$  renders this presentation as directed:

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## Portability: another advantage of Markup languages

### In the HTML world

Think of responsive websites which can be rendered differently on computers and smartphones using the same source code

### In the $\LaTeX$ world

- The same  $\LaTeX$  code can render articles for different journals
- $\LaTeX$  code is plain text, available on all platforms
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- $\LaTeX$  can, in some conditions, be converted to HTML



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# $\LaTeX$ , a typesetting system

Read more: [The not so short introduction to  \$\LaTeX\$](#)  or [Une courte \(?\) introduction à  \$\LaTeX\$](#)

## Origins

- Written originally in 1983 by Leslie Lamport
- Uses  $\TeX$  for typesetting
- Free open source software
- Current  $\LaTeX$  engine: `pdflatex`

## $\LaTeX$ step by step

1. Use your favorite text editor to produce  $\LaTeX$  code
2. Run the `pdflatex` engine on the source code to get the PDF



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- Run the `pdflatex` engine on the source code to get the PDF
- View the result with your favorite viewer



CentraleSupélec

# $\LaTeX$ all-in-one writing environment

TeXStudio, Kile, TeXShop, TeXMaker, WinEdt, TeXnicCenter...

## All-in-one environments simplify the use of $\LaTeX$

- Integrated code writing,  $\LaTeX$ -compiling and PDF viewing
- In-line help on code writing
- Multiple file management
- Spell-checking
- ...

## Collaborative online environment

- Overleaf for collaborative  $\LaTeX$
- CoCalc for a collaborative environment including  $\LaTeX$  and various scientific softwares, allowing interactions between them<sup>a</sup>

<sup>a</sup>For example: embed R, sage ou python calculations in  $\LaTeX$



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# $\LaTeX$ , dedicated to scientists

A few features

Focus on content, forget about presentation

A state-of-the-art typesetting system will do the presentation for you

Neat equation rendering

```
\[\sum_{n=1}^{\infty}\frac{1}{n^2}=\frac{\pi^2}{6}\]
```

$$\sum_{n=1}^{+\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

Journal specific class files

Specifying the journal as your document class will set lay-out up for you

Fixe de Compétence (Français)

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# I Tools for scientific writing

- 1 A scientific paper
  - Papers share the same structure
  - References, so important references
- 2 Separation of content and presentation
  - A concept to ease and enhance writing
  - $\LaTeX$ , a scientific writing tool
  - $\LaTeX$  How To through practice



# My first article

```
\documentclass[12pt]{article}
\title{My very first article in \LaTeX}
\author{Nicolas Fressengeas}
\begin{document}
\maketitle
\begin{abstract}
This is my very first article in \LaTeX. I
will thus try to keep this abstract
short
\end{abstract}
An introductory material can come before
the first section
\section{\LaTeX\ is so great}
I love using \LaTeX. That is the reason why
this section is named this way.
\section{Make the students understand it}
There is simply no other way to write, or
beam, science. May my students
understand this after this class !
\section{Conclusion}
This is nearing to the end of the first
part of this class dedicated to tools
. Now is the time to practice, before
going into more scientific details.
\end{document}
```

My very first article in L<sup>A</sup>T<sub>E</sub>X

Nicolas Fressengeas

September 25, 2018

#### Abstract

This is my very first article in L<sup>A</sup>T<sub>E</sub>X. I will thus try to keep this abstract short

An introductory material can come before the first section

#### 1 L<sup>A</sup>T<sub>E</sub>X is so great

I love using L<sup>A</sup>T<sub>E</sub>X. That is the reason why this section is named this way.

#### 2 Make the students understand it

There is simply no other way to write, or beam, science. May my students understand this after this class !

#### 3 Conclusion

This is nearing to the end of the first part of this class dedicated to tools. Now is the time to practice, before going into more scientific details.



# Learn $\LaTeX$ How-To through practice

Typeset a Wikipedia article of your choice using  $\LaTeX$ .  
Leave out and figures and references, for the moment.  
Try to target a specific journal using its  $\LaTeX$  class.



## Part II

# The process of writing an article





## II The process of writing an article

- 3** Build the reference database
  - Read, share and remember
  - The  $\text{BIB}_T\text{E}_X$  tool
  - Practice time
  
- 4** Design the article
  - Successive approximations writing
  - Self-consistent figures and table
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- 5** Write the article
  - Usual Layout
  - A specific writing style



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# Read before you write

Be sure to stand on the shoulders of the giant

## Literature review

## Scientific & technological intelligence

- Scientific writing is always about a first-time-ever
- Read related work
- Record related work
- Get your scientific intelligence organized
- Get help from a reference manager

## Reference managers

- [https://en.wikipedia.org/wiki/Comparison\\_of\\_reference\\_management\\_software](https://en.wikipedia.org/wiki/Comparison_of_reference_management_software)

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► Complex la Doc



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# Efficiently recording relevant literature for further reference

## BIB<sub>T</sub>E<sub>X</sub>: a reference management software and a raw text file format

BIB<sub>T</sub>E<sub>X</sub>: manage your reference and get them cited in L<sup>A</sup>T<sub>E</sub>X

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# The BIBTEX file format

A raw text file for all your bibliographic data

## A sample BIBTEX item

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@article{ECARNOT2015573,  
title = "Writing a scientific article: A step-by-step guide for beginners",  
journal = "European Geriatric Medicine",  
volume = "6",  
number = "6",  
pages = "573 - 579",  
year = "2015",  
issn = "1878-7649",  
doi = "https://doi.org/10.1016/j.eurger.2015.08.005",  
url = "http://www.sciencedirect.com/science/article/pii/S1878764915001606",  
author = "F. Ecarnot and M.-F. Seronde and R. Chopard and F. Schiele and N.  
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# Build a .bib database of your own

.bib hand editing or using JabRef or Zotero

## .bib hand editing

- Use your favorite raw text editor to manually fill in your .bib file.
- Use references of your own or from a Wikipedia article
- A  $\text{L}_\text{A}_\text{T}_\text{E}_\text{X}$  designed raw text editor<sup>a</sup> can help fill .bib file

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## .bib assisted editing

- Use JabRef and/or Zotero and/or a reference manager of your choice to build a bibliographic database<sup>a</sup>
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# Actual paper writing

OK... Research background read and recorded... Research itself ready for writing...

**DO NOT** start by the beginning

It is **REALLY** difficult to start writing an article without knowing the end

DO NOT start by the end

It is **REALLY** difficult to imagine the end of an article without having written the beginning

Imagine a way to write all the article as a whole

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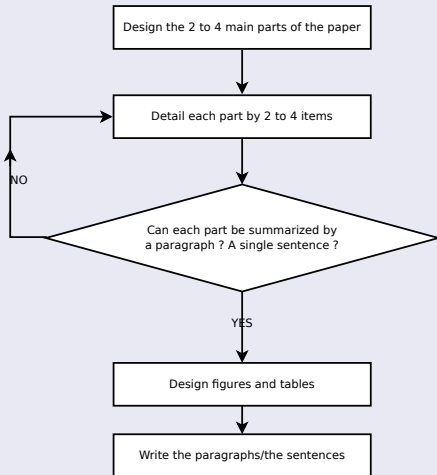
# Successive approximations writing

Writing the paper as a whole to keep consistency throughout the writing process

## A paper being written

- Introduction
- Part I
- Part II
- Part III
- end matter

## A simple algorithm



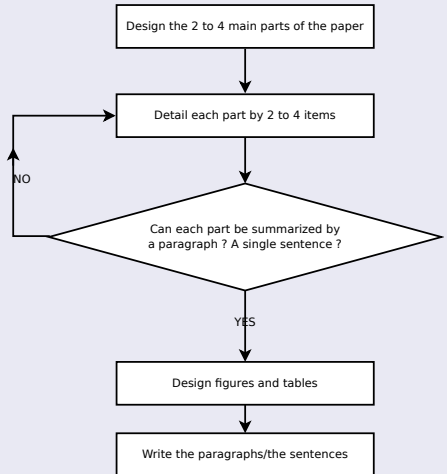
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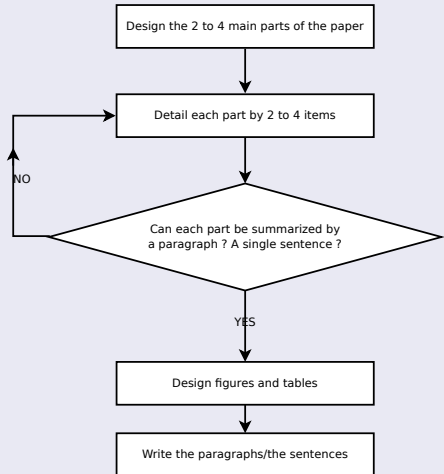
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# Figures and tables are really important

The hasty reader reads: title, abstract, author list, figures, references, conclusion... and sometimes the paper

## Successful production of good figures requires substantial effort

- Use vector graphics<sup>a</sup> for infinite resolution and small file size
- Insure good resolution for pictures
- Keep it clear and simple
- Insure black & white readability
- My favorites to create figures: Python & matplotlib, SageMath and inkscape

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# L<sup>A</sup>T<sub>E</sub>X how-to for figures and tables

Be sure to use PDF<sup>L</sup>A<sub>T</sub>E<sub>X</sub>, otherwise, only EPS file format is allowed

## Include the graphics package

```
\documentclass{article}  
%  
\usepackage{graphicx} % graphicx is the modern version of graphics  
%  
\begin{document}
```

## Create a figure file

- Preferably a vector PDF graphics file
- PNG for bitmap graphics, JPG for pictures

## Declare the figure at the right place

```
\begin{figure}  
\centering  
\includegraphics{Tux.png}  
\caption{Tux, le pingouin}  
\label{Tux}  
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# Inserting figure at the right place

Let  $\text{\LaTeX}$  place the figures nicely, it knows what its doing

## Editing rules for figures and tables

- Figure as close as possible to its declaration
- Figure *never* before its declaration
- Figure does not break text
- Figure preferably on page top, bottom if possible, on page if necessary
- If text is present on page a minimum fraction of the page is required

Let  $\text{\LaTeX}$  place the figure

Declare the figure just before the paragraph where it is referred first



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# Figure and table reference

Automated numbering of figures and tables for an automatic referencing

## The `\label` command

- `\label{AnyKeyYouWant}`
- For figures, table, equations, sections...
- Allows automated referencing to the object it is in

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- The `\ref{AnyKeyYouWant}` command is replaced by the referenced object number

## The `varref` package

- Numerous figures can be rejected far from their reference
- In a long document, figures can lie many pages before `\ref`

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# As you write and cite, the reference list builds up

BIB<sub>T</sub>E<sub>X</sub> and L<sup>A</sup>T<sub>E</sub>X magic

Place at the end of your paper

```
\bibliographystyle{unsrt} % or any other relevant style  
\bibliography{bibfile1,bibfile2,bibfile3...}
```



## II The process of writing an article

- 3 Build the reference database
  - Read, share and remember
  - The  $\text{BIB}_T\text{E}_X$  tool
  - Practice time
- 4 Design the article
  - Successive approximations writing
  - Self-consistent figures and table
  - Practice time
- 5 Write the article
  - Usual Layout
  - A specific writing style



# Build the skeleton of your first scientific paper

Ultra detailed outline, figures and automatic citations

## Get ready for writing

- Design your paper skeleton using successive approximation writing
- Carefully design self consistent figures and tables
- Declare them in your paper skeleton<sup>a</sup>
- Link your bibliography database

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<sup>a</sup>Don't worry,  $\text{\LaTeX}$  will stack them at the end of the paper, but this will change as text is added



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# Introduction

Describes the time and space context of the work to make the paper readable as a whole

## Introduction probably includes

- The paper specific domain
- A description of the problem tackled
- A review of the past attempts to tackle the same problem
  - ▶ Lots of references here
- A description of the novelties your work proposes
- A review of the article organization and strategy to present the work done
  - ▶ Materials, methods, experiments...
  - ▶ Results
  - ▶ Discussion

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# Materials, methods, experiments. . .

Describes the methods used so that the work can be *reproducible*

First goal: convince that your methods are scientifically sound

- Be sure to give all the details
- Include experimental framework and detailed conditions
- Include data collection and analysis
- Justify all, either directly or through references

Second goal: make your work *reproducible*

- Be sure to give all the details
- Open the methods as much as you can:
  - ▶ Measurement apparatus model, reference, *and inner details*
  - ▶ Open source software, or precisely referenced software
  - ▶ Detailed experimental sketches
  - ▶ ...

# Results

Results, only results: give the reader a chance interpret them on his/her own

## Give raw results in a human understandable manner

- Small tables
  - ▶ Avoid huge tables
- 2D curves
  - ▶ Think twice before going 3D
  - ▶ If approximations or interpolations are done, tell why and how

## Consider publishing your data in data warehouses

- Allows the reader to get the numbers
- Insure a long life to your data
- Allow others to browse your data
- Certify your data is sound and honest
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## Discussion

The only section which can go away from raw facts

Finally, you can write about what you are thinking

Potential advices:

- summarize your problem,
- clarify your hypotheses. . .
- and finally write about what you refrained to say from the very beginning.



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# Scientific writing style

Be clear and concise

## Be clear

- Define **everything**: math variables, acronyms. . .
- One word has one specific meaning: chose carefully
- Avoid *and so on, etc.* . . .

## Be concise

- Do not say anything twice,
  - ▶ unless you have a good reason.
- Avoid literature style effects,
  - ▶ except if it allows even more conciseness.

## Avoid

- trying to impress the reader,
- using abbreviations ("does not" instead of "doesn't").

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# Final note on plagiarism and referencing

About using the work of authors, or the shoulders of giants

## Using the work of authors is good, and necessary

- Be sure to completely understand the cited work
- Properly reference the previous writings
- Even properly referenced figures can be reused, if their license<sup>a</sup> allows so
- If absolutely necessary, the words of others can also be used, between quotes and properly attributed

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<sup>a</sup>Present licenses tend to go towards the CC-BY Creative Commons Attributions licence



# Advanced team working

Writing a paper is usually a team work. git is the ultimate solution

## Using git for collaborative L<sup>A</sup>T<sub>E</sub>X

- Use gitlab on <https://framagit.org>
- <https://youtu.be/YprjPIMtFnk>
- <https://www.google.com/search?q=git+latex>
- <https://twitter.com/Blogozoic/status/954089174461755392>

