

How to write a scientific paper or a report

Document provided on the WEB:
ecos.epfl.ch (“teaching”)

version 2.1, nov. 2005

Slide 1

A. Buttler
EPFL
Lausanne



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

- **Which take-home message ?**

- Do your science well, and **write it well**, so that it is accepted by the scientific community
- **Communicate in English in science**. It is almost the only way to be spotted elsewhere in the world and to be fully integrated in the scientific community
- Whenever possible, **start in English** from the beginning. It is best to think in English, then write in English, ... and you can still dream in French

- **What will your take-home gift be ?**
 - A **guideline** for writing a scientific paper
 - For your convenience, it is in French

- **Communicate (1)**

- The communication process is like a chain with inter-dependant steps and cascade effects:

Source ⇒ Emitter ⇒ Transmitter ⇒ Receptor ⇒ Target

- Failing at one step can **interrupt** the communication process or **alter** the message
 - The target puts **constraints** on the previous steps
- The reader has to operate a severe **selection** among the bulk of information he gets
 - This will be achieved according to the **quality** of the written communication which is at hand

• Communicate (2)

- In science, until the results of the research have been **published**, the work is not finished
- This contributes to scientific **knowledge** and your contribution will be recognised by the scientific community
- There are **rules** and the reader expects you to be: ordered, logical, brief, clear and demonstrative
 - Always conform to the **editor's guidelines**
- There are some **advantages** of written over oral communication

• Report or paper ? (1)

- A scientific paper is a type of report that has to conform to **standards** of science ethics as well as format
- To be considered as a **valid primary paper**, it must:
 - contain **original** unpublished results
 - be peer **reviewed**
 - be issued in an **adequate journal**
 - contain enough information to allow for **reproduction** of the results
 - be issued in a **permanent** form
 - be **accessible** without restriction (at least by libraries and data bases)

• Report or paper ? (2)

- A report is a written description of some work and is **not intended to be published**
- Papers in conference proceedings, institutional journals or as MSc/PhD theses are considered to be **secondary papers** and are usually not accepted in the reference list of international journals (“grey literature”)
- Whenever possible, a master thesis or a PhD thesis should be designed **so as to able to produce papers**
 - Partition chapters according to planned papers, each one organised according to the common standards

- **How to design and conduct the work ? (1)**
 - Define precisely the problem
 - What is the **question** ?
 - What are the **aims** ?
 - What do I want to **demonstrate** ?
 - Who do I want to **convince** ?
 - What is the best **method** ?
 - What is the best **statistical analysis** ?

- **How to design and conduct the work ? (2)**
 - Collect the available information
 - What has already **been done** ?
 - **Who knows** something ?
 - Build a network of information **sources**
 - **Search** and **select** with key-words
 - Make a **first analysis** and search for **clues**
 - **Organise** ideas and set **priorities**

- **How to put structure into the writing ?**
 - Set a working schedule (working plan)
 - Set yourself some constraints and **deadlines**
 - This helps to **focus** on the main topics
 - The classical writing format **IMRAD** (writing plan)
 - The most convenient, logical way to communicate science, which is the standard form:
 - **I**ntroduction
 - **M**ethods
 - **R**esults **and**
 - **D**iscussion
 - **C**onclusion
 - **A**bstract
 - The reader likes to find things in the **right place**

• The introduction

- It places the **problem** in context and explains why this paper was written
- It emphasises the **importance** of the work
- It has to **attract** the reader's attention
- It has to raise **questions** or show a **paradox**
- It describes the **current knowledge** and shows why more work is needed
- It can give a short overview on **how** the question is going to be answered
- At the end it states the **hypotheses** which are addressed
- *Use the present tense when describing current knowledge, past tense when citing results of authors*

• Material and Methods

- It provides the **details** on the piece of research
 - Study site and/or species
 - Sampling procedure and experimental design
 - Analytical procedure
 - Statistical procedure
 - Nomenclature
- Information should be **sufficient to allow for the reproduction** (verification) of the work
 - Providing some references for well known and admitted methods may be sufficient
- If there are several aspects to be presented, **subdivide** in paragraphs or subsections
- *Use the past tense*

• Results (1)

- Recall methods and present the **main results**
- Give the **facts**, without interpreting them
- Be **clear, unambiguous** and **straightforward**
- Make the best **choices** for the demonstration, “**predigest**” the data and present them in a **synthetic** form
 - Present bulk of data in **tables** or **figures**, only mention in text **most important** results and overall patterns
- If necessary, present the full data set in an **appendix**
- Keep the same **presentation order** as in the section Material and Methods

• Results (2)

- In general, references are not cited in this part
- Provide well conceived **tables** and **figures**
 - They allow the text to be condensed
 - They allow for **rapid access** to the main results and comparisons are easier to make
 - They offer a more **synthetic view** of the data
- Nevertheless, never give the same information in both, a table and a figure
- *Use the past tense for what was obtained, or the present when describing some figures*

- **The discussion (1)**

- It is where you show the real **importance**, **originality** and **novelty** of your work
- **Sort** the facts and results to show their **meaning**
- **Analyse**, **interpret** and put the various results in **relation** to make the **main ideas** emerge
 - You must convince the reader that your results mean what you say they do

- **The discussion (2)**

- Start from specific facts and move towards a **general idea** (induction)
 - If there are several ideas (not too many), put them in **logical order** and use a **hierarchical approach** which brings you to the most important idea
 - Use a subsection with a subtitle for each idea to be explored, and give facts, discuss them and end with a partial conclusion
 - Make links from one subsection to the other
 - **Demonstrate** what you stated in the Introduction (here you are preparing the general conclusion)

- **The discussion (3)**

- Make some **cross-checks**:
 - It is worthwhile to go back to the Introduction section and check if one is still on track; “Do I answer the questions or hypotheses?”
 - Go back to the Results and see if all the important results have their place in the discussion and if contradictions exist
 - The deduction of the facts based on the ideas must also be possible
 - The discussion must not go beyond what is possible to say with the presented results

• The discussion (4)

- Remember, any result can be interpreted, even if it doesn't conform to the expectation, so you should also **present what you do not understand** so far
 - Unexpected results can be the most interesting ones
 - It may lead to a new paradigm, who knows?
- **Compare** your results with those of **other authors** and put them in a more **general context**
 - It is here where you make the best use of the literature
- *Use past tense when referring to other authors; use past tense when referring to your own results and present tense when you come up with ideas*

- **The conclusion**

- It should **refer to the red-thread** of the paper, the overall approach, recalling partial conclusions from the discussion
- It must **end the demonstration** with some **suggestions** based on the general idea
- It is rather **open to action**

- What is wrong?
 - Integrating new facts or new results
 - Introducing new ideas (put this in the appropriate section, for example Perspectives, in a PhD manuscript)
 - Referring to work other than yours
 - Making a summary
- *Use present tense*

• The title

- It is a **label**, not a sentence
- It must **attract the attention** of the reader, so make it
 - **short**
 - **specific**
 - **explicit**
- It will be the first (and hopefully not the last) contact the reader will have with your piece of work, so
 - **choose words** carefully
 - avoid unnecessary words (Study on ..., contribution to ...)
 - avoid abbreviations that may not be understandable to a general audience (or put them as additional information in brackets)
- You may need to provide the editor with a **running title**

• The keywords

- They should give clues on the **main content** of the paper
 - They often are chosen so as to give information on methods, study object, theoretical framework, application
 - Words in the title, in the abstract and the keywords are the resource for data base queries
- They must **add up** information to the title with other words
- Keep their number low (about five)

• The abstract

- It must be a **short version** (about 250 words) of the paper and give a brief description of **each step**, in a **clear, simple** and attractive way
 - Introduction (aims, hypotheses)
 - Methods (if new)
 - Results (most important ones)
 - Discussion (main ideas and conclusion)
- It must be **self-sufficient**
 - **No references** to figures or tables, **no citations**
- Based on the abstract, the potential reader will decide whether he will spend more time on your paper or not, once he gets past the title and keywords

• Which journal to choose ?

- Choose your journal according to who your **audience** is
- Check the **Science Citation Index**, and remember that your future academic boss will do it too!
- Target the **best possible** journal in your field, where you can reasonably expect to be successful
- Later on, once the editor's decision is made, you will be able to **resubmit** elsewhere if necessary
- Use journal's format from the beginning, refer to **author guidelines** (read several sample papers in that journal)

• Start to write

- Once you know how you will organize your work (working plan) and what will fit in the manuscript (writing plan, ideas, ...), **start to write**
 - Do it **as soon as possible**, even before you have finished your practical work
 - you are still fully in the context and everything is in your mind
 - thinking more carefully about some aspects (methods and preliminary results) could lead to some improvements
 - it helps to overcome the anxiety of the empty page
 - Be **efficient**, for yourself, and for the future reader

- **Simplify and clarify your writing**

- The reader is only interested in your ideas, not in any kind of poetry, so make your story **explicit** and your writing **easy to understand**
 - It makes your paper better **accessible** to scientists whose native language is not English
 - Use **simple** words and short sentences
 - Organise your text in **paragraphs**, which separates the various treated aspects and ideas
 - Try to **modulate** the writing cadence
 - Be **straightforward**
- Go back to your writing a few days later, and try to **improve** both the presentation and the content
 - It may help to read it loudly, or ask a colleague for advice

- **How to do the reference list (1)**
 - Make the list of publications that are **mentioned** in the text, and only these
 - They are supposed to have been **of some use** in the paper and **support your arguments**
 - In principle, journals accept **only primary papers**
 - For secondary papers, it is sometimes possible to indicate “unpublished”
 - **Check** carefully the citations
 - Official citation of the journal, year, issue, pages
 - Correctness of names and title

- **How to do the reference list (2)**
 - **Alphabetic order** (subsequent chronological order)
 - In the text:

This was shown by Buttler (2010), or, Buttler & Day (2010), or, Buttler, Day & Givadinovitch (2010), or, Buttler *et al.* (2010) (for 3 authors, after it has been cited once with all 3 authors, or if more than three authors)
 - In the reference list:

Buttler, A. 2010. Comment rédiger. *Nature* **0**: 1-XX

DAY, R. A. 1988a. *How to write and publish a scientific paper*. 3rd ed. Phoenix, AZ: The Oryx Press.

DAY, R. A. 1988b. (...)

GIVADINOVITCH, J.-M. 1987. *Comment rédiger des notes et rapports*. Ed. de Vecchi, Paris, 280 p.

- **How to do the reference list (3)**

- **Alphanumeric order** (subsequent chronological order)

- In the text:

This was demonstrated [1], or, this was demonstrated by Buttler [1], or, this was demonstrated in 2010 [1]

- In the reference list:

1. Buttler, A. 2010. Comment rédiger. *Nature* **0**: 1-XX
2. DAY, R. A. 1988a. *How to write and publish a scientific paper*. 3rd ed. Phoenix, AZ: The Oryx Press.
3. DAY, R. A. 1988b. (...)
4. GIVADINOVITCH, J.-M. 1987. *Comment rédiger des notes et rapports*. Ed. de Vecchi, Paris, 280 p.

- **How to do the reference list (4)**
 - **Chronological (citation) order**
 - In the text:

This was shown in France [1], but also in England [2], later again in another context [1, 3 ,4].
 - In the reference list:
 1. GIVADINOVITCH, J.-M. 1987. *Comment rédiger des notes et rapports*. Ed. de Vecchi, Paris, 280 p.
 2. DAY, R. A. 1988a. *How to write and publish a scientific paper*. 3rd ed. Phoenix, AZ: The Oryx Press.
 3. Buttler, A. 2010. Comment rédiger. *Nature* **0**: 1-XX
 4. DAY, R. A. 1988b. (...)

- **What about the appendix ?**

- It should be considered as **additional information** for **optional readings**
- Contains generally tables of data, formulae or other kinds of **detailed information**
- Sometimes useful for keeping the core paper straightforward and avoiding overloading it with details

• How to determine the authorship ?

- **No rules**, just common sense, respect and agreement
- Give **priority** to people who have contributed most intellectually; forget about those who did nothing
- For people with a same contribution, use **alphabetic order**
- If the paper is part of a PhD work, it is conventional to put the name of the PhD student first
- It is often so that the boss puts its name at the end as the project leader (also strategic reasons)
- There are some **quantitative criteria** that may be used
- An unreasonable authorship list can be damaging for the group

• How to acknowledge people ?

- Saying thank you to people shows that you are aware of the **human environment** that made you successful
- Be careful, acknowledge the **right people**, and do it in an **appropriate way**
- Do not forget the **institutions who supported you with grants** (give the project name or number) or other **persons who provided logistic support**
- If the paper is part of a PhD work and the student is not first author, it is wise to mention that here

- **Send the paper to the journal**
 - The editor asks generally for 2-4 **printed copies** of the manuscript
 - **doubled-spaced**
 - **numbered** rows and pages
 - including tables and caption to figures
 - and **separate paper copies of the figures, labelled** according to the captions, with name of first author
 - The editor will possibly ask you to send the **electronic version** of the paper (give indication on the computer program and release)
 - **Electronic submission** tends to become the rule for most journals

• Feedback from reviewers (1)

- The editor will send you back his **report** with his **decision**, based on 2-3 anonymous **reviewer's comments**, which you should also get
 - Often you also get **annotated copies** of your manuscript
- If the decision is “**accepted without revision**”, you are a lucky person, and this is rare
- If the paper is **accepted with minor** or **major revisions**, you are still lucky, because, unless you do not comply with the editor's request, your paper will surely end up in press
 - Do your best and you will be lucky soon

• Feedback from reviewers (2)

- If **rejected**, you have failed. But there can be several **reasons**:
 - Maybe there were **too many good papers**, or yours was just **not inline** with the present trend
 - Or, your paper contains some serious **weakness**
- In any case, take the opportunity of having constructive comments to **improve** the paper

- **Feedback from reviewers (3)**

- **Revise** and **resubmit** the paper and **reconsider** possibly the type of journal,
 - if you feel that you did not target the correct journal/audience
 - if you feel the problem in the work cannot be corrected; consider a less demanding journal (still better than not publish at all)
- **Acknowledge the problems**, but **emphasize the contribution** that is made despite these

• The proofs

- You will get back from the editor the proofs to be **signed**, which is the **last step** before your paper goes in press
- Do **take time to check** carefully the paper for typesetting
 - Ask a colleague to help you for a cross-check with the submitted version of your manuscript
 - Major errors are not rare and can severely alter your message
 - Usually, there are only a few days to do this, so **anticipate**
- At this stage, **only minor changes** will be accepted by the editor

How to write
a scientific
paper or a
report

Good luck

Slide 38

A. Buttler
EPFL
Lausanne



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE