

How to Write a Research Paper

Without publication, science is dead

Gerard Piel

Some Basics

- Scientific progress has been the basis of much of the improvement in our standard of living and quality of life. Science has also provided answers to a row of long-standing and deep questions.
- What makes science so strong?
 1. Independence and freedom of research (only within limits for PhD students...)
 2. Open communication of methods, results, data etc. → conferences, seminars, **publications**
 3. Peer review (refereeing) and critical discussion of results
 4. Repeatability of work and compatibility with other results

Some more Basics

- An (maybe the most) important difference between academic & industrial or military research is making your methods and results public.
 - Publication means that results can be openly discussed, tested and compared (Pt. 2 is prerequisite for Pts. 3+4).
 - The checks and balances of science require publication. Also, we need to really trust the results we publish
 - In the real world: Secrecy is often maintained (regarding ideas, techniques, or new results) until published
- We **must** publish our results, even if we don't like to write. Darwin: "A naturalists life would be a happy one if he had only to observe and never to write."

Yet more Basics

- The **number and quality of publications** is an important, possibly the most important factor deciding the career of a scientist, practically a matter of life and death.
 - **Publish or perish!**
- Specifically for our Research School, publication is expected for the successful completion of a thesis.

Before starting to write

- Think early about what you want to communicate.
- Identify main aim & message of your paper.
- Wait with writing until you get final or almost final results.
 - But keep a record of your work as you do it. Our memory of even important details is often surprisingly short.
 - For the same reason start writing a paper soon after getting your results (but not before you have final results)
 - Even if you have “final” results, you will often find that you need to redo some work once you start to write.
- Discuss with your supervisor. He/she can judge best when is the best time to start writing a paper.

Before starting to write

- What kind of publication is it? E.g. Journal paper, review paper, conference proceedings paper, etc.?
- Contents, format (& partly style) differ:
 - **Journal paper**: presents final original results, careful description of technique etc., refereed ←
 - **Review paper**: summarizes, evaluates and synthesizes results already published elsewhere.
 - **Proceedings paper**: Often preliminary results, usually short (page limits), sometimes speculative (not as important as a journal paper, e.g. hardly gets cited)
 - **PhD thesis**: Combination of above. E.g.: 1st chapter like review paper, later chapters like journal papers

Before starting to write

- If it is a journal paper, choose the journal (may not be necessary at this stage). However:
 - Implications of possible page limits (e.g., letters)
 - Implications of format and style requirements (e.g. style of references, B&W or colour)
- Read the literature: Identify what is new in your work relative to what has been done before. Your work must be embedded in what has already been published: each paper is another chapter (or at least a footnote...) in the story of science.

Before starting to write

- Put together structure of the paper:
 - Title, authors, addresses, possibly key words, etc.
 - Abstract
 - 1. Introduction
 - 2. Methods & Materials
 - 3. Results and
 - 4. Discussion & Conclusions
 - Acknowledgements
 - References
- IMRaD is a typical structure (AIMRaDAR). In some cases other structures may be more appropriate.
- Divide long sections (e.g. Results) into subsections

Before starting to write

- Select which results to show
 - Often helpful: first choose the figures to be published
 - Criteria: Does the figure show something new? Is it important to understand technique or results?
 - Remember: your interest in the details of your work is larger than that of the reader → **be selective!**
- Find the order of writing the various parts of the paper that is most natural for you
 - E.g. I like to start at introduction and write through to the end, then add figure captions, references and abstract.
 - Other people prefer to start with figure captions.

Before starting to write

- Practice and if necessary improve your english (Giacconi: the language of science).
 - Remember: A paper is more likely to be read if it can be understood, i.e. if the language is clear.
 - Don't even dream of publishing in another language if you want your work to be noticed.
- You will probably need LaTeX

Time to start!

The Title

- The title often decides if the paper is looked at by colleagues: **So many papers, so little time!**
 - I first check the title (& authors). If interesting I look at the abstract, then possibly at the figures & finally at main text.
 - Often used: “Current Contents” only contain titles
- The title should be attractive
- The title should not be too long
- It should reflect the general field of the paper (e.g. include “asteroid” or “solar” or name of body)
- It should be as precise as possible (without forgetting the points above)
- It should not be too grandiose or promise too much

The Title

- Examples of titles. Which are good ones, which ones should you avoid using?
 - **Planetary atmospheres**
(too general) → (e.g.) Turbulence in the atmospheres of terrestrial planets
 - **New light on the heart of darkness of the chromosphere**
 (“solar” missing) → New light on the heart of darkness of the solar chromosphere (eye-catching, but tricky)
 - **Sizes of spots on sun-like stars**
(fine)
 - **Velocity and temperature in solar magnetic elements from a statistical multi-line centre-to-limb analysis**
(too long, boring) → Centre-to-limb analysis of solar magnetic elements

The Title

- Examples of titles (continued)
 - Magnetic fields in late-type dwarfs: Preliminary results of a multi-line approach neglecting line saturation
(too long, too negative) → Magnetic fields in late-type dwarfs measured using a multi-line approach
 - Some effects of finite spectral resolution on Stokes V profiles
(does not reveal the main result: absence of downflows)
 - The solar iron abundance: the final word
(promised too much. Was followed by paper by another group: The solar iron abundance: not the final word)

Authors & Affiliations

- Choosing the authors and their order can sometimes be a delicate matter.
 - Scientists do science because they enjoy it. However, they usually don't mind some recognition for their work, or their ideas → Co-authorship is a reward.
 - Authorship of good papers is also important for a scientist's career
 - Deciding who should be a co-author, who should be in the acknowledgements & the order in which authors stand on the paper can be tricky. Different fields & groups have different traditions → talk to your supervisor

Authors & Affiliations

- **Affiliation:** Give the whole address when writing the affiliation of each author. E.g. Max-Planck-Institut für Sonnensystemforschung, Max-Planck-Str. 2, 37191 Katlenburg-Lindau, Germany
- It is necessary to **use German original of our Institute's name on your papers**, to ensure that the institute is recognized in publication statistics (increasingly important for funding etc.)
- E-mail address is also very useful (increasingly required by journals)

Authors & Affiliations

- Write out first names or only use initials?
 - Check the guidelines of the journal you propose to publish in.
 - Full name is of advantage if
 - There is another scientist with your Surname and first initial
 - You are a woman in a male-dominated field. Specially important if you are the only author, so that your work isn't cited as, "German idiosyncrasies have been charmingly discussed by M. Curie (2004). As he has shown...."
 - Your first name is particularly beautiful....

Abstract

- Golden rule for abstracts is the same as for women's skirts: *Short is Sexy*
- Abstract should in general be less than 5% of the total length of the (journal) paper.
- Structure of abstracts: condensate of paper in one paragraph
 - Start with typically 1-2 sentences on context & aims
 - Then a very short description of what has been done
 - Finally bring the main results & major consequences
- Astron. Astrophys. requires abstracts structured in this way.

Abstract

- I suggest using the active voice (first person)
- No figures, no tables, no footnotes
- Avoid references, abbreviations, equations and symbols. Make sentences short
- Write the abstract at the very end, once you are sure what the paper looks like and you have found the correct formulations for your main results

Abstract

- Exceptions to above guidelines:
 - Abstracts that will be published in abstract booklets (abstracts submitted to conferences). There it may be worthwhile to fill the space available (I'm usually too lazy, but you hopefully are not)
 - Abstracts of review papers have a different structure. Reviews as a whole are structured differently than normal papers. However, if you are being invited to give reviews then you probably do not need to listen to this talk.

An example journal-paper abstract

Introduction Aim+Method Results Discussion

The extension of the sunspot number series backward in time is of considerable importance for dynamo theory. We have applied a physical model to records of the ^{10}Be concentration in polar ice to reconstruct sunspot number between the year 850 and the present. The reconstruction shows that the period of high solar activity during the last 60 years is unique throughout the past 1150 years. This nearly triples the interval of time for which such a statement could be made.

The Introduction

- In the introduction you describe the **background and context of your work**, i.e. what has been done before. This involves a short overview of the relevant literature. Keep the overview short: the introduction of a research article is not a review article.
- Say why the present work needs to be done. Why it is important. If criticism of earlier work is necessary, try to be mild. You don't want others to be too harsh about your work either.

Introduction contd.

- **Definitely needed:** Goals of your paper. If similar papers exist: what is new in the method or results.
- **Often done, but not necessary:** give structure of remaining paper in last paragraph of introduction.
- Many student authors find the Introduction the hardest section to write. They write it at the end, or even ask their supervisors to write it. Writing the Introduction is good practice. It forces you to learn what the importance of the work you have been doing is! This is important for your future career.

Methods and Materials

- Describes the instruments and data used, as well as the analysis techniques. It may be called differently or can be broken into 2 or more sections.
- Examples of alternative titles:
 - Computational technique
(appropriate for a numerical paper)
 - Instrument and measurements
(e.g. if a new instrument is being described or used)
 - Data and analysis technique
(e.g. if the analysis technique is non-standard)
 - Instrument and observations + Method of analysis
(Section broken into 2 sections)

Methods and Materials

- Scientific results must be reproducible. Methods and Materials section is key to ensuring reproducibility of your results, since it describes what you have done, how you have done it and with which tools.
- The “when” can also be important: give the times & dates of your observations, specially when studying variable phenomena.
- This section is often studied carefully by the referee. It can decide whether he/she feels that the results can be trusted. If he/she feels that the technique is weak, the paper will be rejected.

Methods and Materials

- Find the balance between:
 - Describing everything important
 - Leaving out everything not needed.
- Rule of thumb:
 - New method, new instrument, new type of data → Describe in detail, since required for reproducibility.
 - Known method or instrument, previously used and described in other paper(s) → Often a reference is sufficient.
- Do not repeat descriptions
- Often a figure can illustrate & clarify the method

Results

- The core of the paper, where the results obtained during the long labour of research are presented.
- Be concise. Pre-select the results (i.e. identify the important and new results) before writing about them in the results section.
- Keep in mind:
 - The fool collects facts, the wise man selects them
(John W. Powell)
 - (but don't be too wise: first collect the facts, then select them)
- Avoid repetition! (yes, I know that I'm repeating this statement, but this is a talk and not a paper).

More Results

- Decide on what to put into the Results section and what to move to the Discussions section.
- General rule (but not a very hard and fast one)
 - In the results section you only describe the results, but do not interpret them very much.
 - In the discussion section provide the interpretation and the comparison with the literature, without repeating all the results.

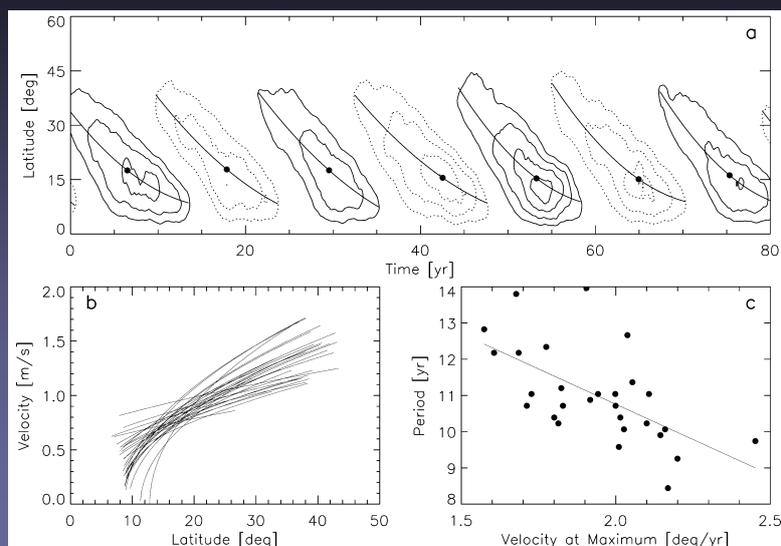
Results: Figures

- Use figures to show the main results if possible.
- Each figure must be referred to in the text.
- Each figure must have a caption.
 - Captions should be short, but self-explaining, since often figures are looked at before the text is read. I.e. if symbols or abbreviations are used, then they must have been defined in an earlier figure caption.
 - Captions should only clarify what is plotted and not try to interpret the figure. Interpret the figures in the main text.
- One way to structure this section is to write it around the figures. However, do not forget to make a logical order.

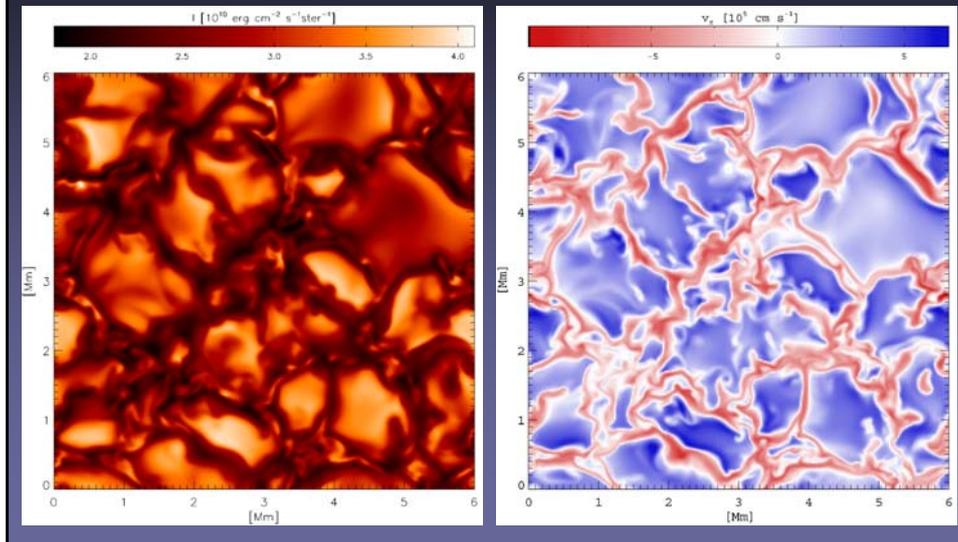
Types of Figures

- X-Y line graphs
 - If data points are linked by a line (shows dependence of one variable on another, with a particular order of the points)
- Scatter plots
 - Same as X-Y line graphs, but if the points are in no particular order
- Contour plots, surface plots, images
 - Different ways of representing 3-D data sets.
- Histograms, bar charts, pie charts
 - Representations of distributions, fractions & their evolution

Examples



Images



An Example

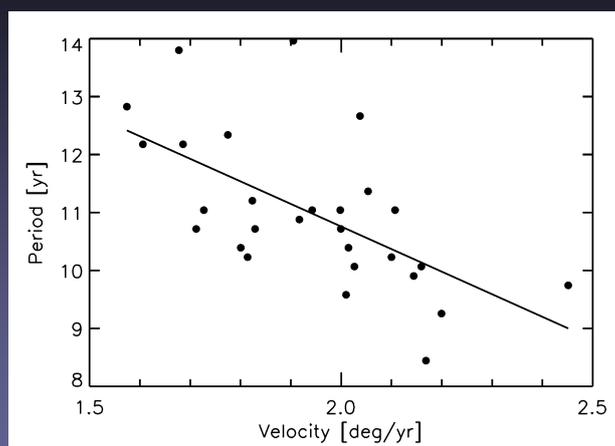


Figure 1. Solar cycle period vs. latitudinal drift velocity at cycle maximum, taken from an $\alpha\Omega$ -dynamo model. The dots represent the data of 28 simulated cycles and the line denotes a linear least-square fit.

Anatomy of a Figure

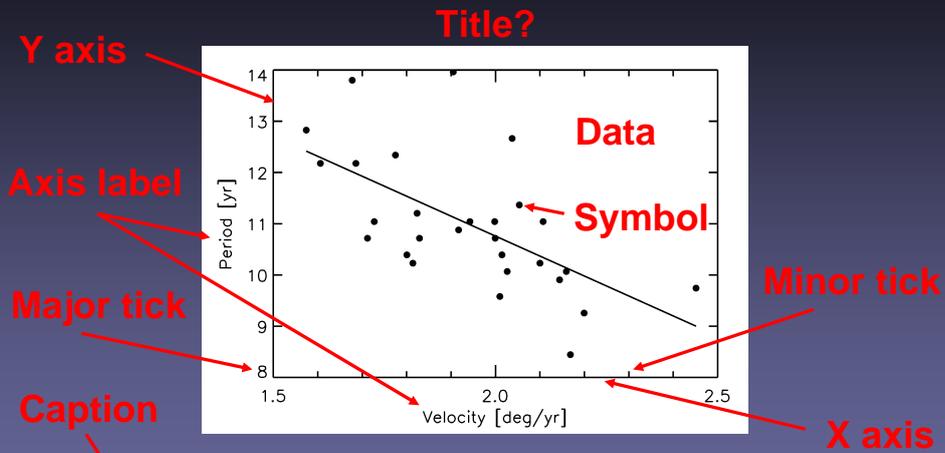


Figure 1. Solar cycle period vs. latitudinal drift velocity at cycle maximum, taken from an $\alpha\Omega$ -dynamo model. The dots represent the data of 28 simulated cycles and the line denotes a linear least-square fit

What to observe when plotting figures

- Line thickness, image resolution
 - Labels, font type & size
 - Number and size of major and minor ticks
 - Axes range (round numbers, fill the frame!), linear/log scale
 - Line style, symbols (type & size), color (cost!)
 - Give a key to symbols (either in plot or in caption)
 - Don't overload figures (too many different quantities)
 - Caption: Should give all the information needed to understand the figure, but is not a discussion (exceptions are possible; e.g. main results).
- } Depend on final size of figure!

What About Colour?

- Colour is easily produced on the screen and colour printers are also common. However, publishing a paper with colour figures is still very expensive.
- Try to avoid publishing colour figures. Use different line styles (solid, dotted, dashed, etc.) instead of coloured lines, use B&W greyscales instead of colour tables unless the figure becomes incomprehensible.
- One possibility offered by some journals: No colour charges if the figures are in colour only in the electronic version, but B&W in the printed version.

Tables

- Make a table if you have multiple numbers to show
 - and you cannot put them into a figure,
 - or if the exact numbers are important
- Remember, figures are generally easier to read than tables.
- Tables may also be useful in the Methods section – e.g. a table of observations.
- Each table must have a title. Keep it short.
- Each table must be referred to in the text.

More Tables

- Describe the different columns of the table!
E.g. as footnote to table or in main text (follow journal style).
- Some journals publish long tables electronically only. Possibly put them in appendix.
- Footnotes (e.g. sources of data are often given in the footnote of a table)

An example of a short Table

Table1. Descriptive caption above table.

Model	l [m]	v [m s ⁻¹]
A	1	10
B	3	-12
C*	5	15

*footnote

Discussion

- In this section the already presented results are discussed and conclusions are drawn from them.
- **Alternative title: Discussion and conclusions.**
Sometime broken up into two separate sections.
- It may be appropriate to repeat the MAIN result(s) (but definitely not all of them). This is not the aim of this section and is not necessary.
- Often a difficult section to write. Drawing sound conclusions from experimental or theoretical results is not always straightforward. It is an exercise in logic, requires some knowledge of the literature and experience in the topic of research.

Acknowledgements

- The acknowledgements are placed between the end of the regular text and the references.
- People who have contributed to the paper, but not by a sufficient amount to be included in the author list, should be thanked in the acknowledgements.
- Discuss with your supervisor, which people should be acknowledged.

Acknowledgements

- Acknowledgements & what they (should not) mean:
 - We thank A. Aabacher for helpful and clarifying discussions. → **Sometimes means:** the authors would have made total fools of themselves if A. Aabacher had not pointed out their error to them.
 - B. Bardot provided figures and input to the text, which is gratefully acknowledged. → B. Bardot wrote the paper.
 - C. Cardinale read through an earlier version of this manuscript → C. Cardinale found so many mistakes that the paper had to be basically rewritten.
 - We thank D. Duck for providing data and helping with their interpretation. → D. Duck actually did all the work

References

- Most important rule: Check the style manual of the journal to which paper is to be submitted. Journals have widely different styles for references.
- In solar physics: alphabetical and chronological, e.g.
 - Aabacher A., 1999, J. Irreproducible Res. 15, 16
 - Bardot B., 1988, B&B 1, 1111
 - Cardinale C., 1977, in Old Movies, ed. C. Chaplin, p. 777
 - Duck D., 1966, The adventures of Daisy D., Disney Press
 - Duck D., and Mouse M., 1955, Goofy's Mag. 13, 13
 - Duck D., McDuck S., and Mouse M., 1933a, ApJ 33, 333
 - Duck D., McDuck S., and Mouse M., 1933b, ApJ 44, 444

References

- Other journals: references are numbered in the order in which they are cited in text. Best use automated numbering scheme (provided by LaTeX)
- If you are using unpublished data or results of another researcher, then cite him/her in the text as, e.g., M. Monroe, 1999, private communication). Ask before you cite!
- No private communications or unsubmitted papers into the reference list.
- Papers that have been submitted, but not yet accepted for publication are cited as “submitted”, those that have been accepted as “in press”.

References

- A lot of errors are propagated in the References
 - Make sure the references are correct! Check the paper directly, e.g. in a data base, such as ADS (Note: ADS references have errors and many BibTeX entries are incomplete. Send ADS an e-mail with any errors you find)
 - Are all papers cited in text also present in the references and vice versa
 - Check if dates, authors etc. agree between text & references; e.g. paper marked as “1995a” in both places
- BibTeX is a great help in this respect.
- ADS provides references in BibTeX format as well. However, ADS has many gaps in planetary science

Appendices

- Material that may be of interest for a few readers, but not for most (e.g. lengthy tables, derivations of equations) can be put into an appendix or into multiple appendices.
- Most papers do not have an appendix.
- An appendix must be referred to in the main paper. E.g., “The derivation of Eq. (15) is given in Appendix B.”

After finishing to write

- Revise
- Important: be consistent. Make sure that you say the same thing everywhere in the paper. However, not always easy. Even Bible has its inconsistencies. E.g. Heaven is hotter than hell, according to Bible.
- Show the paper to your supervisor!!!

Style

- Scientific publications have their own style, different from the spoken work, different from the style of newspapers, or most literature.
- The aim of a scientific paper is to transmit what you have done and the results you have found. Remove everything not needed for this.
 - The style should be clear, simple and concise.
- Golden rule No. 1 of paper writing style: **KISS**
Keep It **S**hort & **S**imple
- Golden rule No. 2 of paper writing style: **KISS**
(for those not paying attention to Golden Rule No 1)
Keep It **S**imple, **S**tupid!

Style: jargon

- Avoid jargon! I.e. do not use unnecessarily many, long and abstruse words to hide your meaning. Do you recognize the well-known adages (the sayings) in these examples of “Jargonese”?
- A sedimentary conglomerate in motion down a declivity gains no addition of mossy material
 - **A rolling stone gathers no moss** (J-factor of 3)
- There is a large body of experimental evidence which clearly indicates that members of the genus *Mus* tend to engage in recreational activity while the feline is remote from the locale.
 - **When the cat is away, the mice will play** (factor >4)

Style: Jargonese the 2nd

- As a case in point, it has been proposed by numerous authorities that slumbering canines are best left in a recumbent position.
 - Let sleeping dogs lie. (J-factor of 6)
- From time immemorial, it has been known that the ingestion of an “apple” (i.e. the pomme fruit of any tree of the genus *Malus*, said fruit being usually round in shape and red, yellow, or greenish in colour) on a diurnal basis will with absolute certainty keep a primary member of the health care establishment absent from one’s immediate environment.
 - An apple a day keeps the doctor away. (factor >10)

Style

- Many publications are often written in an impersonal style (probably to make them appear more objective). Often the passive voice is employed. Also, in many papers written in the active voice, “we” is used, even if only a single author is present.
- My suggestion:
 - Use the first person. Use “I” if you are the only author.
 - Sentences that become too long are hard to understand. However, if all sentences are very short, the text appears to be disconnected.
 - Reading papers written by leading scientists who are native english speakers can help, but be careful, some of them also use jargonese....

Don't forget the reader

- Write at a level for PhD students working in the same general field. E.g., a planetary atmospheres paper should be aimed at atmospheric planetary scientist, but not specializing in the same planet.
- **The 4 principles of writing for the reader:**
 - **The clarity principle:** Make things clear to the reader, but do not give more information than is necessary.
 - **The reality principle:** Assume that readers know how the world works (no need to tell them all again), but tell them anything you believe they may not know & need to know.
 - **The relevance principle:** Stick to your topic and don't lose the aim of your paper from sight.
 - **The honesty principle:** State only what you can provide evidence for.

Style: The Dos

- Spell out your assumptions (Intro. or Methods Sect.)
- Be as precise as possible. Provide numbers!
- Avoid using too many abbreviations. Define the abbreviations the first time they are used. E.g.:
"Another name for Father Christmas (FC) is Santa Clause (SC). FC does most of his work in the run up to Christmas and so does SC, of course."
- Define all symbols the first time you use them
- Give the units!! SI units are now generally used.
- Use italics sparingly, avoid bold face etc.

Style: The Don'ts

- Avoid everything listed in the viewgraphs on how **NOT** to write a scientific paper.
- Don't copy sections or paragraphs from other papers, including your own, even if this seems inviting since they are already well formulated. You may end up with a paper that is both "good and original", but "the parts that are good are not original and the parts that are original are not good" (Samuel Johnson).
- Copying is ethically wrong, specially from other authors' papers. Students caught plagiarising can get thrown out of their PhD programs.

Logical sequences and connectors

- **Typical problem with papers written by beginners.** Thoughts are put to paper, but without making sure that each sentence follows logically from the previous one.
 - **Important:** The sentences within a paragraph should follow a logical sequence (i.e. it should be possible to rearrange the sentences and someone else would still be able to put them back into the correct order again). Examples are given in following slides; as an exercise)
- Importance of connectors

Killer cows and connectors

Connectors & Modifiers

lead from a (part of a) sentence (thought) to the next
A few examples (by far not exhaustive)

Indicating an addition:

additionally	as well (as)	furthermore
also	at the same time	in addition
as mentioned (above)	besides (infml)	moreover

Indicating a parallel:

by the same token	in the same way	that is
equally	likewise	
in other words	similarly	

Contrasts and alternatives:

all the same	<i>even though</i>	nonetheless
alternatively	however	rather (than)
<i>although</i>	in comparison	still (infml)
apart from that	in contrast to + noun	<i>though</i>
by contrast	instead (of ...)	though (infml)
conversely	on the contrary	<i>while</i>
despite the fact that ...	on the other hand	yet
even so	nevertheless	

Indicating a cause:

accordingly	consequently	<i>since</i>
as a consequence	<i>for</i>	so (infml)
as a result	hence	therefore
<i>because</i>	owing to ...	thus

Ordering points:

first	thirdly	in conclusion
second	then	in summary
secondly	finally	to summarise
third	lastly	to sum up

Emphasis:

above all
actually
as a matter of fact
in actuality
in fact

indeed
in particular
let alone
naturally (informal)
of course

specifically
surely
to put it mildly
to say the least
without exception

Modifying a statement:

according to ...
as a rule
by all accounts
for the most part
generally
in general
in most cases
in practice

in principle
in theory
theoretically
to some degree
to some extent
to the best of my
knowledge

Style & language

- Scientific English would be a whole lecture course in itself.
- Here I consider only 2-3 aspects.
- For example, it is important to have a handy list of verbs to use.

A collection of verbs used in describing cause-effect relationships and correlations:

actuate	compel	make
activate	control	originate (from)
affect	contribute (to)	produce
be associated (with)	correlate (with)	prompt
be conducive (to)	counteract	react (to)
be due to	depend (on)	relate (to)
be linked (to)	effect	respond (to)
be responsible (for)	induce	result (in/from)
blame (on/to)	influence	spark
bring about	initiate	stimulate
cause (to happen)	lead (to)	trigger

Which journal?

- Criteria for choice of journal:
 - The journal should cover your field and should be read by colleagues
 - The journal should have a good reputation.
 - Monetary considerations: **page charges** (if any), cost of printing in colour, free reprints provided?
- Examples of appropriate journals:
 - General: Nature & Science
 - Physics: Phys. Rev. Lett., Phys. Rev. A-E
 - Astronomy (including solar system studies): Astronomy & Astrophys., **Astrophys. J.**, Monthly Not. Royal Astron. Soc., **Astron. J.**, **Publ. Astron. Soc. Japan (or Pacific)**

Which journal?

- Examples of appropriate journals (contd.)
 - Specializing in solar phys.: Solar Physics; **JGR A**, **GRL**
 - Specializing planetary science & geophysics: **JGR**, **GRL**, Annales Geophysicae, Icarus, Earth Moon & Planets
- What determines the reputation of a journal?
 - Impact factors: How often articles in the journal are cited on average in the first 2 years after publication.
 - Nature > Science > Phys. Rev. Lett.: highest impact factors.
 - **Important**: Citation rates are very much field dependent
 - **Important**: Better a high impact paper in a low impact journal than vice versa!
 - What scientists think of a journal → talk to your supervisor and other experienced scientists in your field.

The refereeing process

- Every suitable paper submitted to a respectable journal is sent to a referee (in some cases two) to judge its merit and to advise the editor to accept or reject the paper. The editor decides!
- The referee will generally advise to either
 - publish without changes (rare)
 - publish with minor changes (the referee does not generally see the modified version again before printing)
 - publish with major changes (the referee is sent the revised version to comment on)
 - not publish in its present form, but resubmit after major modifications (to then be treated like a new submission)
 - not publish at all.

Most common reasons for rejection of a manuscript

MOST COMMON REASONS FOR REJECTING ARTICLE MANUSCRIPTS (Cited by 85 Editors of Scientific and Technical Journals)

Reason	Number of Respondents
Subject	
Not suitable for journal	63
Not timely	4
Coverage	
Questionable significance	55
Questionable validity	39
Too shallow	39
Too exhaustive	8
Length	
Too long	26
Too short	4
Presentation	
Bad organization	35
Ineffective expression	33
Ineffective or unusable illustrations	11
Failure to follow style guide	4

Contributors' most common mistakes

- **Organization and Presentation (50):** Rambling – do not show problem or significance of results; no summary; failure to make a case; failure to cite previous work; too long – overly detailed information; poor graphics; no mention of uncertainties.
- **Manuscript (21):** Failure to follow instructions for authors.
- **General (15):** Unaware of the scope of the journal – look at a few issues and see what we publish; too PR oriented – tooting their own horns; insignificant papers – not up to professional standards.
- **Expression (8):** Lack of clarity, conciseness (try to write clearly, not profoundly); failure to write for the audience – use of highly specialized terms.

Dealing with referees' reports

- At first sight referees' reports often look more negative than they really are.
- Read the report, show it to your supervisor. If rather negative then put it away for a few days (to calm down). Only then read it again & make the requested changes to the paper.
- When sending back the revised paper, also send back a reply to the referee, pointing out how you have taken his/her comments into account in the revised manuscript. If you disagree with the referee and haven't taken a suggestion into account, explain why not.
- Referees are not always stupid. If the referee does not understand something, then maybe the paper is not clear. Make it clearer.

Dealing with referees' reports

- Remain polite. Usually the referee is trying to help. It is better that the referee catches any errors before the paper is published. Even if the referee is nasty, usually little is gained by showing your anger.
- If you feel that you are being unfairly treated by the referee you can ask for a second opinion. Only worth doing if your paper gets rejected and you have good scientific arguments why the referee's criticisms are unfounded. Editors generally send the paper **and** the report of 1st referee to 2nd referee. If this referee also rejects the paper, then that is it.
- Example of an exception: Parker's solar wind paper

Crimes of Referees

- Sometimes referees really are unfair. Examples of referee's misdemeanors (luckily very rare!):
 - Stealing an idea from a submitted paper written by a novice (happened to Jack Harvey).
 - Instead of pointing out an error in the report, accepting the paper and writing a paper attacking that error (happened of Eugene Parker)
 - Stating that the paper needs to contain more material (a difficult one for editors to catch)
 - Making general statements about the quality of the paper without pointing out what is wrong specifically (e.g. "results are obviously wrong")

Ph.D. Theses

- Basic structure of a Ph.D. thesis can follow two paths (Some Universities leave you no choice):
 - Path 1: Like a long research paper: IMRaD (or similar)
 - Path 2: A succession of almost independent research papers bounded by an introduction and final conclusions.
- In both cases the following parts are necessary:
 - **Summary** [language(s), form & length often prescribed by the university]
 - **Introductory chapter**: Review of the field, to show that the student has mastered the literature and background.
 - **Conclusions chapter**, including an outlook for future work. To show that the student has got his/her own ideas for future work & is ready for independent scientific work.

Ph.D. Theses

- Both IMPRS partner Universities allow paths 1 or 2. No need to rewrite the text of the papers.
- A Ph.D. thesis is longer than a typical research paper, i.e. there is more space for writing about details, specially about the methods.
- Chapter(s) on methods and materials are obligatory only if Path 1 is followed, but are often also introduced for Path 2, since more space is available (see point above).
- For path 1 the references are best listed at the end of the thesis, for path 2 after each chapter.

Ph.D. Theses

- Questions can arise if there are multiple authors of a given paper forming a chapter of a thesis and in particular if the student is not the first author. Often a written statement from the student is required by the university pointing out his/her exact contribution.
- I tend to allow my students more freedom with individual style in the thesis than in papers. However, supervisors differ in this respect.

Ph.D. Theses

- In the IMPRS we expect each Ph.D. thesis to contain the material of multiple research papers.
- Remember that your thesis will be carefully read by multiple people and you will be questioned about it.
→ Don't take writing your thesis too lightly.
- However, very few theses are read as often as research papers once the student has got his/her doctorate (although they are often given to new students starting on a subject as an introduction) → Avoid unnecessary perfectionism.

Posters

- A poster must be attractive and should bring its main message across in 5 minutes (divide the number of posters at a meeting by the lengths of the poster breaks...)
- Basically a poster is an extended abstract with pictures and captions
 - Rules Nos. 1+2+3: **Less text!**
 - Rule No. 4: Show only the absolutely main result(s)
 - Rule No. 5: Use **big** fonts, to be readable from 2m away!
 - Rule No. 6: A picture tells more than a 1000 words
 - Rule No. 7: Do not clutter. Space looks attractive.
 - Rule No. 8: **Use colour!**
 - Rule No. 9: Avoid tables. If at all, only very short tables.

Posters

- Possible structure of a poster:
 - Title (**BIG**) + authors + affiliations
 - Abstract
 - A very short Methods and Materials section (can in some cases even be left out)
 - Main Result, or Results (the bulk of the poster)
 - Conclusions (short)
 - Few references (even no references is o.k.)
- In contrast to a paper in a refereed journal, the results presented in a poster and published in proceedings can be preliminary.

Acknowledgements

- I thank Dieter Schmitt for help with sources and with the slides describing figures and tables.
- Robert Day's book on "How to write and publish a scientific paper" is a rich source of material, both serious and not so serious. Many of the examples and cartoons are borrowed from there.
- Daniel Stotz, whose lecture notes on "Writing English for Science" was another great source of inspiration and material.