ETH zürich

How to write a strong research paper and get it published in a scientific journal?

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Video Seminar at Harbin Institute of Technology, December 17, 2021

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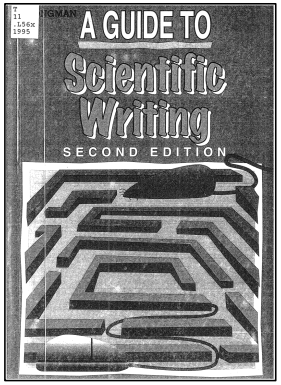
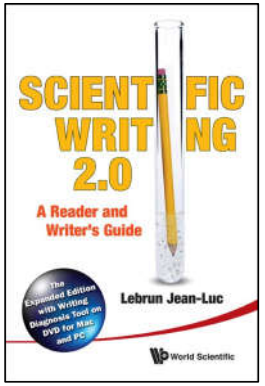
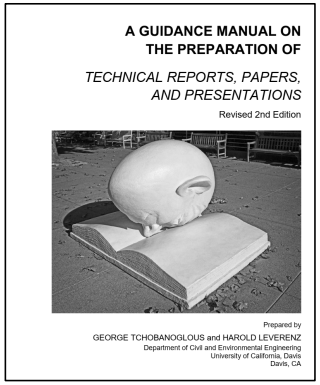
Objectives







- Goal: Provide my **personal perspective** on writing that is based on
  - Working with my students on their research and on journal manuscripts
  - Critically reading and analyzing the scientific literature
  - Reviewing manuscripts for a range of journals
  - Editor-in-Chief for Water Research and Water Research X

- Target audience
  - Early career researchers (e.g., PhD, post-doc)

This presentation is in part based on excellent presentations by Gustav Olsson (“Writing and Publishing Scientific Papers”, 2020) and Günter Blöschl (“How to write (and publish) a scientific paper in hydrology”, 2011)

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Where do I come from?

- **MSc:** University of California, Davis (1994)
- **Dipl.-Ing:** Technical University of Hamburg-Harburg (1995)
- **PhD:** Technical University of Munich (1998)

- **Post-doc:** Technical University of Denmark (1998-2000)
- **Assistant/Associate Professor:** University of Illinois at Urbana-Champaign (2000-2009)
- **Professor and head of Process Engineering Department:** Eawag: Swiss Federal Institute of Aquatic Science and Technology (since 2009)
- **Professor:** ETH Zürich (since 2009)

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KEY TO GOOD WRITING: Think of the reader

The issue is not what you want to say, what you have done, or how hard you worked…

…but what the readers should learn from your paper.

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Who are your readers?

- Your scientific community (Which community? Target journal?)
- Engineering practice (What journals do practitioners read?)

- Reviewers of your paper (Most likely you are citing their work)
- Editor of the journal (Has broad overview but not necessarily detailed knowledge)

Ask yourself:
How will your readers read your manuscript?
Who will read word-by-word? Who will read selectively?

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Why publish a journal paper?

- Sharing results is rewarded in academic research – compare to industrial setting

- Personal motivations for publishing journal papers
  - **Share your findings** with others to advance knowledge in your scientific community, in engineering practice, in policy and decision making (altruistic sharing)
  - **Quality control** (e.g., requiring 3 – 4 journal papers for granting a PhD degree)
  - Advancing your **academic career**

Notes:
Aim to focus on overall impact and not only number of publications and impact factor
Quality over quantity: Declaration of Research Assessment (DORA) (https://sfdora.org)

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Structure of today's presentation

- Guiding principle: Think about your readers
- **How to publish a journal manuscript?**
- **How to write a journal manuscript?**
- Some other topics in scientific publishing
  - Open access
  - Open data
  - Cheating

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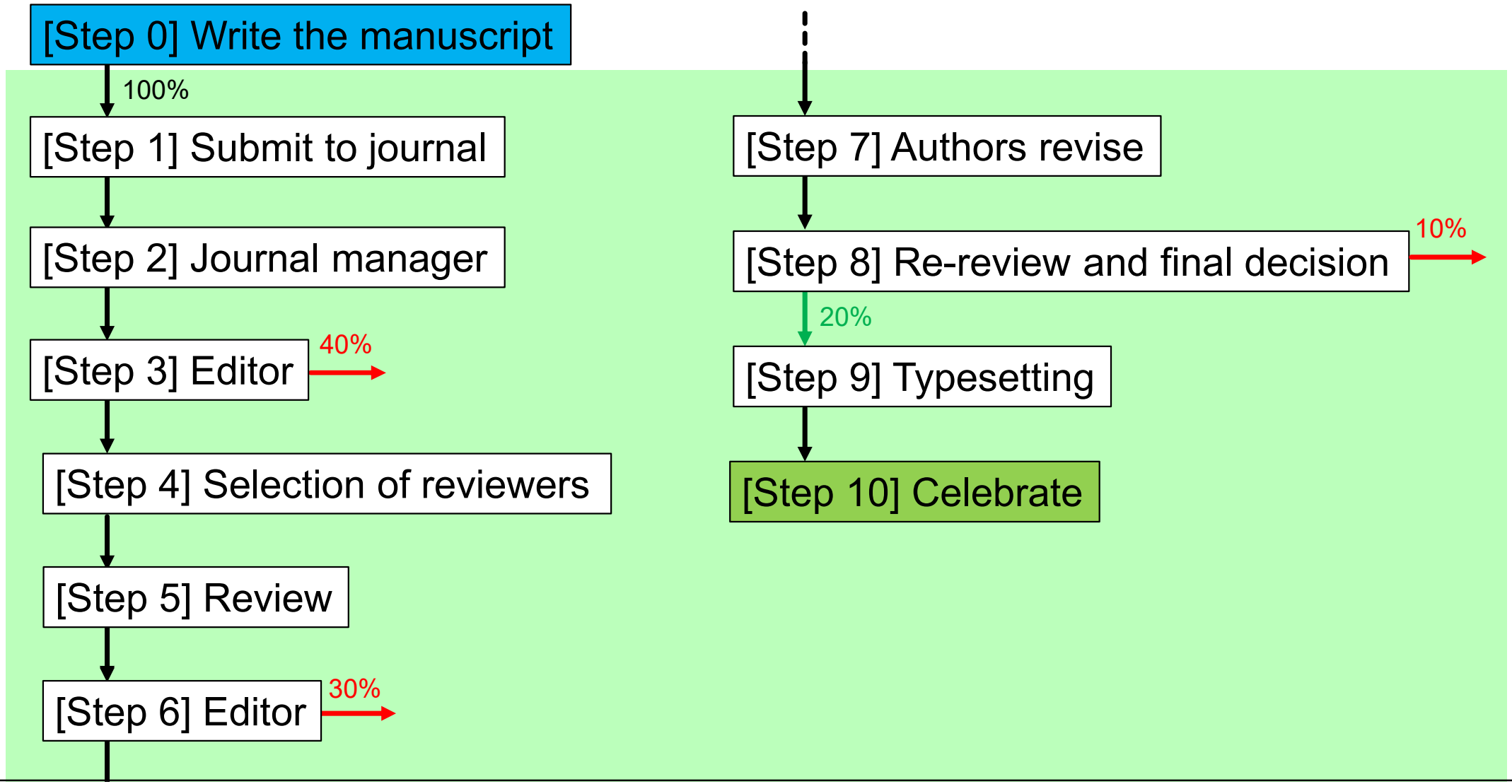
Your journey towards publishing your paper



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[Step 1] Submission process

- Material you must submit with your manuscript (check “Instructions For Authors”)
  - Since January 2021, Water Research requires authors to deposit their research data in a relevant data repository and to cite this dataset in their article. If this is not possible, authors are required to make a statement explaining why sharing their research data is not possible.
  - Supplemental information (if applicable)
  - Names of suggested reviewers

- Authors of your manuscript
  - Include only people as authors that have actively contributed to the research and the writing
  - All authors must agree to the submission

Morgenroth, E. and Pinto, A. (2021) Make your research more accessible. *Water Research 188, 116453.* https://doi.org/10.1016/j.watres.2020.116453

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[Step 3] Editor (your first reader) – Plagiarism check

- Plagiarism check
  - Plagiarism detection software provides numerical score quantifying overlap with journals, books, and resources on the internet
  - Editor evaluates the relevance of any overlap

- Plagiarism and limited novelty
  - Plagiarism as “stealing” from papers published by other authors
  - Plagiarism as “reusing” from your own papers (…often without citing your other papers)
  - Salami tactic: Authors cut their research as “thin as salami slices” in order to maximize number of publications

→ Plagiarism and salami tactic result in the up-front rejection of your manuscript

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[Step 3] Editor (your first reader) – Basic quality check

- Quick evaluation of your manuscript
  - Basic quality (first impression, spelling, structure, quality of figures)
  - Fitting the scope of the journal
  - Relevance
  - Identifies and addresses a specific research gap

→ Manuscripts that do not pass this basic quality assessment are up-front rejected

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[Step 3] Criteria for up-front rejections (*Water Research*)

- Poor English and insufficient attention to language and presentation
- Excessive length
- Lack of literature background
- Inadequate references
- References mainly being to the authors' own papers
- Commercial content, marketing a product
- Weak content or insufficient relevance
  - Lack of conclusions and discussion
  - Lack of quantitative information (data, tables, etc.)
  - Case studies or local issues, where observations are not generalized
  - Insufficient research content (a lack of novelty, deliberate division of results into serial manuscripts) = salami tactic
  - Minor chance of being generally useful or cited (might be a nice piece of formal research work that no one is interested in)

van Loosdrecht, M.C.M. and Henze, M. (2012) Up-front rejections or which type of paper should I not submit to Water Research. *Water Research* 46(8), 2487-2487. https://doi.org/10.1016/j.watres.2012.01.038

[Step 4] Editor selects and invites reviewers

Reviewers are invited from

- Suggestions by the authors (must not have a conflict of interest – do not suggest previous colleagues or personal friends)
- Reviewers identified by the editor based on
  - Authors cited in your manuscript
  - Authors citing a key reference in your manuscript
  - Authors using similar citations as your manuscript
  - Literature search based on topics or keywords
  - Expertise of the editor

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[Step 4] Editor selects and invites reviewers

- How many reviewers are invited?
  - Initially, three reviewers are invited, and are expected to review within 21 days
  - More reviewers must be invited if those invited do not accept
  - Editor decides on number of completed reviews as basis for decision (typically two reviews)

Note: Reviewers will read title and abstract of your manuscript before they decide to accept reviewing

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[Step 5] Peer review

- Typical time a reviewer spends on a manuscript: 2 h (90% of the manuscripts)
- Approach for the reviewer
  - First inspection: Get an overview by going through highlights, conclusions, figures, tables, introduction
  - Relevance: Evaluate relevance based on your own expertise or based on going a bit into the literature. → If the work is not relevant, then "reject" and provide proper argumentation why the manuscript is not of interest or not of sufficient quality. No need to go into further details.
  - Critical evaluation: Approach, results, interpretation of results, discussion, logical structure
  - Details
- Reviewer prepares a report with focus on (a) relevance, (b) critical evaluation (major comments), and (c) details (minor comments)

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[Step 6] Editor takes first editorial decision

- Decision of the editor (Minor revisions, Major revisions, Reject) based on
  - Recommendations by the reviewers
  - Written comments of the reviewers to authors and to editor
  - Own evaluation

Note: Criteria for the editor when making the decision

- *How will readers benefit from this manuscript?*
- *Will this manuscript have an impact on science and/or engineering practice?*
- *Is it feasible that the next version of the manuscript can be accepted?*

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[Step 7] Authors revise their manuscript

- Read the critical feedback from the editor and from the reviewers
- Get over the pain after the initial suffering
- Identify key problems and necessary changes based on the critical feedback
- Note: It is still your paper. Do not simply implement all suggestions provided by the reviewers.
- Revise your manuscript using track changes
- Prepare a point-by-point response
  - If you agree with the criticism - what was changed and why?
  - If you do not agree with the criticism – why not?

Note: Who will read your responses? Editor and possibly one or more of the original reviewers will evaluate the revised manuscript and your responses.

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[Step 8] Editor takes final editorial decision

- Decide to accept or reject (in rare cases revise) based on
  - Re-review by one or more of the original reviewers
  - Own evaluation

Note: In case of rejection – Water Research *and* Water Research X *do not allow for resubmission of rejected manuscripts*

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[Step 9] Typesetting of your manuscript

- Typesetting is easy, if you have prepared figures and tables in a way that they fit to journal (e.g., font size in figure suitable for printed paper)

- Publisher provides page proofs for your review. Check them carefully!

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[Step 10] Paper is published!

- The world is now ready to read your published paper.

- Will the paper have real impact? This is the true test of your manuscript!

Note: What was your intended impact when publishing the paper? Advance scientific understanding? Advance engineering practice? Advance your career?

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Editor's perspective: Main reasons for rejecting/accepting

Leading to rejection

- Lots of data and detailed statistical analysis – but **lack of relevance**, **lack of specific question**, **lack of take-home message**
- **Sloppy** writing or sloppy data analysis
- Lack of **quantitative information**
- Not focused: **Too long** or too many figures and tables
- Not linked to the **available literature**
- Case study *without* **broader implications**

Leading to acceptance

- Addresses a **scientific or engineering challenge** with an interesting and novel **approach**
- Provides interesting **discussion** that extends beyond the specific experimental results
- Stimulates **new thinking and discussion**
- Case study *with* **broader implications**

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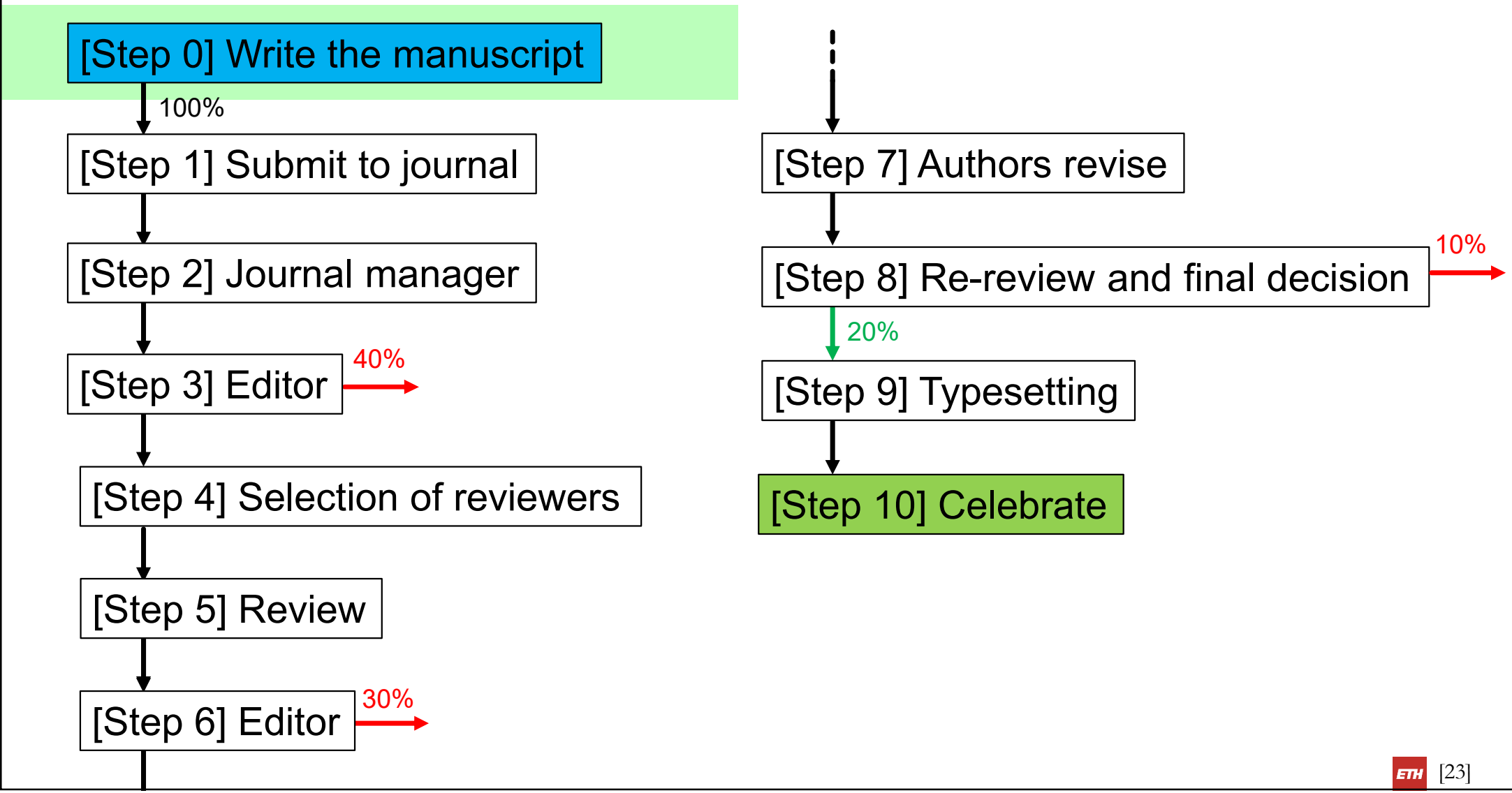
Your journey towards publishing your paper



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Your journey towards publishing your paper

[Step 0] Write the manuscript

[Writing 1] What you need BEFORE you can start writing:
Experimental design and **story to tell**

[Writing 2] Identify **take-home message**: **Conclusions**

[Writing 3] Prepare a **commented outline**: Outline each section in a few bullets

[Writing 4, 5, …] **Write the manuscript** > Review > **Rewrite** > Review…

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BEFORE you start writing: You must have a story

- You CANNOT write a good paper if you do not have a story to tell

- Key elements of a good story
  - Relevant topic and problem → Know the literature
  - Clear question
  - Relevant results
  - Clear take-home message

  } → Experimental design

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Editor's perspective: Experimental design

Bad experimental design

- Choose relevant **topic**
- Do lots of **experiments** varying many relevant variables and measuring many relevant performance indicators
- Write a paper **describing your results**

Good experimental design

- Choose relevant **topic**
- Read the literature and identify relevant unresolved questions (**research gaps**)
- Identify **approaches to answer these specific unresolved questions**
- Think about your **expected conclusions** and how these conclusions can be supported with **expected results**
- Do dedicated **experiments**
- Writer a paper that **addresses the research gap → take-home message**

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What is your take-home message?

- You know you have a good take-home message if you can do all of the following
  - Summarize your take-home message in a **few sentences**
  - Explain your take-home message in a **few minutes** to a **colleague who is not an expert** in the topic
  - Present your overall story using a **piece of paper** and a pencil (or a **white board**)
  - Consider the following scenario: Who are key experts on the topic (most likely you are citing their work in the discussion section of your paper)? Pretend you **explain the novelty of your manuscript to these experts**.
- Do not start writing if you do not have a clear understanding of your take-home message

Note: Take advantage of discussions within your research group or at conferences to test your take-home message

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Conclusions

- Your conclusions contain your key take-home message
- Conclusions are NOT a summary of your results
- Conclusions are NOT a discussion
- Conclusions are NOT an extension of your paper
- Present your conclusions in form of a bulleted list
- Start with your most relevant conclusion

Note: Your conclusions should be relevant beyond the specific experiments you are describing in your manuscript. What can the reader learn in more general terms?

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Editor's perspective: Conclusions

Bad conclusions

- The treatment system reached 95% COD and 70% nitrogen removal.
- The model sufficiently fitted the experimental data.
- Experiments were performed for a period of 400 d with variable influent loading and different solids retention times resulting in the accumulation of suspended solids.

Good conclusions

- Decreased nitrogen removal can be explained by the competition of heterotrophic and autotrophic bacteria for oxygen in deeper layers of the biofilm.
- Suppression of filamentous microorganisms in mixed cultures can be achieved by a selector. The selector forms the initial part of a biological reactor and is characterized by a low value of the dispersion number, desirably below 0.2, and by an adequate substrate concentration gradient.(1)

(1) From Chudoba and Ottova (1973) *Water Research (7), 1389-1406.*

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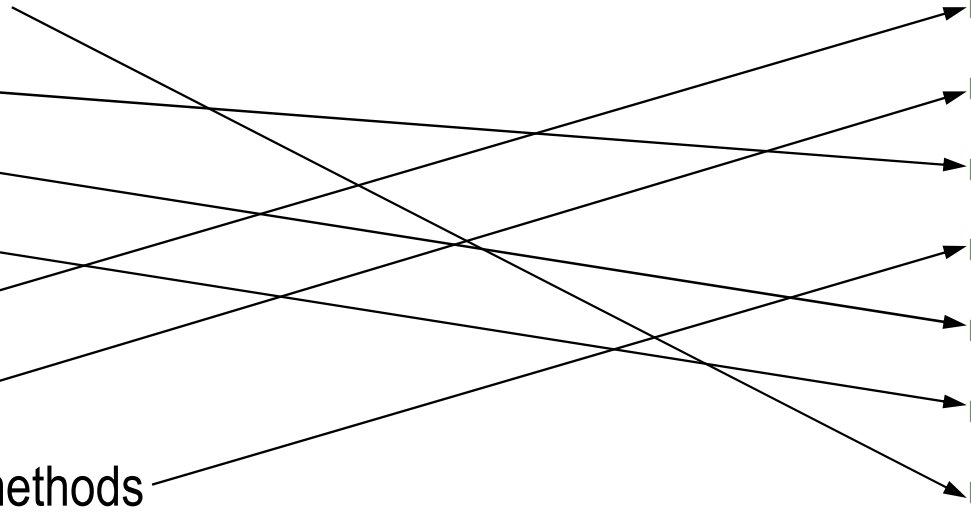
Prepare a commented outline before detailed writing

- Typical commented outline is two or three pages long, mostly bulleted list
- List key information and key references for each of the section

- Suggested sequence when preparing outline
  - Conclusions
  - Introduction
  - Results
  - Discussion
  - Title
  - Abstract
  - Material and methods

- Sections in final paper
  - Title
  - Abstract
  - Introduction
  - Material and methods
  - Results
  - Discussion
  - Conclusions



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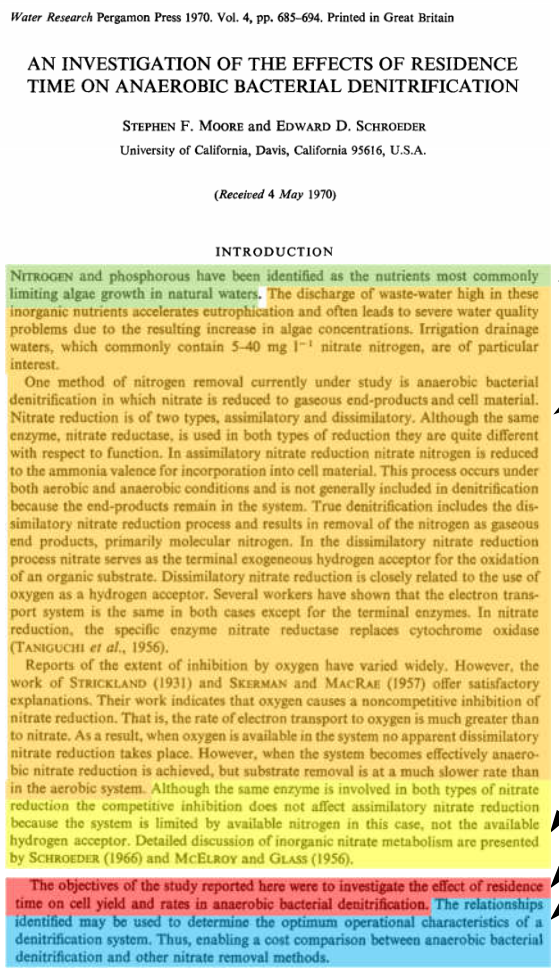
Introduction



Water Research Pergamon Press 1970. Vol. 4, pp. 685–694. Printed in Great Britain

AN INVESTIGATION OF THE EFFECTS OF RESIDENCE TIME ON ANAEROBIC BACTERIAL DENITRIFICATION

STEPHEN F. MOORE and EDWARD D. SCHROEDER
University of California, Davis, California 95616, U.S.A.

(*Received* 4 *May* 1970)

INTRODUCTION

NITROGEN and phosphorous have been identified as the nutrients most commonly limiting algae growth in natural waters. The discharge of waste-water high in these inorganic nutrients accelerates eutrophication and often leads to severe water quality problems due to the resulting increase in algae concentrations. Irrigation drainage waters, which commonly contain 5–40 mg l^{-1} nitrate nitrogen, are of particular interest.

One method of nitrogen removal currently under study is anaerobic bacterial denitrification in which nitrate is reduced to gaseous end-products and cell material. Nitrate reduction is of two types, assimilatory and dissimilatory. Although the same enzyme, nitrate reductase, is used in both types of reduction they are quite different with respect to function. In assimilatory nitrate reduction nitrate nitrogen is reduced to the ammonia valence for incorporation into cell material. This process occurs under both aerobic and anaerobic conditions and is not generally included in denitrification because the end-products remain in the system. True denitrification includes the dissimilatory nitrate reduction process and results in removal of the nitrogen as gaseous end products, primarily molecular nitrogen. In the dissimilatory nitrate reduction process nitrate serves as the terminal exogeneous hydrogen acceptor for the oxidation of an organic substrate. Dissimilatory nitrate reduction is closely related to the use of oxygen as a hydrogen acceptor. Several workers have shown that the electron transport system is the same in both cases except for the terminal enzymes. In nitrate reduction, the specific enzyme nitrate reductase replaces cytochrome oxidase (TANIGUCHI *et al.*, 1956).

Reports of the extent of inhibition by oxygen have varied widely. However, the work of STRICKLAND (1931) and SKERMAN and MACRAE (1957) offer satisfactory explanations. Their work indicates that oxygen causes a noncompetitive inhibition of nitrate reduction. That is, the rate of electron transport to oxygen is much greater than to nitrate. As a result, when oxygen is available in the system no apparent dissimilatory nitrate reduction takes place. However, when the system becomes effectively anaerobic nitrate reduction is achieved, but substrate removal is at a much slower rate than in the aerobic system. Although the same enzyme is involved in both types of nitrate reduction the competitive inhibition does not affect assimilatory nitrate reduction because the system is limited by available nitrogen in this case, not the available hydrogen acceptor. Detailed discussion of inorganic nitrate metabolism are presented by SCHROEDER (1966) and MCELROY and GLASS (1956).

The objectives of the study reported here were to investigate the effect of residence time on cell yield and rates in anaerobic bacterial denitrification. The relationships identified may be used to determine the optimum operational characteristics of a denitrification system. Thus, enabling a cost comparison between anaerobic bacterial denitrification and other nitrate removal methods.

- **Topic:** Simple sentence to introduce the context and the specific problem
- **Background:** How have other researchers approached this specific problem? What is the take-home message from their work?
- **Knowledge gap:** What unresolved questions remain?
- **Specific objectives for this paper**
- **Approach**

Note: In the detailed outline you should include one or two bullets and key references for each paragraph of the introduction

Moore, S.F. and Schroeder, E.D. (1970) *Water Research 4(10), 685-694.*

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Results

- Figures and tables
  - Plot and list all your relevant results in different ways and print them out
  - Find a big table and sit with your printouts to identify figures and tables that are essential to support your conclusions and your overall story
  - Include only essential figures and tables in your main manuscript

- You do NOT have to present everything that you have measured – but you must also NOT hide results that contradict your conclusions (no “cherry picking” – this is cheating and an ethical offense)

Note: The detailed outline should include relevant figures and table together with a bulleted list of key information you want to highlight for each figure or table

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Discussion

- This is your main intellectual contribution in a manuscript
- Do NOT simply compare your result with other papers
- Put your results (and your take-home message) in perspective relative to the available literature (and take-home messages from the literature)
- What are the limitations of your findings? What are broader implications?
- Choose: Separate “Discussion” or combined “Results and Discussion” sections (either choice is OK for *Water Research* or *Water Research X*)

Note: Imagine an author of the papers you are citing (a possible reviewer of your manuscript) is reading your discussion. What will he/she learn from your discussion? Will he learn something new and relevant?

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Editor's perspective: Discussion

Bad discussion

- We observed fluxes of 12 L/m^2.h while Jones (2018) observed 8 L/m^2.h and Smith (2019) observed 15 L/m^2.h.

Good discussion

- We observed fluxes of 12 L/m^2.h where the hydraulic resistance was dominated by biofilm growth. An increased flux of 15 L/m^2.h was observed by Smith (2019) due to improved pretreatment resulting in less biofilm formation in their system.

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Title and Abstract

- Title
  - Concise, interesting, informative
  - Avoid abbreviations

- Abstract
  - Briefly state the purpose of the research, the principal results and major conclusions
  - An abstract is often presented separately from the article, so it must be able to stand alone

Note: Most readers and invited reviewers will decide to read the full manuscript based on title and abstract. Make them attractive.

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Materials and Methods

- You can write them already as you are doing your research
- This is the easiest section to write
- Provide all relevant information to reproduce your experiments
- No need for justification
- No results

Note: If you were the reader - what would you want in the Material and Methods to (1) understand the results or (2) to reproduce the experiments?

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Writing is hard work

- Good writing is not a talent people have – it is a skill that you can learn
- Follow a stepwise approach[1]
  - Step 1: **Commented outline** (This is most likely the hardest part)
  - Step 2: **First draft**. Write the sections following your outline (This should be relatively easy and quick with the commented outline as guide) – do NOT worry about details
  - Step 3: **Fluency test** – does the flow of the sections work as planned?
  - Step 4: **Readability**
  - Step 5: **Final polishing**
- If you are stuck or unhappy with your current draft
  - Prepare a reverse outline from your current material – does it make sense?
  - How does your reverse outline compare with your original outline?

[1] Lindsay, D.R. (1995) *A Guide to Scientific Writing*, Longman, Melbourne.

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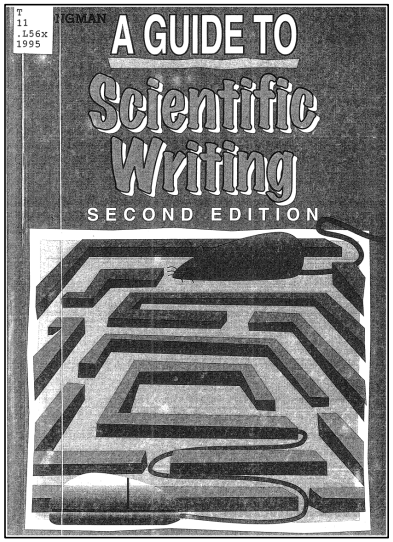
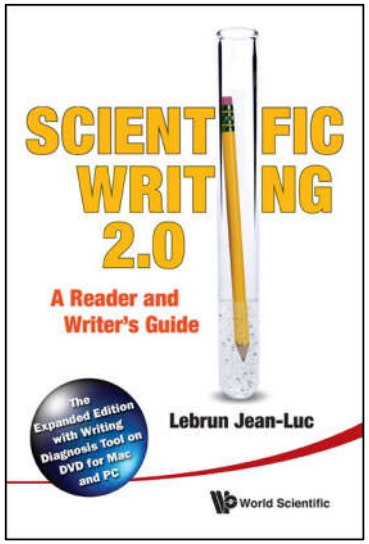
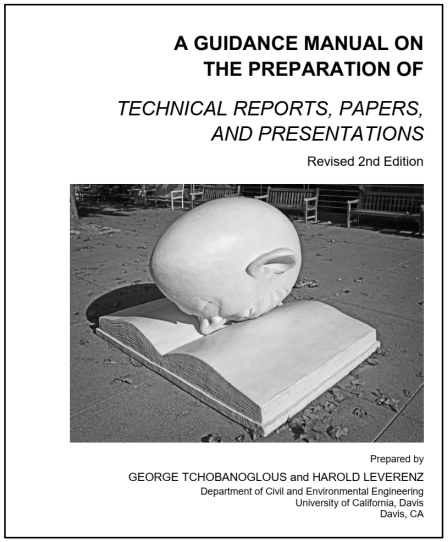
Excellent resources on writing are available – read them!

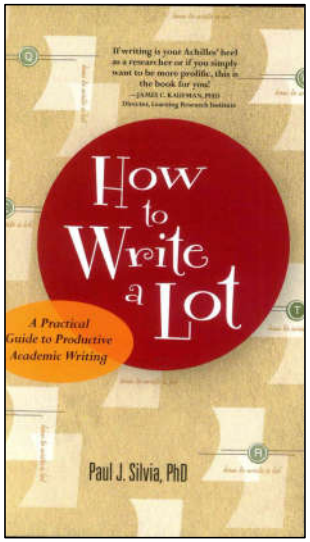
- Lindsay, D.R. (1995) *A Guide to Scientific Writing*, Longman, Melbourne. (Out of print)
- Lebrun, J.-L. (2011) *Scientific writing 2.0 a reader and writer's guide*, World Scientific, New Jersey. https://doi.org/10.1142/9789814350617_0001
- Tchobanoglous, G. and Leverenz, H. (2013) *A guidance manual on the preparation of technical reports, papers, and presentations*. https://aeesp.org/sites/default/files/publications/writingGuidance2nd_01dec13.pdf
- Silvia, P.J. (2019) *How to write a lot: A practical guide to productive academic writing*, Second edition., American Psychological Association, Washington, DC. https://www.apa.org/pubs/books/4441031

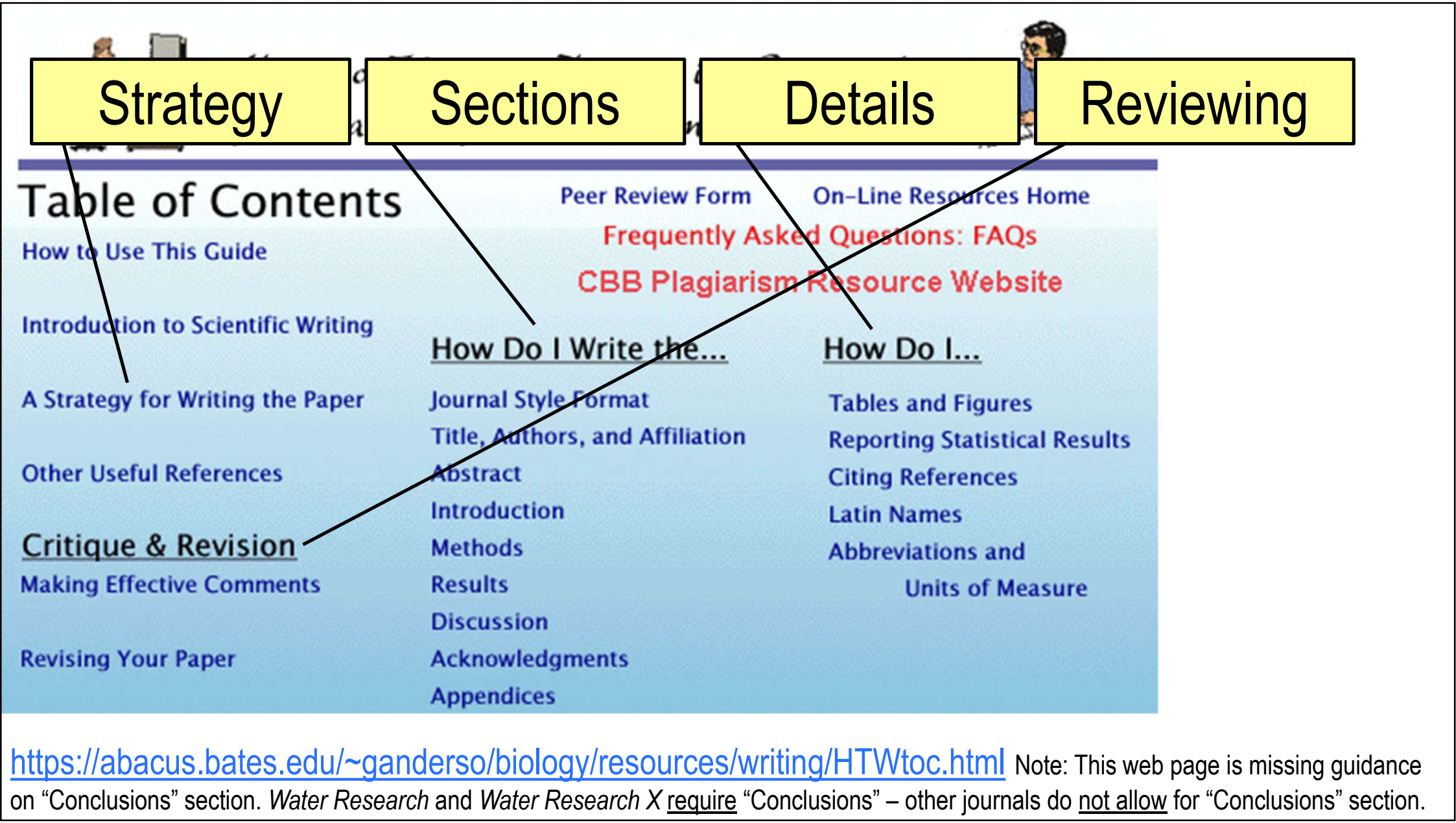
- Web resources (next slide)











https://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html Note: This web page is missing guidance on "Conclusions" section. *Water Research* and *Water Research X* require "Conclusions" – other journals do not allow for "Conclusions" section.

Types of papers in *Water Research* and *Water Research X*

- **Research papers** (this is what I have discussed so far)
  - 8'000 words
- **Critical Reviews**
  - NOT simply an aggregation of what can be found in the literature
  - Provide critical and new perspective
  - Usually includes a senior author with significant experience on the topic
  - 12'000 words
- **Making Waves**
  - Identify emerging topics and approaches, provide opinions and perspectives, discuss a visionary way forward, present solutions for research bottlenecks
  - 3'000 words

Two journals of the International Water Association (IWA) published by Elsevier

https://www.journals.elsevier.com/water-research, https://www.journals.elsevier.com/water-research-x

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Structure of today's presentation

- Guiding principle: Think about your readers
- **How to publish a journal manuscript?**
- **How to write a journal manuscript?**
- Some other topics in scientific publishing
  - Open access
  - Open data
  - Cheating

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Publication landscape: Open Access (authors pay - free for readers)

- Benefit for you: Open Access can increase your impact

- Research funders in Europe and North America are starting to require authors to publish in Open Access journals
- Many countries have negotiated direct contracts with publishers so that authors do not need to pay article processing charges (APC) from their own budget
- IWA Publishing has initiated “Subscribe to Open” that allows for free publishing for authors and for free reading (https://iwaponline.com/s2o)

- Beware of predatory journals that do NOT provide quality control but try to maximize their income from article processing charges (APC)

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Open Access in *Water Research* and *Water Research X*

- *Water Research* and *Water Research X* are two separate journals
- But we have one editorial board responsible for the review of manuscripts and editorial decisions in both journals
- Editor and reviewers do NOT know which journal the manuscript is submitted to
- *Water Research X* will receive an official impact factor in 2022

Journal	Choice	Open Access	Article processing charges (APC)
Water Research	Default	No	No
	Author requests Open Access	Yes	Yes
Water Research X	Default	Yes	Yes

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Publication landscape: Open Data (raw data provided to reader)

- Benefit to you: Open Data can increase your impact
- *Water Research* and *Water Research X* require Open Data since January 2021
  - Authors decide what data are relevant to provide access to the reader
  - If authors cannot publish their data, they are required to make a statement explaining why sharing their research data is not possible
  - See instructions for authors for further guidance, details, and approaches to share
  - FAIR principles for Open Data that meet principles of Findability, Accessibility, Interoperability, and Reusability

Morgenroth, E. and Pinto, A. (2021) Make your research more accessible. *Water Research 188, 116453.* https://doi.org/10.1016/j.watres.2020.116453
Wilkinson et al. (2016) The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data* 3(1), 160018. https://doi.org/10.1038/sdata.2016.18

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Cheating

- Fabrication of data
- Omission of unfavorable data (“cherry picking”)

- Plagiarism
  - Sentences or entire sections are copied from other sources without using quotation marks
  - As above, keeping the form and structure but changing words to trick the plagiarism software

- Authors added that did not contribute to the research and the writing of the paper
- Authors omitted that did contribute

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Summary of my personal perspective

- Guiding principle: Think of the readers of your manuscript
  - Editor
  - Reviewers
  - Scientific and engineering community

- Focus on strong research and impact

- Before you start: Make sure you have a story to tell → Take home message
- Start with a commented outline (this is the hard part)
- Scientific writing is hard work – but it is a skill that can be learned
- Scientific writing can be fun and rewarding – get started today

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