

How to Write a Scientific Research Paper

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Objective of Academic Research

- Publish! Publish! Publish!
- “No point in conducting research if it is not published.”¹
- “Unpublished and interesting = non-existent”¹

1. Whitesides. *Adv. Mater.* **2004**, *16*, 1375–1377.

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What is a Scientific Paper

- “Organized description of hypotheses, data and conclusions, intended to instruct the reader.”¹
- Whitesides calls a paper a “Structure for planning your research in progress”
 - A good paper outline can also be a good research plan that is constantly being revised as you collect and organize your results.¹
- Think of it as a storyline.
 - e.g. There is an ideal adsorption isotherm for adsorption refrigeration operating at a given set of conditions.
 - e.g. Fused deposition modeling print rates are limited by the heat input rate, pinchwheel force, and gantry motion.

1. Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

Outline – First Thoughts

- Start by asking yourself these questions:
 - **Why** did I do this work?
 - What does it mean?
 - What hypotheses did I mean to test?
 - What hypotheses did I actually test?
 - What were the results?
 - What measurements did I make?
- Sketch the major figures, equations, schematics
- What if your data tests a hypothesis that you were not expecting to test? Write them both down, and choose the one that best aligns with your results.

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

Outline – 3 Key Section

1. Introduction

Why did I do this work? What were the central motivations and hypotheses?

Key here is to understand literature and identify the novelty and contribution of your paper.

Source: Whitesides. *Adv. Mater.* **2004**, *16*, 1375–1377.

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Outline – 3 Key Sections

2. Results and Discussion

What were the results? How were the measurements conducted and analyzed? What was measured?

Source: Whitesides. *Adv. Mater.* **2004**, *16*, 1375–1377.

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Outline – 3 Key Sections

3. Conclusions

What does it all mean? What hypotheses were proved or disproved? What did I learn? Why does it make a difference?

Basically, need to answer “so what”???

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

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Rough Outline – 3 Key Sections

- Organize these three sections in finer detail.
- Concentrate on organizing the data.
 - Make figures that are easy to understand. Try different methods of presenting your data, to find the simplest way to convey the results.
 - Not unusual to make many versions of a figure before settling on the optimal presentation. Matlab is your friend.
- You should iterate this outline with your advisor.
- Whitesides advocates not waiting for all the experiments to be complete. *“Do not under any circumstances, wait until the collection of data is “complete” before starting to write an outline.”*
 - And says for data that is not yet in, sketch what you hypothesize the results will be for discussion.

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

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Detailed Outline

1. Title
2. Authors
3. Abstract –*Do this after everything else is complete.*
4. Introduction –
 - Objective of work and importance in first sentence.*
 - Justification for these objectives. Why is the work important?*
 - Background: Who else has done what? How?*
 - What should reader expect as conclusion? (No suspense)*

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

Detailed Outline

5. Results and Discussion
 - *Try to break results into separate relevant sections*
6. Conclusions
 - Summarize the conclusions of the paper.
 - Link the conclusions back to the literature and why the finding is noteworthy/novel/important/useful.
 - Do not repeat the results section.
7. Experimental (*Depending on journal maybe in different order*)

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

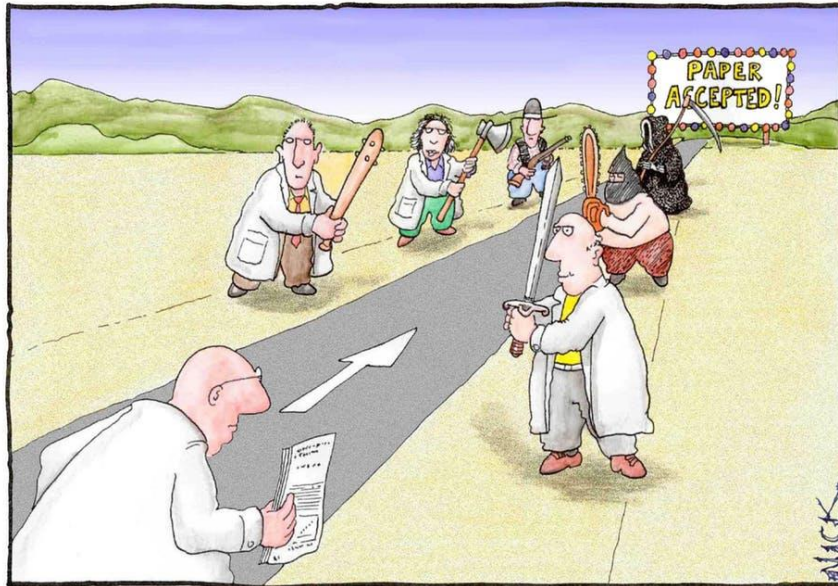
Detailed Outline

- Organize the outline to sort what is really important and what is not.
 - Do not organize by chronology.
 - Cut whatever is not central to supporting your hypothesis.
 - It is normal to have experiments/simulations that do not make it in the paper or SI. Don't sweat it.
- Identify what will be in the Supplementary Information
 - Derivations that are too detailed to interest most readers
 - Material that answers questions you think a reviewer will ask, but are not of general interest.
 - Tools that would be useful to future researchers (eg software code)
 - Figures that advance the paper, but are not critical to the work or are somewhat repetitive should go in SI.

Source: Whitesides. *Adv. Mater.* **2004**, 16, 1375–1377.

Where to Submit

- Your adviser and you should discuss
- Consider fit to journal
- Impact factor
- Time to review
 - More competitive journals are normally quicker to get reviews back.
- Have a backup plan (journal B)
- Look the part!
 - Bibliography style, text, figure styles, figure dimensions (full or half width).
- Write cover letter to your editor.
 - Get your adviser's help drafting.



Most scientists regarded the new streamlined peer-review process as "quite an improvement."

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Impact

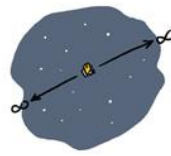
ADVANTAGES OF PUBLISHING YOUR THESIS IN OUTER SPACE



1) High Impact
Factor
(if it crashes)



2) In space, no one
can hear your
advisor scream.



3) You can make the
margins whatever
size you want.
Space is infinite.



4) Someone might
actually read it!

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**When you graduate you may be
superficially judged based on:**

Impact factor of journal
Citations of your article
H-factor

Create a ResearchGate and a GoogleScholar
page. It will increase you and your lab's
visibility.

(Don't post unpublished
work there though.)

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Some Points of Styles

- Draft papers should be double spaced, so it will be easy to write comments/edits on print copy.
- Leave two spaces after periods and colons.
- Leave normal margins, so there is space to write notes.
- Look at articles in your target journal to observe style of references, equations, tables, etc.
- Check the journal style guides (eg ACS Handbook for Authors for ACS Nano, ACS Langmuir)
- Good book on writing is Strunk and White, *The Elements of Style*, 1973. (Not specifically for scientific papers, but a good start.)

Source: Whitesides. *Adv. Mater.* **2004**, *16*, 1375–1377.

Questions?

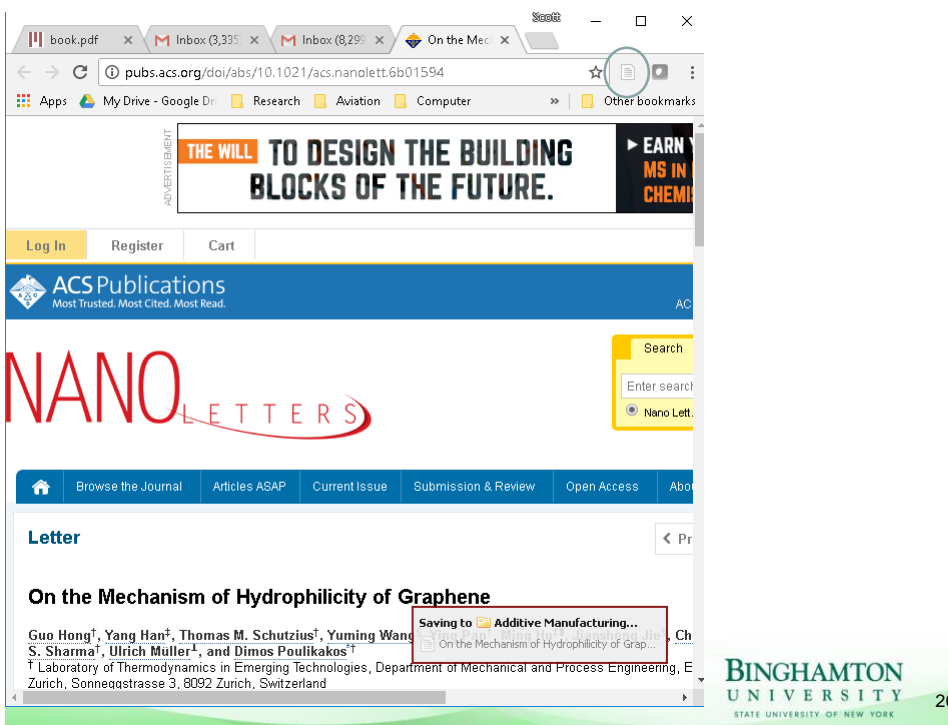
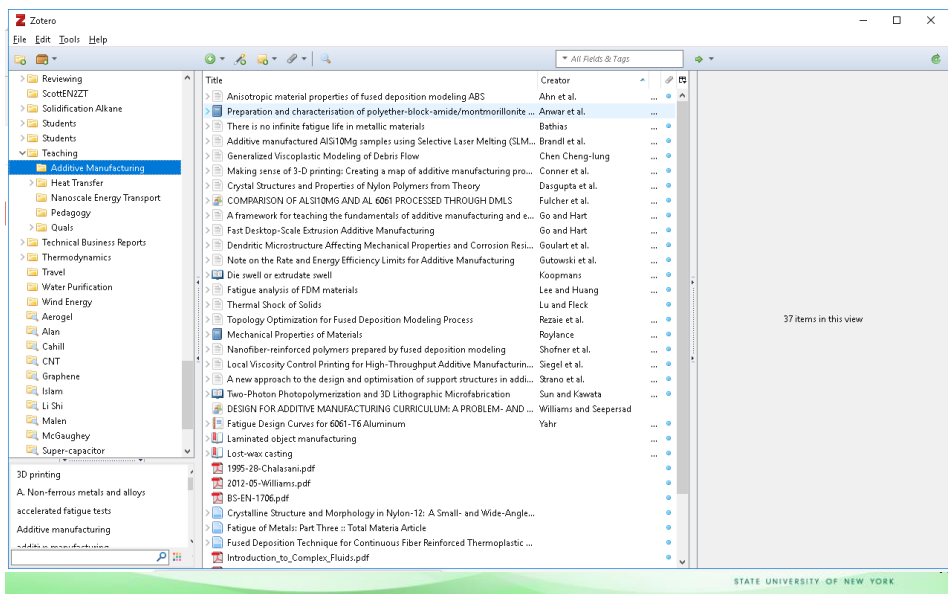
Reference Manager

- Organize and store references
- Allows easy citations in word via plugin (can also be exported to latex)
- Browser plugin allows you to click a button and save reference to your reference library
- Can change citation style by changing the bibliography settings in the reference manager word plugin

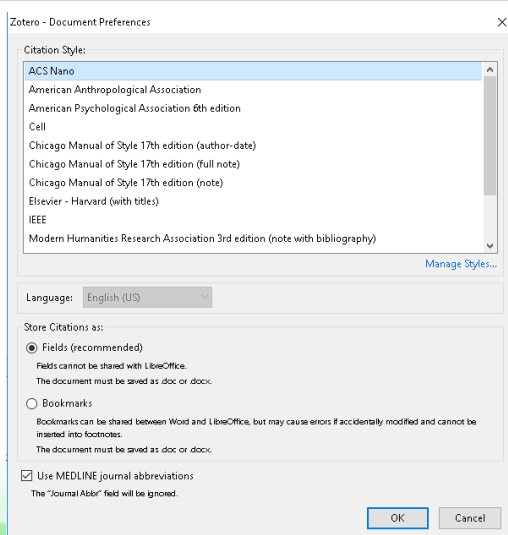
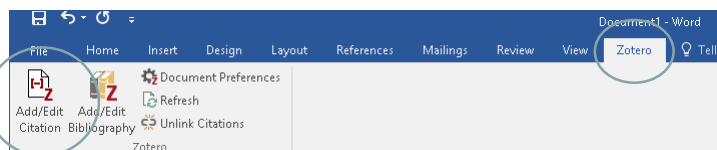
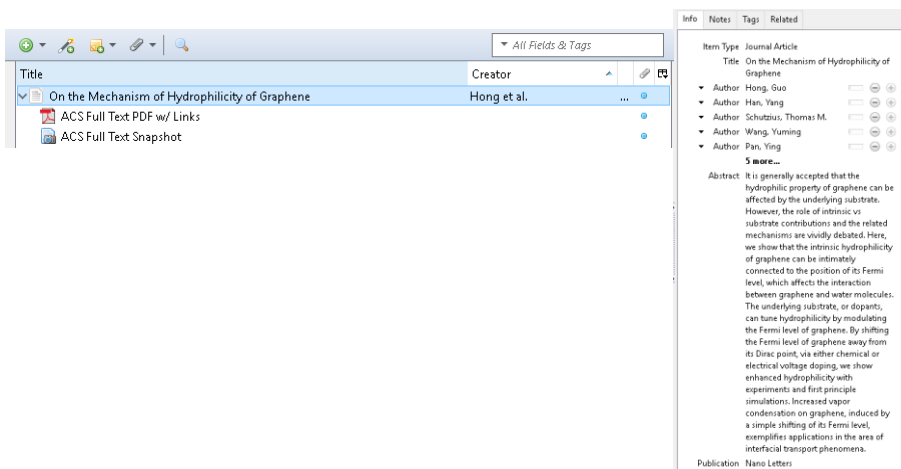
Reference Manager

- Zotero
 - Free and made by a non-profit, with good Word and web browser plugins)
- Mendeley
 - Free, but owned by Elsevier publisher
- EndNote
 - Not free, but works well. Used old version, but need to buy new version with every new word version. Not better than Zotero.
- Try to use the same as your advisor, as they do not play well with each other, and sometimes citations will be corrupted between softwares.

Zotero Reference Manager



Adds PDF, Title, Author Info, Journal Name, etc. Automatically!



Can download
or create new citation
styles.

Cite Paper

Z Morteza

My Library
Ideal Adsorption Refrigeration Morteza and Schiffres.
Ideal Adsorption Isotherm Behavior for Cooling Applications Bagheri and Schiffres (2017), <i>Submitted</i> .
Ideal Adsorption Isotherm Behavior for Cooling Applications Bagheri and Schiffres (2018), <i>Langmuir</i> .

Use in Word

The screenshot shows the Microsoft Word interface with the Zotero ribbon active. The ribbon includes options for 'Add/Edit Citation', 'Add/Edit Bibliography', 'Document Preferences', 'Refresh', and 'Unlink Citations'. The document content shows a placeholder 'Your next paper¹' and a citation: '(1) Bagheri, M. H.; Schiffres, S. N. Ideal Adsorption Isotherm Behavior for Cooling Applications. *Langmuir* 2018.'

Use in Word

The screenshot shows the Microsoft Word interface with the Zotero ribbon active. The ribbon includes options for 'Add/Edit Citation', 'Add/Edit Bibliography', 'Refresh', and 'Unlink Citations'. A red circle highlights the 'Unlink Citations' button, with a red arrow pointing to it and the text 'NEVER PRESS THIS!!'. Below the ribbon, the document text reads 'Your next paper¹' followed by a citation: '(1) Bagheri, M. H.; Schiffres, S. N. Ideal Adsorption Isotherm Behavior for Cooling Applications. *Langmuir* 2018.' A dialog box is open, titled 'C:\Program Files (x86)\Zotero\zotero.exe', with the message: 'Removing field codes will prevent Zotero from updating citations and bibliographies in this document. Are you sure you want to continue?'. The dialog box has 'OK' and 'Cancel' buttons. In the bottom right corner, the Binghamton University logo and the number '25' are visible.

GoogleScholar – Integrate with BU Library


The screenshot shows a Google Scholar search for 'adsorption refrigeration metal organic frameworks'. The search results list several articles. A red circle highlights the 'PDF' and 'Get It @ BU' links for the first article, 'Water adsorption in porous metal–organic frameworks and related materials'. A red arrow points to this circle with the text 'Configure Google-S to work with BU Libraries'. The search results include the following information for each article:

- Water adsorption in porous metal–organic frameworks and related materials** (PDF) berkeley.edu Get It @ BU
- Water stability and adsorption in metal–organic frameworks** (PDF) psu.edu Get It @ BU
- Characterisation of metal organic frameworks for adsorption cooling** (HTML) sciencedirect.com Get It @ BU
- Hydrogen storage in microporous metal–organic frameworks with exposed metal sites** (PDF) berkeley.edu Get It @ BU
- Enhanced CO₂ Adsorption in Metal-Organic Frameworks via Occupation of Open-Metal Sites by Coordinated Water Molecules** (HTML) northwestern.edu Get It @ BU

In the bottom right corner, the Binghamton University logo and the number '26' are visible.

GoogleScholar – Integrate with BU Library

The screenshot shows the Google Scholar interface. On the left is a navigation menu with options: Articles, Case law, Profiles, My profile, My library, Alerts, Metrics, and Advanced search. The main content area is titled 'Settings' and includes tabs for Search results, Languages, Library links (highlighted with a red circle), Account, and Button. Below the tabs, there is a section 'Show library access links for (choose up to five libraries):' with a search input field (example: Harvard) and three checked options: Binghamton University - Get It @ BU, SUNY BINGHAMTON - ProQuest Fulltext, and Open WorldCat - Library Search. A note at the bottom explains that online access to library subscriptions is usually restricted to patrons of that library.


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Get Out There

- Get an ORCID ID.
 - Provides a unique number that you can associate with all your past and future publications. Many people with same first name and last.
- Create accounts on Research Gate and GoogleScholar
 - Get alerts to authors you follow
 - Provides additional visibility for your work
 - Do NOT post unpublished work or drafts on ResearchGate. Could hurt publish-ability of your future work. ResearchGate is encouraging this, but it is a bad idea.


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References

1. Whitesides, G. M. Whitesides' Group: Writing a Paper. *Adv. Mater.* **2004**, *16*, 1375–1377.
2. Jeanne M. VanBriesen, Writing a Scientific Paper (Unpublished)