

Master's Project Paper

Non-thesis track

Introduction

Students who are on the non-thesis track in the Chemistry or Biochemistry options of the MSc program are to write a *Master's Project Paper* to fulfill the requirements of the degree and the associated course CHEM 7050 (*Master's Project*). There is no set or prescribed recipe for constructing this document, so what follows are suggestions for proceeding. You should work closely with your assigned advisor.

Your research paper **should** focus on a particular problem of current interest to the disciplines of chemistry or biochemistry. Your paper should pose queries about your topic as well as providing a summary of research in that chosen area. You should suggest an overall question about the topic to form the thesis statement of the paper. If you choose an area of interest for which the available research papers are incomplete for responding to a thesis statement, you should consider offering suggestions in your paper for future research in the field. Think of your topic as a possible question or series of questions. An objective of this research paper is to give the student author an opportunity to pursue an area of scientific interest in depth. All MSc students, whether on the thesis or non-thesis track, should develop an appreciation for reading the scientific literature as a basis for supporting research.

An example: Suppose you are interested in functionalization of C-H bonds. Upon perusing recent issues in the *Journal of Organic Chemistry* and *Organic Letters*, you find some key phrases to use in SciFinder to start gathering research articles. Using the phrase, "C-H bond functionalization" yields about 1300 citations. Narrowing the search with phrases like " sp^3 " and "Pd catalyst" results in 16 citations. This smaller, more reasonable number of papers is reasonable to begin developing your topic. Reading review articles may be very helpful in giving you an overall perspective of the field from which to base questions to develop your research paper. You might ask, "Are constraints on Pd-catalyzed C-H bond functionalization due to the size of attached ligands?" Upon reading papers you find, you can then state, "The influence of ligand size dictates effectiveness of Pd-catalyzed C-H functionalization."

How to Decide on a Topic

You may have an idea already formed of a topic that you are interested in, but if you have no idea of where to start, you may consider reading news stories from popular news websites (physorg.com, sciencedaily.com, *Nature Communications*, or *Science*, for example). Ask your advisor about searching for topic ideas as well.

Locate and Organize Sources

- Use search engines that provide access to peer-reviewed scientific literature: SciFinder, Google Scholar, and ScienceDirect are all great places to start.
- Try to locate a few well written *review* articles about your topic, if possible. There won't be review articles for very new topics. These review articles should help you to understand the current state of research in a field as well as methods/experimental approaches utilized. As well,

these review articles are rich with primary literature citations: your project paper should cite these primary articles whenever possible!

- There may be good books written about your topic as well. These are an excellent complement to review and primary articles.
- Look to the review articles as an example of how to guide the construction of your project paper. *Accounts of Chemical Research* is a good model for papers. Often these reviews tell a story.
- As you start to collect sources, make sure to curate and organize these references using an online citation manager tool like RefWorks or Mendeley. The UCCS Kraemer Family Library frequently holds classes on how to get started with these tools.

Create an Outline

- Frame the topic. Why is this topic timely, relevant to your interests, or worth pursuing?
- Indicate significance of the topic.
- Find the most relevant background material. Use this information to:
- Develop your scientific question followed by your thesis statement.
- Make a plan of how to best support your thesis (that is, plan the body of the paper).
- Develop main ideas of each argument or position/stance to support your thesis statement.
- Add details to these main ideas. Start including your references in this outline as you go. This will help with writing individual sections of the paper. Your review paper should be about 50 pages in length, so you will want to make sure that this outline encompasses both breadth AND depth of your chosen topic.

Write the Introduction

- State your thesis within the framework of previous work in the field.
- Include basic information, background, key terms or concepts necessary to understand your thesis.
- Expand upon your thesis to enlighten the reader concerning important parts of the thesis.
- Be sure to provide figures, images, or chemical structures to your paper. You may take complex figures from papers and provide reference citations in the figure legend or create your own figures. Use ChemDraw for structures.
- Discuss your approach of writing the main body of the paper with your advisor after setting the stage in the introduction.

Write the Body

- Start with your outline and follow it, but feel free to modify it as you progress.
- Try to include the important points as key sections of your paper.
- Cite ideas of others and include your references throughout the paper!!!! RefWorks has a 'write-n-cite' tool that allows you to cite in Word while you're writing the text.
- When citing others, try to be critical and note how each work fits into your overall picture of plan of the paper.
- For each section, start with a general idea and support with references. This will take you from the forest to individual trees.

- Consult frequently with your advisor throughout the writing process.

Develop the Conclusion

- This may be short or detailed depending on the topic and how you have concluded individual sections of the paper.
- Give a conclusion that will make the reader believe that your paper was worth reading.
- Include any of the following: future areas of research within your topic, new experiments that need to be completed, or what you consider to be major gaps in the field that need to be addressed.

Revise, Revise, Revise

- Look for gaps in the paper. Are there holes in your position or arguments as it relates to your thesis statement?
- Look for conclusions that you make that are not adequately supported. Did you go in depth to each issue?
- Examine the development of your paper. Does it have good flow? Are transitions adequately and appropriately used?
- Check your grammar carefully.
- Make sure that your references are cited properly and that the list of citations is accurate.

Other Issues to Consider

- Make sure that you and your advisor let the Graduate Program Director know of your progress in the paper. Your advisor will alert the director with regards to successful completion of the paper.
- Work with your advisor to use your project paper to develop a presentation in the department seminar series.
- Use ChemDraw for drawing chemical structures. You should create these structures unless they are very large and complex. In this latter case, you should include a citation to provide the source of the image.
- Any imported figures or tables from the primary literature should be properly cited.
- Use the [three-line table format](#) for any tables that you create.
- Most, but not necessarily all, of your citations should come from primary literature that is published in peer-reviewed journals from ACS, Wiley, RSC, Elsevier, Nature, and Science.
- A rubric will be shared with you so that you know how this document will be evaluated.
- A paper of 40-50 pages, including citations, is considered to a typical size. Your paper may be 10-15% longer or shorter depending on the topic. Your advisor will guide you as to the appropriate length of the document.