

THE ORIGINAL RESEARCH PROPOSAL (ORP) REQUIREMENT

Beyond being able to complete independent research commensurate with a PhD, all graduate students of the Department of Chemistry at Northwestern University are expected to be able to:

- research and refine relevant chemical literature
- independently generate novel scientific hypotheses and concepts
- formulate logical and rational arguments based on data and literature precedent
- write using concise and convincing scientific language
- deliver scientific information in a clear presentation or lecture

The Original Research Proposal requirement of the PhD program in chemistry at Northwestern University is designed to teach and refine these skills over a two-year period during the third and fourth years of graduate study. While the ability to craft scientific research proposals has direct relevance to a planned career path in academia, the general skills developed during this process are also highly transferable to all careers that utilize a chemistry Ph.D. Common career paths pursued by chemistry graduate students, such as those within industry, or at consulting firms or within patent law all require the ability to research information, formulate arguments, and present ideas in both written and oral formats. Thus, the Original Research Proposal is a crucial cornerstone for all graduates in the program.

The process of writing an original research proposal (ORP) is broken down into two required parts. This multi-step strategy is intended to develop the skills needed for proposal writing in stages rather than in one concerted activity. These stages are: **(i)** literature search and topic choice, accomplished through construction of *Quad Chart Proposals*, and **(ii)** writing and defense of the *full original research proposal document*.

The ORP meetings will occur in years 3 and 4 and

be accompanied by a brief research update, as outlined below.

2. YEAR 3: LITERATURE SEARCH AND TOPIC CHOICE: QUAD-CHARTS

(Deadline for completion: Last day of Summer quarter of the third year; committee meetings can occur during Winter, Spring or Summer quarter of the 3rd year)

By the end of Summer quarter of the third year, students must have committee approval for a set of 3 approved “Quad-chart Proposals” (see attached template). *It is strongly recommended that the student bring at least 4 quad charts to this meeting, so that three can be chosen with which the student moves forward.* These quad charts contain the key elements of original research proposals. All four quadrants of the chart must be filled in for each ORP topic. The student can use text and/or schematic diagrams and figures to illustrate their points in one or more quadrants. They cannot use more space than provided by the quad chart on 8.5x11” paper (with no smaller than 11-pt Arial font), as oriented in the attached template. A list of at least five literature references must accompany each quad chart.

Students are encouraged to get their quad charts approved before Summer quarter if possible.

The Quad Chart committee meeting will also include a research update. To this end, the student will prepare a brief summary (*2 pages max, 2 power point slides max*) of their **research progress** and plans for the next year, to be discussed at the Quad Chart committee meeting for what the committee considers an appropriate time.

a. Choice of Topics for the Quad-chart Proposals. Each proposal should be for a focused

research project that could be carried out by 1 – 2 graduate students or postdocs over ~2 years. Each quad chart should represent a distinct topic, and not, for example, a larger topic split into three parts.

In choosing the topics for the quad charts, the students should imagine that they are choosing topics for proposals for postdoc fellowships or faculty applications. Each topic must be an independent idea of the student. The topics can be related to the student's area of expertise (more expertise usually leads to a more feasible and interesting proposal) **but should not be projects that their research advisor has addressed in the past, addresses currently, or would reasonably be expected to address in the near future as an extension of ongoing research.** Derivative proposals that are based on small to negligible extensions of the advisor's research projects ("methyl, ethyl, propyl") are not allowed, either.

A space is provided on the approval form for you advisor to certify that your proposals are independent ideas and satisfy the above criteria. The student can propose a topic in an area unrelated to their general expertise; however the student should realize that, in reality, to be considered for a faculty position or fellowship, they must be considered a credible principal investigator for the project.

Examples of recent Quad Charts are posted online.

b. Approval of the Quad-chart Proposals. By the final day of the summer academic quarter of the student's 3rd year, the student is required to have three quad-chart proposals approved by all of their thesis committee members (as indicated by their signatures on an approval form, available online). This approval will occur through a single, one-hour meeting (the Quad Chart committee meeting) of the student with their three or four committee members.

The student's committee in the third year is the same as their QE committee, with the advisor acting as chair of the committee. During this committee meeting, the committee members will provide feedback on the quad chart proposals, and either approve three of them, or ask the student to revise them before approval, in which case approval must occur through email or individual meetings with committee members. *As stated above, it is strongly recommended that the student bring at least 4 quad charts to this meeting, so that three can be chosen with which the student moves forward. The same three quad-chart proposals must be approved by all thesis committee members.*

Importantly, *before the committee meeting*, the student should obtain their research advisors' signature indicating that the chosen topics are distinct enough from their own research to be appropriate for the ORP exercise.

If three quad-charts are not approved by the committee by the end of the summer quarter, the student will be declared to be not in good standing in the graduate program. The student's committee can grant a modest extension of the deadline for completion of the quad-charts if it is clear that progress is being made.

c. Research Update. The Quad Chart committee meeting will also include a research update. To this end, the student will prepare a brief summary (*2 pages max, 2 power point slides max*) of their **research progress** and plans for the next year, to be discussed at the Quad Chart committee meeting for what the committee considers an appropriate time. This brief summary should ideally consist of copies of TOC graphics and abstracts of the student's manuscripts that are in preparation on under review, or papers already published.

3. YEAR 4: COMPLETION AND ORAL DEFENSE OF THE FULL ORIGINAL RESEARCH PROPOSAL

(Deadline: Last day of Summer quarter of the fourth year; students can set up their oral PhD defense during either Spring or Summer quarter of their 4th year)

Between the 3rd year committee meeting and the end of summer quarter of the fourth year, the student will develop their chosen quad chart project into a full proposal (format detailed below). The student will then make a 25-30 minute presentation and defense of this ORP to their committee, in a ~1 hour format similar to that of the QE oral examination.

This committee meeting will also include a research update. To this end, the student will prepare a brief summary (*2 pages max, 2 power point slides max*) of their **research progress** and plans for the final year, to be discussed at the Quad Chart committee meeting for what the committee considers an appropriate time. Just like for the Quad Chart committee meeting, this brief summary should ideally consist of copies of TOC graphics and abstracts of the student's manuscripts that are in preparation on under review, or papers already published.

a. Format of the Full Original Research Proposal. The full ORP written document will have 7 sections (total maximum of 13 pages, double-spaced, one-inch margins, including abstract and figures, but excluding references):

- (1) Title and abstract (1 page) - The title and abstract should be descriptive of the total document
- (2) Introduction, Background, and Significance of the Research. This section should include the “intellectual merit” of the project: what it will do to move the field forward and further fundamental understanding. It should also demonstrate the student’s mastery of the literature in their field
- (3) Scientific Objectives, if NSF- or DOE-style, or Specific Aims if NIH-style.
- (4) Previous Work (no fewer than 2 full pages, including figures and tables) - a summary of the relevant prior art and literature on the scientific topic
- (5) Proposed Research (no fewer than 6 full pages, including figures and tables).
 - a. A research plan for 2 years, including general objectives and specific experimental or theoretical plans.
 - b. A brief description of contingency plans
- (6) Summary and Conclusions
- (7) References (as many as appropriate, not included in the page count) should be the following format:

Journal articles: Kramer, I.J.; Levina, L.; Debnath, R.; Zhitomirsky, D.; Sargent, E.H. Solar cells using quantum funnels *Nano Lett.* **2011**, *11*, 3701-3705.

Books: Odian, G. Principles of Polymerization; 4 ed.; John Wiley and Sons: Hoboken, NJ, 2004.

The student decides how to partition the document between text and figures, but should note that figures should not be seen as a replacement for text (i.e., the text must be a complete narrative). All text must be *12-point, Times New Roman, and double spaced, with 1-inch margins*. Pages must be numbered starting with the title/abstract page. Sample ORPs are posted online.

b. Scheduling the ORP Oral Exam (Deadline: Before the end of summer quarter of the fourth year of graduate study)

The department will arrange for you to meet with the administrative assistants of your committee members to schedule a QE exam date (which should be either spring or summer quarter of your fourth year) and reserve a conference room. This meeting room must have a projector screen and a chalkboard or whiteboard. Please contact gradasst@northwestern.edu with questions about ORP scheduling.

c. Other Information about the ORP

The student should reserve 2 hrs for this exam, although it might take less time. The format is similar to the QE oral exam, where the student prepares a 25-30 minute presentation that mirrors and elaborates on the ORP written document and the faculty have the opportunity to ask questions about this or related material.

****The ORP document must be turned in to committee members at least one week before your examination date.**** If two or more committee members believe that the ORP document is not satisfactory to move on with the oral exam portion, then the Chair of the committee (the student's advisor) must inform the student – *no later than 48 hours before the scheduled exam time* – that the exam will be postponed. The committee should give the student a general idea about why the written document was rejected, but is not required to provide detailed feedback to the student. It is then the student's responsibility to revise the document and reschedule the exam. The student is advised to consult with the Graduate Program Assistant about a timeline for this process. It is desirable to reschedule within the same quarter, but the student can petition the Director of Graduate Studies for an extension.

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