G. THE ORIGINAL RESEARCH PROPOSAL (ORP) REQUIREMENT

The process of writing an original research proposal (ORP) is broken down into three 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*, **(ii)** topic development, accomplished through construction of an *ORP outline*, and **(iii)** writing and defense of the *full original research proposal*.

I. Literature Search and Topic Choice: *Quad-chart Proposals* (Deadline: Last day of Spring quarter of the third year; students can set up meetings during Winter or Spring quarter of the 3rd year)

By the end of Spring quarter of the third year, students must construct a set of "Quad-chart Proposals" (see attached template). 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.

IA. 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, 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**. 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 his/her general expertise; however the student should realize that, in reality, to be considered for a faculty position or fellowship, he/she must be considered a credible principal investigator for the project.

For examples of Quad Charts, please see:
http://www.chemistry.northwestern.edu/graduate/current/timeline/third-year.html#thirdyear

IB. Approval of the Quad-chart Proposals. By the final day of the spring 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). This approval will occur through individual meetings of the student with each of his or her committee members (there is no full committee meeting in the 3rd year). During these individual meetings, 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 additional individual meetings will be scheduled. Students can construct as many quad charts as they like, but the same three quad-chart proposals must be approved by all three members of their thesis committee (or four members, if they have two advisors).

The student should first obtain his/her research advisors' signature *before* meeting with their other Committee members (if at all possible – in some cases, schedules will not permit this). If three quad-charts are not approved by the committee by the end of the spring 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.

We emphasize that (i) although the individual meetings with committee members are only intended to be 30 minutes long, the student should schedule these meetings 3 months ahead of time in order to ensure that the student can meet the deadline, and (ii) these meetings can take place during either winter or spring quarter of the student's third year.

II. Topic Development: *ORP Outline* (Deadline: Last day of Winter quarter of the fourth year; students can set up meetings during either Fall or Winter quarter of their 4th year)

By the last day of winter quarter of the fourth year, the student will meet with his/her entire thesis committee at once to discuss the student's further development of one of the approved quad-chart proposals. By this time, the student should have chosen one topic (or something closely related), and written an outline of the ORP document (with format described below).

IIA. Format of the *ORP Outline*. The ORP outline needs to be detailed and well-thought-out enough such that the committee can assess the student's progress on the ORP, and can give the student helpful feedback on the further development of the proposal. The ORP outline will have 5 sections (**total maximum of 4 pages, 1.5-spacing, *excluding* tables, figures and references**):

(1) Title

(2) Scientific Objectives ("Specific Aims")
- bullet points that list the specific scientific questions to be answered

(3) Background, Previous Work and Significance of the Research
- bullet points that summarize the "intellectual merit" of the project: what it will do to move the field forward and further fundamental understanding. Why is this project new and important?
- bullet points (with citations) that demonstrate the student's thorough survey and understanding of the literature on the topic.

(4) Proposed Research
- bullet points that outline the general research plan for 2 years
- bullet points briefly describing possible challenges and contingency plans

(5) References (**at least 15**; not included in the page count)
- references 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.

****Please see attached an example of an ORP outline****

****The ORP outline document must be turned in to committee members at least one week before the scheduled 4th-year committee meeting date.****

IIB. The Fourth Year Committee Meeting. During this meeting, the student should be ready to *lead* an organized discussion of his/her ORP outline, and to take notes on the committee's feedback on the outline. The meeting is not a formal presentation, and the student is not required to present PowerPoint slides. *It should last no more than one hour* (note this constraint when scheduling your committee). If the student feels that slides are helpful to communicate aspects of the ORP outline, **then he/she should prepare no more than 5 slides**.

The ORP outline document must be turned in to committee members at least one week before the scheduled 4th-year committee meeting date.

The recommendation of graduate affairs is for the student to begin the scheduling process at least 3 months prior to the desired meeting date. The 4th year meeting can take place during either fall or winter quarter of the 4th year.

The student passes this checkpoint if all of the members of the committee are satisfied with the development of the proposal and indicate so by signing a form prepared by the graduate program coordinator. Discussion of a student's progress on his or her thesis research during this meeting is not required, unless the student has any particular concerns or questions they would like to discuss.

III. Writing and Defense of the *Full Original Research Proposal* (Deadline: submitted with thesis)

Between the 4th year committee meeting and graduation, the student will develop their ORP outline into a full proposal (format detailed below) to be submitted as an Appendix to the copy of the Ph.D. thesis document that is submitted to the dissertation committee. By default, the proposal *will not* be included in the version of the thesis submitted to the graduate school, and therefore will not be published with the thesis. If the student and the advisor want the original research proposal to be bound with the thesis, the student must submit an explicit request to do so to the Chair of the Graduate Affairs Committee through a form available from the Graduate Program Assistant.

The student has the option to allocate time at the end of his/her thesis defense to the proposal (5 minutes maximum in addition to time allotted for the defense presentation), but all students should be prepared to answer questions about the proposal at the thesis defense.

IIIA. Format of the Full Original Research Proposal. The full ORP written document will have 7 sections (**total maximum of 13 pages, double-spaced, 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
- 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 ("Specific Aims")

(4) Previous Work (no fewer than 2 full pages, including figures and tables)
- a summary of the literature on the scientific topic

(5) Proposed Research (no fewer than 6 full pages, including figures and tables)
- a research plan for 2 years, including general objectives and specific experimental or theoretical plans.
- a brief description of contingency plans

(6) Summary and Conclusions

(7) References (as many as appropriate, not included in the page count)
- references 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. Pages must be numbered starting with the title/abstract page.