Timeline for Completion: The Oral Qualifying Examination will occur after the Thesis Advisory Committee has approved the written qualifying exam document.

What to Expect

The student should prepare material corresponding to a 30 minute uninterrupted PowerPoint/Keynote presentation (see the ACS style guide for tips on creating presentations: https://pubs.acs.org/doi/full/10.1021/acsguide.10801), though the actual duration of the exam will be much longer due to discussion. The total duration of the oral exam should not exceed 2 hours. The number of results at this stage will vary significantly depending on the particular project, and it is recognized that publishable results may not yet be available; however, the student needs to present clear evidence of a substantial research effort and a deep understanding of their experiments to date.

While there is significant topical overlap between the exam written document, which will have been assessed prior to the oral exam, the emphasis of each assignment is different. Whereas the written document requires a detailed examination of the literature within the field and experiments that have been completed already, the oral exam will shift this emphasis to assess the student's understanding of fundamental concepts and general knowledge, their understanding of the design of the current project and future directions, and their ability to imagine new solutions and methods if the planned experiments run into problems. As an example, the student may mention that the ligands of an inorganic compound produce a particular energetic ordering of the d-orbitals in the written document, but they would likely not explain ligand field theory, a topic from fundamental inorganic chemistry, in that document; however, in the oral exam, the committee may ask the student to explain ligand field theory and how it can explain the energies of those d-orbitals. Of course, the written document assesses the student's writing skills, from the sentence to whole document level, and the oral presentation assesses oral presentation and visual design.

Areas of Assessment

The oral qualifying exam will assess student's skills in a number of areas:

- **General Knowledge in Chemistry**. For instance, can the student relate concepts important to their project to more general concepts from their courses? Can they relate broad important chemical concepts to their particular area of expertise?
- **Conceptual Understanding**. Is the student well versed on the important concepts within their specialty? Can the student relate these specialized concepts to their particular methodology?
- **Research Techniques and Methods**. The student should have a good understanding of why particular research methods are being applied to this problem and should be aware of alternative methods. The important experimental parameters should be known and understood. For instance, the student should be able to explain why any particular parameter in their experiments was chosen, e.g. reaction temperature and solvent, laser power, chromatographic columns, etc.
- **Significance of Research**. It is critical for any scientific project to have a good understanding of the overall impact of the work if it was successful. The student should be able to explain the significance of their results to their own specialized field and to broader chemistry and scientific community.
- **Organization and Clarity of Presentation**. The overall structure of the presentation should follow a logical format and slides should be professionally prepared. Each slide should present an idea with clear text and graphics. The conditions for experimental results should be clearly stated. When prior results from the literature

are presented, the reference should be clearly indicated.

- **Familiarity with Literature**. The student should be familiar with both the most recent and more distant, foundational published work in their area. It is important to know what has been done in their particular field and also who has done it.
- **Project Design Understanding**. To advance to PhD candidacy, the student should be able to explain why a particular experimental approach or methodology was chosen. Of course, this has overlap with "Research Techniques and Methods", but in this category, the committee is seeking to understand if the student has a big picture perspective on why the chosen methodology is the best approach to answer the question at hand.
- **Creative Problem Solving**. The committee will seek to understand how the student would approach problems when they arise and how the student would work around those problems to be able to complete their project. What alternative methods might be used? What is the riskiest or most difficult step in the chose methodology and how will you respond if that step does not work?

Each of these areas will be explored by the committee, who will ask questions to get a better understanding of what the student knows and how the student thinks about their project.

Evaluation Rubric for the Oral Examination

Criteria	Exemplary (4)	Proficient (3)	Developing (2)	Needs Improvement (1)
General Knowledge in Chemistry	Demonstrates a thorough understanding of fundamental chemical concepts, both within and outside the student's project area.	Shows good familiarity with key chemical concepts related to the project but may have gaps outside the project area.	Understands some fundamental chemical concepts, but there are clear gaps in foundational knowledge outside the project area.	Struggles to demonstrate understanding of fundamental chemical concepts, both within and outside the project area.
Conceptual Understanding	Clearly explains and contextualizes all central concepts with depth and precision.	Explains key concepts well, though some are not fully developed or contextualized.	Explanation of key concepts lacks depth or clarity, though basic understanding is evident.	Struggles to explain central concepts related to the project.
Research Techniques and Methods	Provides thorough explanations of all relevant techniques and methods with clear understanding of their application.	Explains relevant techniques and methods, though some details or applications are unclear.	Demonstrates some understanding of techniques and methods, but explanations are incomplete or superficial.	Struggles to explain or understand the techniques and methods central to the project.
Significance of Research	Articulates the broader significance of the project with clarity and insight.	Provides a reasonable understanding of the significance of the project within a broader context.	Demonstrates limited understanding of the project's significance; connections to broader context are weak.	Fails to demonstrate an understanding of the project's significance beyond its immediate scope.
Organization and Clarity of Presentation	Presentation is exceptionally well-organized, ideas flow logically, and visuals are clear and compelling.	Presentation is organized and coherent but may lack smooth transitions or clarity in some sections; some visuals may need refinement.	Presentation is somewhat organized but lacks clear flow and coherence in several areas; visuals need considerable refinement.	Presentation is poorly organized, making it difficult to follow the ideas and arguments presented.
Familiarity with Literature	Demonstrates strong knowledge of relevant literature, including key precedents and recent developments.	Shows familiarity with relevant literature but lacks depth in understanding key studies or gaps.	Has basic knowledge of the relevant literature, but there are significant gaps in understanding or coverage.	Lacks sufficient familiarity with key literature relevant to the project.
Project Design Understanding	Clearly understands and explains the overall design of the project, including both current progress and future work.	Demonstrates understanding of the overall project design but may not fully articulate future directions.	Has basic understanding of project design but lacks insight into future work or broader implications.	Struggles to explain the overall project design or how it fits within a broader research context.
Creative Problem Solving	Demonstrates exceptional creativity in proposing alternative solutions to research problems, showing deep insight.	Provides reasonable alternative solutions to research problems, though may lack some depth in creativity.	Suggests alternative solutions but lacks depth or innovation in approach.	Struggles to propose meaningful alternative solutions to research problems.

Final Evaluation

Oral exams are evaluated on a Pass/Fail basis. **In order to pass the exam, students must achieve a minimum**

score of 20 (out of 32 possible points). Committees will assign scores using the rubric above, and will discuss the evaluation outcome with the student at the end of their exam.

Committee ratings will be aggregated and returned to the student to help them determine areas for improvement. The student's advisor will also submit a written summary of the committee's discussion to the Graduate Coordinator.

Students who fail the oral exam may retake the exam if the examining committee deems it appropriate. The second qualifying examination, if permitted, may be taken within six (6) calendar months.