

**Graduate Learning Objectives/Outcomes for Ph.D. & MS Programs**  
**CHEMISTRY, College of Science**

The following table indicates what we have identified as "universal" graduate learning objectives, by which we assess graduate learning outcomes; also for each we include the broadly used means of assessment. Individual programs and Departments may have additional graduate learning objectives; most often these are explicitly stated in a Departmental Graduate Handbook, in documentation provided by a professional organization or society, or included as degree requirements. The overarching objectives in the table address what are considered to be critical areas of competency (a comprehensive appreciation of the field of study, an understanding of current issues of importance in the field, a grounding in ethics, and a demonstration of creativity) at various points on the path through graduate studies (admissions, matriculation to candidacy, graduation). Some of the objectives apply to any degree program, and some are specific to the non-thesis (coursework) MS, the non-thesis (project) MS, the thesis MS, or the PhD, as indicated. Likewise there is some variation amongst the degree programs as regards means of assessment.

Means of assessment referenced in the table below include:

- (1) minimum admission standards, assessment of application materials, admissions process interviews;
- (2) meeting a predetermined standard in graduate level coursework (content/subject matter and GPA);
- (3) graded cumulative exams;
- (4) a pass/fail oral preliminary exam;
- (5) written thesis or research paper;
- (6) oral defense;
- (7) other (as indicated).

Ph.D. Objective	MS Objective
Students will have met the objectives for learning outcomes in an undergraduate discipline relevant to their graduate field of study. <i>Scoring methods:</i> 1	Students will have met the objectives for learning outcomes in an undergraduate discipline relevant to their graduate field of study. <i>Scoring methods:</i> 1
Graduates will be able to summarize major central issues and current research problems in their field. <i>Scoring methods:</i> 2,3,4,5,6	Graduates will be able to summarize major central issues and current research problems in their field. <i>Scoring methods:</i> 2,5,6
Graduates will be able to communicate the major tenets of their field and their work orally and in writing for students, peers and the lay public. <i>Scoring methods:</i> 2	Graduates will be able to communicate the major tenets of their field and their work orally and in writing for students, peers and the lay public. <i>Scoring methods:</i> 2
Graduates will be able to explain and identify areas of uncertainty in their fields. <i>Scoring methods:</i> 2,3,4	
Graduates will be able to identify areas where ethical issues may arise in their work or discipline. <i>Scoring methods:</i> 2,5,6	Graduates will be able to identify areas where ethical issues may arise in their work or discipline. <i>Scoring methods:</i> 2,5,6
Graduates will be able to articulate strategies for dealing with ethical issues in their field. <i>Scoring methods:</i> 2,4,5,6	
Graduates will have designed, carried out and presented an original work of research at the leading edge of their discipline.  <i>Scoring methods:</i> 2,5,6	Graduates will have completed and defended: <ol style="list-style-type: none"> <li>(1) an original manuscript based on either a review and synthesis of the primary literature [non-thesis (project) MS] or original research [thesis MS]; or</li> <li>(2) mastery of appropriate advanced coursework in the field. [non-thesis (coursework) MS]</li> </ol> <i>Scoring methods:</i> 2,5,6

Attachment 2: Scoring Guide (Rubric) for Graduate Learning Outcome Assessment, College of Science

Ph.D. THESIS DEFENSE EXAM in Chemistry

Candidate Name: \_\_\_\_\_ Date: \_\_\_\_\_

Title of Thesis: \_\_\_\_\_

Evaluation/Guidance	Does not meet Expectations	Meets Expectations	Exemplary Performance
1. <b>Problem Definition:</b> Has stated the research problem clearly, providing motivation for undertaking the research			
2. <b>Literature and Previous Work:</b> Demonstrated sound knowledge of literature in the area, and of prior work on the specific research problem			
3. <b>Impact of Proposed Research:</b> Demonstrated the potential value of solution to the research problem in advancing knowledge within the area of study			
4. <b>Solution Approach:</b> Has applied sound state-of-the field research methods/tools to solve the defined problem and has described the methods/tools effectively			
5. <b>Results:</b> Analyzed and interpreted research results/data effectively			
6. <b>Quality of Written Communication:</b> Communicates research results clearly and professionally in written form			
7. <b>Quality of Oral Communication:</b> Communicates research results clearly and professionally in oral form			
8. <b>Critical Thinking:</b> Has demonstrated capability for independent research in the area of study and expertise in the area			
9. <b>Broader Impact:</b> Demonstrated awareness of broader implications of the concluded research. Broader implications may include social, economic, technical, ethical, business, etc. aspects.			
10. <b>Publications:</b> Journal or conference publications have resulted (or are anticipated) from this research			

**Overall Assessment:** The assessment of the overall performance of the candidate based on the evidence provided in items 1 – 10 above.

CRITERIA	PERFORMANCE RATINGS for THESIS EXAM		
	<i>Does NOT PASS Exam</i>	<i>PASSES Exam</i>	
OVERALL, My rating of the Thesis indicates that it:	Does not meet expectations	Meets expectations	Exemplary performance

Name of the Examining Committee Member: \_\_\_\_\_

Signature of the Examining Committee Member: \_\_\_\_\_

*Examiner: Please use the reverse side of this form for written commentary as needed.*

**Mapping Guide for the Ph.D. Degree - Chemistry**

Only the top 5 activities are listed for each outcome. Other activities may also support the outcomes, however data will be collected for those listed in each column

<b>Learning Outcomes:</b> <i>Graduate students in the PhD program will demonstrate →</i>	<b>Outcome 1: Knowledge and Scholarship</b>	<b>Outcome 2: Communication</b>	<b>Outcome 3: Critical Thinking and Problem Solving</b>	<b>Outcome 4: Ethical Conduct</b>	<b>Outcome 5: Professional Development</b>
<b>Activities and Evidence:</b>	Identify and conduct original research, scholarship or creative endeavors	Effectively communicate their field of study	Think critically, creatively and solve problems in their field of study	Conduct research in an ethical and responsible manner	Demonstrate attributes of professional development consistent with expectations within their field of study
<b>1. Teaching Seminar</b> (one time for all incoming graduate students)				Attend workshops or take online training on effective service as a TA and responsible conduct of research	Gain appreciation for membership in professional societies; Attend scientific seminars across campus
<b>2. Research Seminar</b> (for advanced 2nd or 3rd year PhD students)			Critically analyze ideas and data presented and discussed by others and participate in the peer review process	Participate in discussions on responsible conduct of research	Understand the importance of membership in professional societies; Organize a departmental seminar with an invited speaker; Participate in a graduate research competition; Attend at least one professional development workshop
<b>3. Plan of Study Coursework</b>	Gain knowledge needed for conducting original research				
<b>4. Research credits</b>	Earn a Satisfactory in at least 81 credits of CH 603				

<b>5. PhD Research Proposal</b>	Define and justify a set of original research objectives in a formal research proposal	Write and defend an original proposal	Define and defend a set of research methods and analyses that will achieve the research objectives	Define methods to achieve the research objectives in an ethical and responsible manner
<b>6. Written and Oral Preliminary Exam</b>	Demonstrate sufficient knowledge of subject matter to become a PhD Candidate	Demonstrate ability to communicate knowledge and research through a written and oral preliminary exam	Demonstrate the ability to think clearly and solve problems through a written and oral preliminary exam	
<b>7. Publish Research in Appropriate Outlets</b>		Submit manuscripts for publication in the peer-reviewed literature		Publish research, extension, or teaching results in peer-reviewed and/or other outlets
<b>8. Presentation of Research at Appropriate Venues</b>		Present an oral presentation or poster to a professional audience		Present an oral presentation or poster to a professional audience
<b>9. Ph.D. Dissertation</b>	Prepare a dissertation that meets expectations for original, independent research	Prepare a dissertation that demonstrates critical thinking and creativity	Prepare a dissertation based on ethical and responsible research.	
<b>10. Dissertation Defense</b>	Present the research in a public seminar and defend the dissertation	Defend the dissertation research before the student's Advisory Committee	Present the dissertation research in a public seminar and defend the dissertation research before the student's Advisory Committee	Present the dissertation research in a public seminar and defend the dissertation research before the student's Advisory Committee