

CHEMISTRY GRADUATE PROGRAM ASSESSMENT PLAN

This assessment plan outlines how the program will assess student learning and progress, the data collection tools and approaches that will be used, and the timeline for implementation.

Mission: The Chemistry graduate program trains the next generation of chemists for productive careers in the global economy. Our graduate students grow personally and professionally through structured mentoring by compassionate faculty, staff, and students that fosters a safe, inclusive learning and working environment. The mission of the Chemistry graduate program is consistent with that of the University as a whole and of the Eberly College of Arts and Sciences.

Program Description: The Graduate Program in Chemistry is a professionally oriented Master's and Ph.D. program designed to educate and train students in all aspects of the field of chemistry. It offers a variety of rigorous graduate-level courses and maintains cutting-edge research programs within individual laboratories. The program encompasses all traditional disciplines of chemistry: Analytical, Biochemistry, Inorganic, Organic, Physical, and Education chemistry. Within these areas, the department demonstrates research strengths in mass spectrometry, proteomics, forensic chemistry, pharmaceutical and medicinal chemistry, catalysis, and spectroscopy. The full-time program has a normative time to completion of five academic years, in line with the national average as reported by the American Chemical Society. Candidates for a Ph.D. degree in Chemistry must demonstrate the ability to plan, execute, evaluate, and communicate original chemical research. Throughout the program, students take two types of exams. The first, the Guidance Examination, assesses their command of analytical, inorganic, organic, and physical chemistry. The second, the Candidacy Examination will test the student's ability to use basic knowledge in their major field of chemistry using a written research progress report and an oral defense of the progress report. Other milestones are used to assess students' progress relative to the program's learning objectives as well as to assess research skills specific to their field of specialization. An Individual Development Plan is established and reviewed yearly to assist students in career and personal development.

Program Objectives: The objectives of the Ph.D. program in chemistry are as follows:

1. To provide students with the necessary knowledge and skills to identify and solve complex technical problems in chemistry.
2. To enable students to develop as successful professionals in a collaborative, interdisciplinary environment in preparation for highly competitive positions in industry, government, academia, and non-profit organizations.
3. To contribute to and advance the body of knowledge in the field of chemistry.
4. To enhance the visibility of the Ph.D. in Chemistry program nationally and internationally.

Program Learning Outcomes: Upon completion of the Ph.D. in chemistry, students will be able to:

1. Communicate chemical concepts orally and in writing.
2. Explain advanced chemical principles as they pertain to their specific field of research.
3. Analyze and critically evaluate the existing literature published within their field of research.

4. Independently design and execute original research that can address important scientific questions.
5. Generate quality data using a variety of experimental and/or computational techniques and interpret the meaning and implication of their data.
6. Effectively communicate their research in oral and written formats, including the ability to author manuscripts suitable for publication in peer-reviewed scientific journals.
7. Inquire about and prepare for various career opportunities with their advanced degree.
8. Learn and adopt best safety practices (chemical hygiene, personal protective wear, proper handling of chemical waste streams, etc.) in chemical research.
9. Learn and apply the ethical impact of personal and professional behavior.

Data-Collection Instruments: They encompass both direct and indirect measures.

Direct Measures:

- Coursework/Examination: Students are expected to take a minimum of six 3-credit hour advanced courses. A final grade of B or better is required to have the course count toward satisfying this requirement. Course grades are available in the student transcript. Coursework is used to assess PLOs 1,2 and 3.
- Divisional seminars: Graduate students in the Ph.D. program must register for a seminar every semester. Students must present at least three graded seminars while in residence at WVU. The seminar provides experience in collecting relevant research material, organizing the subject in a logical order, presenting the material clearly and scientifically, and leading a discussion. These topics relate to PLOs 1,2 and 3. A letter grade is provided by the seminar instructor and faculty in attendance and communicated to the Associate Chair of Graduate Studies.
- Department Colloquium: The department colloquium allows students to interact directly with experts in their field of research. Active participation in the colloquium assesses PLOs 3 and 7. Attendance is recorded by the colloquium instructor and added to the student's transcript.
- Candidacy: The two-part candidacy examination tests the ability of a student to use basic knowledge in their major field of chemistry. The written report and the presentation must contain a comprehensive review of the pertinent literature and applicable scientific concepts, a discussion of current results, a description of studies needed to finish the project, a discussion of expected results and alternative approaches, and a timeline for completing the work. These topics relate to PLOs 1,2, 3, 4, and 9. There are three possible outcomes for the examination: (1) pass, (2) conditional pass, or (3) fail. The results from the candidacy exam are communicated to the Associate Chair for Graduate Studies.
- Original proposal: The proposed research must demonstrate originality and independence on the part of the student. The written proposal and the presentation are evaluated by the faculty in attendance and the seminar instructor. The original proposal results (Pass/Fail) are communicated to the Associate Chair for Graduate Studies and are used to assess PLOs 1,2, 3, 4, and 9.

- **Final Dissertation Examination:** After the Ph.D. dissertation has been prepared, a copy is submitted to the student's Graduate Research Committee. The examination includes a defense of the results and conclusions through an oral presentation. The outcome of the examination is determined by the student's Graduate Research Committee and is used to assess PLOs 1,2, 3, 4, and 5.
- **Presentations and Publications:** The number of presentations and students' first author's publications directly relate to PLO 6. While attending conferences, students are also likely to network and prepare for various career opportunities, PLO 7. The data is collected annually through the Yearly Research Progress Report

Indirect Measures:

- **Yearly Research Progress Report:** The yearly report assesses student's progress toward graduation and sets objectives after obtaining candidacy. The report is reviewed and approved annually by the student's Research Graduate Committee. By having students provide a concise description of their research accomplishments and productivity during the previous academic year, the report assesses PLOs 1, 2, 3, 4, 5 and 9.
- **Individual Development Plan:** The plan is developed annually by all students and their research advisor. It is designed to assess all PLOs.
- **Exit Survey:** It is designed to collect feedback from graduate master's and doctoral students on the theoretical and practical training they received during graduate school. It is developed both in terms of quality and experience. It also provides direct information about the student's post-graduation plans. The survey assesses PLOs 4, 6, 7, and 9.

The Research Progress Report, Individual Development Plan, and Exit Survey are filed in the student's portfolio.

Methods of Assessment, Timeframe for Data Collection and Analysis: The Graduate Studies Committee collects and analyzes data to assess students' progress in achieving the nine program learning outcomes. Data are collected according to the following schedule:

Program Learning Outcome	Direct/Indirect measures	Source of Data	Time of Collection
PLO1 Communicate chemical concepts orally and in writing.	Coursework (I R)	Academic transcript	Every semester
	Divisional seminars (I\R)	Seminar instructor	Every semester
	Written and Oral Candidacy (I R, A)	Student's committee	Every semester
	Annual research report (R A)	Student	Annually
	Individual development plan (I R)	Student/Advisor	Annually
	Original research proposal (R,A)	Faculty/Seminar instructor	Every semester
	Written dissertation (R M, A)	Student's committee	Every semester
	Oral Dissertation defense (R M, A)	Student's committee	Every semester

PLO 2 Explain advanced chemical principles as they pertain to their specific field of research	Coursework (I R) Divisional seminars (I\R) Written and Oral Candidacy (R, A) Annual research report (R A) Individual development plan (I R) Original research proposal (R,A) Written dissertation (R M, A) Oral Dissertation defense (R M, A)	Academic transcript Seminar instructor Student's committee Student Student/Advisor Faculty/Seminar instructor Student's committee Student's committee	Every semester Every semester Every semester Annually Annually Every semester Every semester Every semester
PLO 3 Analyze and critically evaluate the existing literature published within their field of research	Coursework (I R) Department Colloquium (I R) Divisional seminars (I\R) Written and Oral Candidacy (R, A) Annual research report (R A) Individual development plan (I R) Original research proposal (R,A) Written dissertation (M, A) Oral Dissertation defense (M, A)	Academic transcript Colloquium instructor Seminar instructor Student's committee Student Student/Advisor Faculty/Seminar instructor Student's committee Student's committee	Every semester Every semester Every semester Every semester Annually Annually Every semester Every semester Every semester
PLO 4 Independently design and execute original research that can address important scientific questions	Written and Oral Candidacy (R, A) Annual research report (R A) Individual development plan (A) Original research proposal (R,A) Written dissertation (R M, A) Oral Dissertation defense (R M, A) Exit Survey	Student's committee Student Student/Advisor Faculty/Seminar instructor Student's committee Student's committee Student	Every semester Annually Annually Every semester Every semester Every semester At graduation
PLO 5 Generate quality data using a variety of experimental and/or computational techniques and interpret the meaning and implication of their data	Written and Oral Candidacy (I R, A) Annual research report (R A) Individual development plan Written dissertation (M, A) Oral Dissertation defense (M, A)	Student's committee Student Student/Advisor Student's committee Student's committee	Every semester Annually Annually Every semester Every semester
PLO 6 Effectively communicate their research in oral and written formats, including the ability to author manuscripts suitable for publication in peer reviewed scientific journals	Divisional seminars (I\R, A) Written and Oral Candidacy (I R, A) Individual development plan (A) Original research proposal (R,A) Written dissertation (M, A) Oral Dissertation defense (M, A) Attending conferences Published articles Exit Survey	Seminar instructor Student's committee Student/Advisor Faculty/Seminar instructor Student's committee Student's committee Student Student Student	Every semester Every semester Annually Every semester Every semester Every semester Every semester Every semester At graduation

PLO 7 Inquire about and prepare for various career opportunities with their advanced degree	Department Colloquium (R)	Colloquium instructor	Every semester
	Attending conferences	Student	Annually
	Individual development plan (I R)	Student/Advisor	Annually
	Exit Survey	Student	At graduation
PLO 8 Learn and adopt best safety practices (chemical hygiene, personal protective wear, proper handling of chemical waste streams, etc.) in chemical research	Annual research report (R A)	Student	Annually
	Individual development plan (I R)	Student/Advisor	Annually
PLO 9 Learn and apply the ethical impact of personal and professional behavior	Annual research evaluation (R A)	Student	Annually
	Individual development plan (I R)	Student/Advisor	Annually
	Exit Survey	Student	At graduation

introduced (I), reinforced/practiced (R), mastered (M), and Assessed (A)

Use of Assessment Data: The data are collected and analyzed by the chair of the Graduate Studies Committee and the administrative staff. The data are shared with the Leadership Committee, Graduate Studies Committee, and Lecture and Colloquium Committee to determine if the courses and seminars are meeting the needs of the students in the program. The Graduate Studies Committee and the Leadership Committee will make recommendations for program changes and improvements as needed in response to the analysis of assessment data. The collected data and any program changes based on assessment are documented and reported to the faculty at the end of each academic year (May faculty meeting).