

# CHEMISTRY: CHEMISTRY EDUCATION (PH.D.)

<https://ceps.unh.edu/chemistry/program/phd/chemistry-chemistry-education>

## Description

The Ph.D. Option in Chemistry Education is designed for students who plan a career at the interface of Science and Education (e.g. discipline-based education research, educational program assessment, STEM curricular design, chemistry teaching, etc.). The rigorous program involves coursework in Chemistry, Psychology and Education and original research in Chemistry Education, leading to the submission of a dissertation. Students with a research-based MS (or equivalent) will be admitted directly to the program. Students with a BS (or equivalent) will first obtain an MS degree, carrying out original laboratory-based research with a faculty mentor, and submitting a thesis. The program has a focus on developing strong writing and oral communication skills. Financial support is typically available through a teaching assistantship.

## Requirements

### Ph.D. Option in Chemistry Education

- Demonstration of a broad understanding of undergraduate chemistry by passing a series of basic examinations or satisfactory performance in approved courses.
- Demonstration of chemistry laboratory research proficiency by completing a thesis-based M.S. (or equivalent) either at UNH or another university.
- Satisfactory performance in a series of courses in science education, cognition, and qualitative/quantitative research methods.
- Attendance at Department seminars.
- Attendance at Graduate Research Update (GRU) sessions and presentation once annually from year 2 onward.
- Satisfactory presentation of a Thesis Research Proposal (TRP) in the second year of residence,
- Preparation and oral defense of an Original Research Proposal (ORP) in the third year of residence. Successful completion of the Original Research Proposal (ORP) enables the student to advance to candidacy.
- One oral presentation at a regional or technical conference, and one oral or poster presentation at the UNH Graduate Research Symposium.
- Preparation, public presentation, and oral defense of a written dissertation.
- GPA of 3.0 or higher required to graduate.
- Please contact the department for additional information on this option.

### Faculty Research Advisor and Dissertation Committee

Students select a research advisor during the first semester in the program after interviewing at least three faculty members. During each semester thereafter, students conduct independent research under the supervision of the Faculty Research Advisor. In the second year of residence and before the Thesis Research Proposal, a dissertation

committee is selected. This committee evaluates the student's Thesis Research Proposal and the Original Research Proposal. Once the Original Research Proposal has been passed and the student advances to candidacy, a fifth committee member is selected and added to the Dissertation Committee to evaluate the Dissertation Defense.

Code	Title	Credits
<b>Required Department Courses</b>		
CHEM 800	Introduction to Chemistry Teaching and Research Practices	1
CHEM 801	Modern Tools for Researchers in the Chemical Sciences	1
CHEM 802	Critical Thinking for Chemists	1
CHEM 803	Creative Thinking for Chemists	1
<b>Chemistry Courses</b>		
CHEM 995	Colloquium (CHEM 995F Colloquium: Chemistry Education)	1-4
CHEM 997	Seminar	1
CHEM 999	Doctoral Research	0
3 Chemistry CORE courses in a sub-discipline recommended by research advisor or MS degree		
<b>Quantitative Statistics</b>		
Choose 2 courses (see examples below)		
PSYC 705	Tests and Measurement	4
PSYC 805	Research Methodology and Statistics I	4
PSYC 806	Research Methodology and Statistics II	4
PSYC 907	Research Methods and Statistics III	4
EDUC 978	Applied Regression Analysis in Educational Research	4
EDUC 979	Applied Multilevel Modeling	4
EDUC 981	Quantitative Inquiry: Methods and Techniques of Educational Research	4
MATH 835	Statistical Methods for Research	3
MATH 836	Advanced Statistical Modeling	3
MATH 839	Applied Regression Analysis	3
<b>Qualitative Methods</b>		
Choose 1 course (see examples below)		
EDUC 904	Qualitative Inquiry in Research	4
EDUC 982	Qualitative Fieldwork & Data Analysis	4
<b>Cognition</b>		
Choose 1 course (see examples below)		
PSYC 710	Visual Perception	4
PSYC 731	Brain and Behavior	4
PSYC 914	Advanced Seminar in Cognition	4

## Student Learning Outcomes

### Program Learning Outcomes

All Chemistry graduate students will be able to:

### Display a comprehensive knowledge of chemistry, with greater depth demonstrated in at least one subdiscipline.

- Chemistry students in the Ph.D. and the M.S. program should have a basic knowledge of the field, with that knowledge being at least the level of the material taught in first-year chemistry and the initial courses in undergraduate sub-disciplinary classes (analytical, inorganic, organic, physical chemistry, and biochemistry).

**Ph.D. students should demonstrate focused and deep expertise in their area of scholarly exploration, including an understanding of the current status of the topic. M.S. students should also demonstrate clear focus in scholarly pursuits.**

- In the area of specialization, a Ph.D. student's knowledge of the field should, at a minimum, be comparable to special topics classes at the graduate level.
- Students should demonstrate capabilities of searching the literature to become familiar with the current state of the field.

**Apply critical thinking skills in the evaluation of scientific work, by analyzing, organizing, and evaluating scientific data and knowledge.**

- Careful attention to and critical evaluation of material encountered in the literature, in seminars, and research activity is evidence of scientific maturation.

**Generate hypotheses, design strategies, perform studies, and interpret results that lead to new knowledge in the field, including the**

- Application of central methods and techniques, including laboratory skills, statistical and computational methods, data gathering, and record-keeping to deliver detailed information and reproducible results.
- Demonstration of an understanding of the scientific method through the Original Research Proposal and through laboratory research (dissertation).
- Conduct of consequential scientific inquiry that advances a scientific field as required for a dissertation and peer-reviewed publications.

**Communicate scientific information with effectiveness to both experts and novices in oral and written form, including methods, results, and conclusions.**

- Demonstration of the ability to engage in communication appropriate for the audience.
- Present scientific material with clarity, accuracy, and precision.

**Perform research in a professional, ethical, and safe manner.**

- Students must participate in and apply knowledge from required training in laboratory safety and the responsible conduct of research; additional specialized training in these areas is encouraged.

- Students should develop skills in applicable professional areas, such as pedagogy, teamwork and team building, and leadership, through mentoring, instructional activity, and workshops.
- Safety and ethical behavior should be demonstrated in all activities, including both instructional and research activity.