**CWEO 4.1**

**Breadth and depth of knowledge:** Understanding the foundational content and philosophical assumptions of one’s specialized area of study

**ULO 2**

**Breadth and depth of knowledge** Develop knowledge common to the liberal arts and sciences in the fields of arts, humanities, natural sciences, and social sciences. Students will also develop specialized knowledge and disciplinary expertise

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| **Student Learning Outcome/Objective** | **Courses in which students receive feedback** | **Measure** | **Target** | **Timeline** |
| **Describe the fundamental principles and applications of chemistry*** Describe the structure and composition of matter
* Describe the major reaction types in chemistry
* Apply fundamental principles from thermodynamics and kinetics to the study of chemical and biochemical systems
* Identify the splendor of God’s creation in the context of molecules, atoms, and electrons
* Describe the role of chemistry in science and society
* Explain the workings of living systems at the cellular level
 | CHEM 105CHEM 106CHEM 309BIOL 160 | ACS First Term General Chemistry ExamACS General Chemistry ExamACS First Term Organic Chemistry ExamFinal grade in BIOL 160 | Class mean > 60% percentile on each of these examsAll with grades of C or better | Every fallEvery springEvery fallEvery fall |

**Pink is difference from BA, blue is additions for ACS**

**CWEO 4.3**

**Specialized skills:** Developing proficiency in one’s specialized area of study sufficient to pursue a career and/or continue education at the graduate level

**ULO 4.3**

**Specialized skills** Become proficient in the scholarship of their discipline and demonstrate specialized skills needed to pursue a career and/or graduate school

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| **Student Learning Outcome/Objective** | **Courses in which students receive feedback** | **Measure** | **Target** | **Timeline** |
| **Apply fundamental and advanced principles across multiple areas of chemistry*** Use the theories of microscopic properties to explain macroscopic behavior
* Explain the role of energy and chemical bonding in determining the structure and reactivity of molecules
* Describe the theoretical basis for modern methods of analysis and separation
* Apply the laws and principles of thermodynamics and kinetics to chemical and biochemical systems
* Describe the chemistry of important groups of elements with emphasis on periodic trends
* Summarize the chemistry involved in catabolic and anabolic pathways
* Describe the role of various types of biomolecules in living systems
* Describe the transfer of information in biological systems
* Demonstrate scientific thinking, problem solving skills, and the ability to think critically
 | CHEM 221 CHEM 321CHEM 310CHEM 342CHEM 361CHEM 437 CHEM 438CHEM 410412 | Comprehensive final examACS Analytical Chemistry ExamACS Organic Chemistry ExamFinal ExamACS Inorganic Chemistry ExamACS Thermodynamics Exam ACS Quantum Mechanics ExamACS Comprehensive PChem ExamComprehensive Final ExamACS Biochemistry ExamETS Major Field TestSenior Skills AssessmentAlumni Survey | Mean ≥75%≥ 70th percentile≥ 70th percentileMean ≥ 85% ≥ 70th percentile≥ 60th percentile≥ 60th percentile≥ 80th percentileMean ≥ 75%≥ 70th percentile≥ 60th percentileAverage of 4 (of 5) on all outcomesPositive feedback about preparation | Every fallEvery springEvery springEvery other springEvery other fallEvery fallEvery other springEvery other springEvery fallEvery springEvery fallTo all graduatesAsked of all grads at 1 year and 5 year mark |
| **Work accurately and safely in the laboratory*** Apply fundamental laboratory techniques to a variety of experiments
* Read and follow written experimental protocols
* Properly set up and safely manipulate laboratory equipment, glassware, and chemicals
* Maintain accurate records of experimental work
* Use computers for collecting and processing experimental data
* Prepare and manipulate living organism cultures
 | Laboratory components of CHEM 105CHEM 106CHEM 309 | Incident reportsLab notebook grades  | Less than two incident reports in first year course≥ 80% on cumulative lab notebook grade | Evaluated in springEvery fall |
| **Demonstrate advanced lab knowledge and skills*** Apply various techniques for synthesizing chemical compounds
* Apply various wet and instrumental techniques for characterizing chemical and biochemical compounds
* Perform accurate and precise quantitative measurements
* Analyze data statistically and assess reliability of results
* Maintain legally defensible records of experimental work
* Interpret experimental data and draw warranted conclusions
* Use and understand modern instrumentation
* Isolate, purify, and identify various biomolecules
* Manipulate biological material on the molecular level, including typical molecular biology skills such as cloning, restriction digests, etc.
 | Laboratory component of CHEM 221CHEM 221CHEM 221CHEM 310CHEM 342CHEM 437CHEM 410 | Lab component of gradeMethods PaperFormal Lab ReportAssigned technique gradeCumulative notebook gradeLab component of gradeLab component of gradeLab grades for skill based reportsSenior skills assessment | ≥ 80% ≥ 80% ≥ 80% ≥ 80% ≥ 80% ≥ 80% ≥ 80% ≥ 80% Average of 4 (of 5) on all outcomes | Every fallEvery fallEvery fallEvery springEvery springEvery other springEvery fallEvery fallEnd of program |
| **Identify and respond appropriately to chemical safety issues*** Anticipate, recognize, and respond properly to hazards of laboratory work
* Find information on chemical and biological hazards
* Dispose of chemical and biological waste safely
 | All courses.CHEM 390 | Reported safety incidentsSafety Exercise | Less than 2 per yearMean ≥ 85% | End of courses |

**CWEO 4.2**

**Scholarship:** Engaging in scholarship in one’s specialized area of study

**ULO 4.2**

**Specialized scholarship** Become proficient in the scholarship of their discipline and demonstrate specialized skills needed to pursue a career and/or graduate school

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| **Student Learning Outcome/Objective** | **Courses in which students receive feedback** | **Measure** | **Target** | **Timeline** |
| **Demonstrate research and communication skills needed in the discipline*** Retrieve specific chemical and biochemical information from the primary and secondary literature, including research articles, books, and databases
* Read and understand peer-reviewed chemical and biochemical literature (primary literature)
* Regularly attend department seminars
* Produce clear, high-quality writing for lab reports and literature reviews according to the conventions appropriate for the chemical profession
* Present effective talks on biochemical topics
 | CHEM 221CHEM 390 / 490 | Formal lab reportMethods paperAbstracts turned in for seminars | ≥ 80% ≥ 80% Summarize talks each semester of these courses | Every fallEvery fallIn courses |
| **Plan and execute original research in collaboration with a faculty mentor*** Prepare a research proposal that includes a survey of the current literature, a clear research problem, and a research plan
* Budget laboratory time effectively to execute the experimental work detailed in the proposal, using appropriate laboratory and data analysis skills
* Keep a legally defensible laboratory notebook that fully describes the experimental work
* Produce a well-written research paper and deliver a research presentation on the project
 | CHEM 393CHEM 322, 422, 497, and/or 498Participation in SEH Symposium | Final draft of proposalEvaluation by mentor | Grade of at least B+Final grade of at least B+ | When course is takenWhen courses are takenCount at time of symposium |

**CWEO 4.4**

**Intrapersonal Awareness:** Gaining an awareness of options for employment, voluntary service, and/or graduate education in one’s specialized area of study

**ULO 5**

**Self-Awareness** Gain awareness of identity, character, and vocational calling

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| **Student Learning Outcome/Objective** | **Courses in which students receive feedback** | **Measure** | **Target** | **Timeline** |
| **Identify ways careers in chemistry connect with God’s vocational call*** Describe career options in chemistry and how these connect with God’s call on one’s life
* Access career opportunities for persons with chemical and biochemical training
 | CHEM 390, 490Departmental SeminarsCHEM 495 | Faith Integration PaperSenior skills assessmentAlumni survey | Each student ≥ 75percentAverage of 4 (of 5) on all outcomesPositive feedback | All alumni surveyed at year 1 and year 5 |