**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 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
 | CHEM 105CHEM 106CHEM 309 | ACS First Term General Chemistry ExamACS General Chemistry ExamACS First Term Organic Chemistry Exam | > 60% percentile on each of these exams | Every fallEvery springEvery fall |

**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 systems
* Demonstrate scientific thinking, problem solving skills, and the ability to think critically
 | CHEM 221CHEM 310CHEM 437  | Comprehensive final examACS Organic Chemistry ExamACS Thermodynamics ExamETS Major Field TestSenior Skills AssessmentAlumni Survey | Mean ≥ 75%≥ 70th percentile ≥ 60th percentile≥ 60th percentileAverage of 4 (of 5) on all outcomesPositive feedback about preparation | Every fallEvery springEvery fallTo all graduates |
| **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
 | 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 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
 | Laboratory component of CHEM 221CHEM 310CHEM 437 | Lab component of gradeAssigned technique gradeCumulative notebook gradeLab component of gradeSenior skills assessment | ≥ 80% ≥ 80% ≥ 80% ≥ 80% Average of 4 (of 5) on all outcomes | Every fallEvery springEvery 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 hazards
* Dispose of chemical waste safely
 | All courses.CHEM 390 | Reported safety incidentsSafety Exercise | Less than 2 per yearMean ≥ 85% | End of coursesEvery spring |

**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 information from the primary and secondary literature, including research articles, books, and databases
* Read and understand peer-reviewed chemical 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 chemical topics
 | CHEM 221CHEM 390 / 490 | Formal lab reportMethods paperAbstracts turned in for seminars | ≥ 80% ≥ 80% Summarize talks each semester of these courses | Every fallIn courses |

**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 training
 | CHEM 390, 490Departmental Seminars | Senior skills assessmentAlumni survey | Average of 4 (of 5) on all outcomesPositive feedback |  |

**CWEO 4.5**

**Faith knowledge & application:** Articulating how faith connects to one’s specialized area of study and to potential career options in that area of study

**ULO 3**

**Faith knowledge & application** Develop informed and mature convictions about Christian faith and practice

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| **Student Learning Outcome/Objective** | **Courses in which students receive feedback** | **Measure** | **Target** | **Timeline** |
| **Demonstrate the integration of faith and science*** Define the goals and limitations of the scientific process
* Recognize that the physical world is created and sustained by God and science is our tool to understand the physical world
* Commit to ethical decision making, service, and faithful stewardship of natural resources
 | Introduced in all coursesCHEM 495 | Integration paperAlumni survey | ≥ 75% using an established rubricPositive feedback | End of CHEM 495 |