**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 105  CHEM 106  CHEM 309 | ACS First Term General Chemistry Exam  ACS General Chemistry Exam  ACS First Term Organic Chemistry Exam | > 60% percentile on each of these exams | Every fall  Every spring  Every 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 221  CHEM 310  CHEM 437 | Comprehensive final exam  ACS Organic Chemistry Exam  ACS Thermodynamics Exam  ETS Major Field Test  Senior Skills Assessment  Alumni Survey | Mean ≥ 75%  ≥ 70th percentile  ≥ 60th percentile  ≥ 60th percentile  Average of 4 (of 5) on all outcomes  Positive feedback about preparation | Every fall  Every spring  Every fall  To 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 105  CHEM 106  CHEM 309 | Incident reports  Lab notebook grades | Less than two incident reports in first year course  ≥ 80% on cumulative lab notebook grade | Evaluated in spring  Every 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 221  CHEM 310  CHEM 437 | Lab component of grade  Assigned technique grade  Cumulative notebook grade  Lab component of grade  Senior skills assessment | ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  Average of 4 (of 5) on all outcomes | Every fall  Every spring  Every fall  End 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 incidents  Safety Exercise | Less than 2 per year  Mean ≥ 85% | End of courses  Every 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 221  CHEM 390 / 490 | Formal lab report  Methods paper  Abstracts turned in for seminars | ≥ 80%  ≥ 80%  Summarize talks each semester of these courses | Every fall  In 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, 490  Departmental Seminars | Senior skills assessment  Alumni survey | Average of 4 (of 5) on all outcomes  Positive 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 courses  CHEM 495 | Integration paper  Alumni survey | ≥ 75% using an established rubric  Positive feedback | End of CHEM 495 |