**Curriculum map** **and assessment of student learning**

**Department of Chemistry and Biochemistry**

**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 105  CHEM 106  CHEM 309  BIOL 160 | ACS First Term General Chemistry Exam  ACS General Chemistry Exam  ACS First Term Organic Chemistry Exam  Final grade in BIOL 160 | Class mean > 60% percentile on each of these exams  All with grades of C or better | Every fall  Every spring  Every fall  Every 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 321  CHEM 310  CHEM 342  CHEM 361  CHEM 437  CHEM 438  CHEM 410  412 | Comprehensive final exam  ACS Analytical Chemistry Exam  ACS Organic Chemistry Exam  Final Exam  ACS Inorganic Chemistry Exam  ACS Thermodynamics Exam  ACS Quantum Mechanics Exam  ACS Comprehensive PChem Exam  Comprehensive Final Exam  ACS Biochemistry Exam  ETS Major Field Test  Senior Skills Assessment  Alumni Survey | Mean ≥75%  ≥ 70th percentile  ≥ 70th percentile  Mean ≥ 85%  ≥ 70th percentile  ≥ 60th percentile  ≥ 60th percentile  ≥ 80th percentile  Mean ≥ 75%  ≥ 70th percentile  ≥ 60th percentile  Average of 4 (of 5) on all outcomes  Positive feedback about preparation | Every fall  Every spring  Every spring  Every other spring  Every other fall  Every fall  Every other spring  Every other spring  Every fall  Every spring  Every fall  To all graduates  Asked 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 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 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 221  CHEM 221  CHEM 221  CHEM 310  CHEM 342  CHEM 437  CHEM 410 | Lab component of grade  Methods Paper  Formal Lab Report  Assigned technique grade  Cumulative notebook grade  Lab component of grade  Lab component of grade  Lab grades for skill based reports  Senior skills assessment | ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  ≥ 80%  Average of 4 (of 5) on all outcomes | Every fall  Every fall  Every fall  Every spring  Every spring  Every other spring  Every fall  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 and biological hazards * Dispose of chemical and biological waste safely | All courses.  CHEM 390 | Reported safety incidents  Safety Exercise | Less than 2 per year  Mean ≥ 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 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  Every fall  In 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 393  CHEM 322, 422, 497, and/or 498  Participation in SEH Symposium | Final draft of proposal  Evaluation by mentor | Grade of at least B+  Final grade of at least B+ | When course is taken  When courses are taken  Count 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, 490  Departmental Seminars  CHEM 495 | Faith Integration Paper  Senior skills assessment  Alumni survey | Each student ≥ 75percent  Average of 4 (of 5) on all outcomes  Positive feedback | All alumni surveyed at year 1 and year 5 |