



OFFICE OF ACADEMIC ASSESSMENT  
*The* UNIVERSITY of OKLAHOMA

# Program Assessment Report

2022 - 2023

CAS - Chemistry and Biochemistry (BS)

### General Information

#### **Mission**

Our mission is to serve the citizens of the State of Oklahoma and the nation through instructing our undergraduate majors, those in cognate disciplines and as part of the general education programs of the College of Arts and Sciences to understand the role of chemistry and biochemistry in the natural world, through professional training of graduate students and postdoctoral researchers, through creating and disseminating new research-based understanding of chemistry and biochemistry, through providing expert advice and consultation to educational, industrial and governmental units, and through participating in service to the university and professional communities.

In particular, the Chemistry and Biochemistry (Standard) major is the most flexible degree program offered by the department, as it allows for some choice among the advanced courses. It allows students with other interests to develop a curriculum that best suits them. The resulting degree is Bachelor of Science. It requires a minimum of 36 credit hours of chemistry courses beyond General Chemistry.

#### **College**

Arts & Sciences

#### **Department/School/Division**

Chemistry and Biochemistry

#### **Assessment Liaison**

Paul A. Sims

## Knowledge of the Discipline

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### Student Learning Outcome (SLO)

Upon completion of the B.S. in Chemistry and Biochemistry (Standard Option), students should be able to demonstrate a thorough understanding of chemical principles that underlie the inner-workings of the natural world. Specifically, students should be able to:

- a) demonstrate knowledge of the composition of matter, especially the particulate nature of matter
- b) demonstrate knowledge of the chemical principles that are involved in intramolecular and intermolecular interactions
- c) demonstrate knowledge of the thermodynamic principles that govern chemical transformations in the natural world

### Outcome Status

Active

### Direct - Examination

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#### Assessment Method Description

This learning outcome is addressed through formative assessments as students progress through the program, and cumulative assessments as students near the completion of the program. The formative assessments include: i) comprehensive final exams in General Chemistry I and II, and Organic Chemistry I and II. Cumulative assessments include Physical Chemistry I, Introduction to Biochemistry, and Quantitative Analysis.

Both formative and cumulative assessments will be scored on a percentage basis.

#### Performance Target

On formative assessments, 50% of Chemistry and Biochemistry (Standard) Majors are expected to score at or above the 70% level. On the cumulative assessment, 60% of Chemistry and Biochemistry (Standard) Majors are expected to score at or above the 70% level.

#### Assessment Results and Use of Results

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##### Reporting Period

2022 - 2023

##### Assessment Results Entry Date

09/28/2023

##### Assessment Results

#### Formative Assessment:

On the cumulative final exam in CHEM 1315 for the F22/S23 academic year, 3/8 (38%) scored 70% or better.

On the cumulative final exam in CHEM 1415 for the F22/S23 academic year, 4/8 (50%) scored 70% or better.

On the cumulative final exam in CHEM 3064 for the F22/S23 academic year, 3/5 (60%) scored 70% or better; in CHEM 3053 for the F22/S23 academic year, 3/3 (100%) scored 70% or better.

On the cumulative final exam in CHEM 3164 for the F22/S23 academic year, 3/5 (60%) scored 70% or better; in CHEM 3153 for the F22/S23 academic year, 1/3 (33%) scored 70% or better.

#### Cumulative Assessment:

On the cumulative final exam in CHEM 3423 for the F22/S23 academic year, 3/6 (50%) scored 70% or better.

On the cumulative final exam in CHEM 3523 for the F22/S23 academic year, 3/3 (100%) scored 70% or better.

On the cumulative final exam in CHEM 3653 for the F22/S23 academic year, 0/2 (0%) scored 70% or better.

On the cumulative final exam in CHEM 3005 for the F22/S23 academic year, 3/9 (33%) scored 70% or better.

#### Results Status

Inconclusive

#### Number of Students Assessed

46

#### USE OF ASSESSMENT RESULTS

##### Overall Program Effectiveness

The target was met in the formative assessment in 3/4 cases; the target was met in the cumulative assessment in 1/4 cases; however, the number of students who were assessed is relatively low. In fact, the number of students who are choosing in the Chemistry and Biochemistry degree plan is relatively low and has been so for the last few years. These low numbers suggest that this major may no longer be a viable major, and the Department as a whole may wish to consider whether to continue with this major. This discussion will occur initially among the undergraduate assessment committee and may then occur among all members of the department.

#### Performance Skills

##### Student Learning Outcome (SLO)

Students will demonstrate proficiency in safely planning, executing, and analyzing chemical and biochemical experiments, including the use of computers for modeling and quantitative analysis of data. Specifically, students should be able to:

- exemplify safe practices by consistently adhering to safety standards (e.g., wearing safety goggles while in the laboratory) and by routinely following proper disposal guidelines.
- plan and execute the necessary experimental procedures to attain a desired outcome in a laboratory setting (e.g., be able to determine the concentration of a sample using a spectrophotometer, or, be able to experimentally determine parameters such as pKa of a molecule of interest).
- demonstrate the proper use of computer-aided analysis by selecting the best available program (e.g., ChemDraw, WebMO) and choosing the most appropriate model and fitting method (e.g., nonlinear fitting with the Solver algorithm when a nonlinear model is the "best" model).

##### Outcome Status

Active

#### Direct - Performance

#### Assessment Method Description

This learning outcome is addressed through a combination of i) enforcement of a policy that requires undergraduates to wear safety goggles (and other safety equipment, as appropriate) at all times within the lab, and ii) successful completion of the sequence of laboratory investigations that comprise the "performance-based" Quantitative Analysis course.

The teaching assistants will require that all students must wear safety goggles while in the lab (any students who do not have safety goggles will not be allowed to complete the lab). In addition, the entire structure of the laboratory portion of the Quantitative Analysis course is performance based; each student, working independently, must analyze samples and, for example, determine the concentration of an unknown to a high degree of accuracy.

### **Performance Target**

All Chemistry and Biochemistry (Standard) Majors will show 100% compliance in following established safety protocols such as wearing eye goggles at all times while in the lab; 70% of Chemistry and Biochemistry (Standard) Majors will demonstrate the proper quantitative analysis of experimental data, including the proper use of computers for fitting data to model equations, as appropriate.

### **Assessment Results and Use of Results**

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#### **Reporting Period**

2022 - 2023

#### **Assessment Results Entry Date**

09/28/2023

#### **Assessment Results**

The teaching assistants continued to require that all students wear safety goggles at all times when they are in the lab. In addition, the use of other safety equipment (e.g., gloves) continued to be mandatory when the experiment in question required/requires such equipment. All students complied with these safety requirements.

On the sequence of performance-based laboratory investigations in CHEM 3005 for the F22/S23 academic year, 9/9 (100%) scored 70% or better on the laboratory portion of the course.

#### **Results Status**

Target Met

#### **Number of Students Assessed**

9

### **USE OF ASSESSMENT RESULTS**

#### **Overall Program Effectiveness**

Although 9/9 students met the target with respect to safety compliance and laboratory performance, the number of students assessed was relatively low. As noted elsewhere, the undergraduate assessment committee, and (possibly) the department at large will meet to discuss whether to continue with this major.

### **Communication Skills**

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#### **Student Learning Outcome (SLO)**

Students will demonstrate proficiency in communicating the results of chemistry- and biochemistry-related investigations. Specifically, students should be able to:

- provide an introduction and overview of the reported work that is appropriate for the intended audience
- describe with the appropriate level of detail the materials used and the methods that were followed
- report the results that were obtained in an appropriate manner and construct appropriate tables and figures to aid in the reporting of the results
- discuss the relevance of the results that were obtained and interpret the results in the context of the field in which the experimental work has relevance.

#### **Outcome Status**

Active

## Direct - Project

### Assessment Method Description

This learning outcome is addressed through evaluations of written laboratory reports that Chemistry and Biochemistry (Standard) Majors submit in the General Chemistry I and II courses that students take early in the program. In addition, some of the Chemistry and Biochemistry (Standard) Majors perform research under the supervision of a faculty member, and as part of this research they write and submit a Senior Thesis as part of the Senior Thesis Capstone class. This thesis is evaluated by both the faculty advisor of the student and a non-supervisory outside reader of the thesis. Thus, the students who complete the thesis option will gain additional experience in communicating the results of chemistry-related research.

Students in General Chemistry I and II will have completed a formal, peer-reviewed laboratory report that followed a specific rubric. Students in more advanced laboratory courses will gain additional experience in conducting laboratory investigations and writing up the results of these investigations in lab reports.

### Performance Target

The performance target for this learning outcome is the following: 60% of Chemistry and Biochemistry (Standard) Majors in General Chemistry I and II will submit written, peer-reviewed laboratory reports that score at or above 70%. Similarly, 70% of Chemistry and Biochemistry (Standard) Majors in the Senior Thesis Capstone course will submit a senior thesis that is judged to be A-level work by their advisor and outside reader. In addition, 70% of the Senior Thesis students who present their research during a department-wide poster presentation will be judged to have done so at the 70% level or better by the senior thesis advisor.

### Assessment Results and Use of Results

#### Reporting Period

2022 - 2023

#### Assessment Results Entry Date

09/28/2023

#### Assessment Results

Formative Assessment:

On the peer-reviewed lab report in CHEM 1315 for the F22/S23 academic year, 7/8 (88%) scored 70% or better.

On the peer-reviewed lab report in CHEM 1415 for the F22/S23 academic year, 8/8 (100%) scored 70% or better.

Cumulative Assessment:

For the Senior Thesis Capstone course, no Chemistry and Biochemistry students enrolled in this course during the F22/S23 academic year.

#### Results Status

Target Met

#### Number of Students Assessed

16

### USE OF ASSESSMENT RESULTS

#### Overall Program Effectiveness

Although the formative assessment targets were met, the cumulative assessment was not possible because zero students enrolled in the Senior Thesis Capstone course. (Note that all the other Capstone courses have been discontinued, which has greatly hampered our ability to perform cumulative assessment on communication skills for any of our majors.) Aside from the difficulty of performing cumulative assessment in this category, the undergraduate assessment committee (and, possibly, the Department) will need to consider whether to continue with this major due to the relatively small number of students who choose this major.

