

Academic Program Workspace

Chemistry (B.S.)

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General Information (Academic Program Workspace)

General Program Information

NAME OF DEPARTMENT CHAIR

Alena Kubatova

NAME OF PERSON SUBMITTING REPORT

Alena Kubatova

SPECIALIZED ACCREDITATION IF APPLICABLE (NAME OF ACCREDITING AGENCY, STATUS OF ACCREDITATION, DATE OF NEXT ACCREDITATION)

BS in Chemistry certified by American Chemical Society

LICENSURES OR CERTIFICATES OFFERED IF APPLICABLE (EX. RN, SECONDARY EDUCATION, PROFESSIONAL PILOT, ETC.)

None besides Bachelor's Degree Certified by the ACS listed as spealized accreditation

PERCENTAGE OF DEGREE OFFERED ONLINE (100% ONLINE, ONLINE WITH SOME CAMPUS VISITS, OR NOT ONLINE)

None

DO YOU OFFER 50% OR MORE OF YOUR COURSES LEADING TO YOUR DEGREE(S) AT ADDITIONAL LOCATIONS?

No

Standing Requirements

MISSION STATEMENT

Chemistry is the central science, and so the Department plays a pivotal role in advancing the mission of the University of North Dakota. Our Department occupies a unique niche as one of the smaller Ph.D.-granting programs in the country. As such, this enables us to accomplish nationally and internationally significant research and yet allows us to give individualized graduate education in the context of vibrant, externally supported research. We also provide outstanding chemical education for a large fraction of the UND student body through service courses and for chemistry majors with a variety of emphases. The active participation of most of our faculty members in research facilitates the transfer of cutting-edge knowledge to the classroom, and the strong commitment of our faculty to teaching produces a solid foundation of learning for both majors and non-majors alike. Implementation of high impact practices such as experiential learning through active participation in research by both undergraduate and graduate students will continue to be a hallmark of our Department. We impact the economic development of the state and region as a direct consequence of grant activity, with our service and community work, and by educating and training students to become successful alumni who assume leadership positions in regional industries. We respect and value the individuality of faculty members with regard to research, teaching, and service contributions while accomplishing the overall mission of the Department.

OUTCOMES

Chemistry (B.S.) Outcome Set

SLO1: Critical Thinking in Chemistry

Student Learning Outcomes (SLO)1: Application of critical thinking skills to understand different chemistry concepts and the relationships among them

Mapping

Essential Studies Goals: Critical Inquiry & Analysis

SLO2: Laboratory Techniques and Instrumentation Skills

Student Learning Outcomes (SLO)2: Use of modern laboratory techniques and instrumentation to perform chemistry experiments

Mapping

One UND Strategic Plan: Enhance discovery at a level consistent with most research-intensive universities (Carnegie R1).

SLO3: Information Literacy in Chemistry

Student Learning Outcomes (SLO)3: Use of multiple sources of information to critically analyze chemistry problems

Mapping

Essential Studies Goals: Information Literacy, Written Communication

SLO4: Orals Communication Skills in Chemistry

Student Learning Outcomes (SLO) 4: Effective oral communication skills to describe and interpret chemistry facts and concepts

Mapping

Essential Studies Goals: Oral Communication

SLO5: Written Communication Skills in Chemistry

Student Learning Outcomes (SLO) 5 Effective written communication skills to describe and interpret chemistry facts and concepts

Mapping

Essential Studies Goals: Written Communication

PO1: Student Success in Course Work

Program Outcomes (PO) 1 Student success in course work based on DFW rates

Mapping

One UND Strategic Plan: Increase undergraduate, graduate and professional graduation rates.

PO2: Service to Other UND Programs

Program Outcomes (PO) 2 Service to other UND programs by offering modern and relevant chemistry courses based on curriculum needs

Mapping

One UND Strategic Plan: Deliver more educational opportunity online and on-campus., Provide a strong undergraduate liberal arts foundation.

PO 3: Number of Chemistry Majors

Program Outcomes (PO) 3. Optimize the number of chemistry majors and ensure their multidisciplinary knowledge of chemistry

Mapping

One UND Strategic Plan: Increase undergraduate, graduate and professional graduation rates., Provide a strong undergraduate liberal arts foundation.

CURRICULUM MAP

Active Curriculum Maps

- BS in Chemistry (See appendix)
Alignment Set Chemistry (B.S.) Outcome Set
Created 09/21/2020 12:32:17 pm CST
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Assessment map

Assessment Map (When are outcomes measured? Upload map)

ASSESSMENT MAP OF WHEN OUTCOMES ARE MEASURED (UPLOAD TABLE DETAILING WHAT OUTCOMES ARE MEASURED EACH YEAR)

Outcome	Where and how the assessment occurs	Year(s) Assessed						
		2020	2021	2022	2023	2024	2025	2026
SLO1	American Chemical Society (ACS) exams will be used to assess student skills. In classes not using ACS exam, averages on instructor-developed final exams will be compared to those on exams given in previous years.	X	X	X	X	X	X	X
SLO2	Student final percentages will be used to assess student performance in chemistry lab courses according to specific rubrics. The percentages will be compared with those in previous years.	X	X	X	X	X	X	X
SLO3	Bibliography in Chem 495 written reports is evaluated for accuracy and appropriateness.	X	X	X	X	X	X	X
SLO4	Instructors of Chem 442, 443, and 495 develop and consistently apply rubrics to evaluate student presentations in the corresponding course		X		X		X	
SLO5	In Chem 462 and 467, student final percentages will be used to assess student writing skills. The percentages will be compared with those in previous years. In Chem 495, a rubric developed for this capstone course will be used.		X		X		X	
PO1	Student grades in all Chem courses will be used to assess student success in course work. Target: DFW rate <20%	X	X	X	X	X	X	X
PO2	Results of meetings with partner (or potential partner) departments to determine chemistry curriculum needs		X		X		X	
PO3	The number of (i) chemistry majors at each level and (ii) chemistry graduates is evaluated. The results of the DUCK exam will be used for the assessment of chemistry knowledge of our graduates		X		X		X	

2019-2020 Assessment Cycle

ASSESSMENT REPORT

Mission Statement

Chemistry is the central science, and so the Department plays a pivotal role in advancing the mission of the University of North Dakota. Our Department occupies a unique niche as one of the smaller Ph.D.-granting programs in the country. As such, this enables us to accomplish nationally and internationally significant research and yet allows us to give individualized graduate education in the context of vibrant, externally supported research. We also provide outstanding chemical education for a large fraction of the UND student body through service courses and for chemistry majors with a variety of emphases. The active participation of most of our faculty members in research facilitates the transfer of cutting-edge knowledge to the classroom, and the strong commitment of our faculty to teaching produces a solid foundation of learning for both majors and non-majors alike. Implementation of high impact practices such as experiential learning through active participation in research by both undergraduate and graduate students will continue to be a hallmark of our Department. We impact the economic development of the state and region as a direct consequence of grant activity, with our service and community work, and by educating and training students to become successful alumni who assume leadership positions in regional industries. We respect and value the individuality of faculty members with regard to research, teaching, and service contributions while accomplishing the overall mission of the Department.

Measures

Chemistry (B.S.) Outcome Set

Outcome

Outcome: SLO1: Critical Thinking in Chemistry

Student Learning Outcomes (SLO)1: Application of critical thinking skills to understand different chemistry concepts and the relationships among them

Measure: Chem 121 - General Chemistry

Course level Direct - Exam

Details/Description:	ACS certified exam for the First Semester of General Chemistry
Target:	45–55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in most Chemistry lecture courses, including Chem 121, as a final examination. Chem 121 is offered in the fall, spring, and summer semesters. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Measure: Chem 221 - Fundamentals of Chemistry

Course level Direct - Exam

Details/Description:	ACS certified exam for two semesters of General Chemistry
Target:	45- 55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 221, as a final examination. Chem 221 is offered in the fall semester only. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Measure: Chem 333 - Analytical Chemistry
Course level Direct - Exam

Details/Description:	ACS certified exam for Analytical Chemistry
Target:	45-55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 333, as a final examination. Chem 333 is offered in the fall semester only. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Measure: Chem 341 - Organic Chemistry I
Course level Direct - Exam

Details/Description:	ACS certified exam for the First Semester of Organic Chemistry
Target:	45–55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 341, as a final examination. Chem 341 is offered in the fall, spring semesters. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Outcome: SLO2: Laboratory Techniques and Instrumentation Skills

Student Learning Outcomes (SLO)2:

Use of modern laboratory techniques and instrumentation to perform chemistry experiments

Measure: Chem 115L / 116L - General / Organic, Biochemistry Laboratories
Course level Direct - Other

Details/Description:	Comparison of Student Final Course Percentage
Target:	At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Chem 115 lab and chem 116 lab is offered in the fall, spring, and summer semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Measure: Chem 121L / 122L - General Chemistry I and II Laboratories
Course level Direct - Other

Details/Description:	Comparison of Student Final Course Percentage
Target:	At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Chem 121 lab and Chem 122 lab is offered in the fall, spring, and summer semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Measure: Chem 341L / 342L - Organic Chemistry I & II Laboratories
Course level Direct - Other

Details/Description:	Comparison of Student Final Course Percentage
Target:	At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Chem 341 lab and Chem 342 lab is offered in the fall, and spring semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Outcome: SLO3: Information Literacy in Chemistry

Student Learning Outcomes (SLO)3

Use of multiple sources of information to critically analyze chemistry problems

Measure: Chem 495 - Chemistry Capstone

Course level Direct - Other

Details/Description:	Specific learning goal References are relevant to the chosen topic. References have at least 4 papers published within 3 years. Bibliography includes the studies of at least three different groups. References are given in the proper ACS format.
Target:	75% of students achieve levels 4 (Agree) and 5 (Strongly Agree) for specific learning goals in the rubric for SLO 3.
Implementation Plan (timeline):	Chem 495 is offered in the spring semester only. Final drafts of Chem 495 student papers with bibliography are submitted at the end of the course to the Chemistry office. Instructors of Chem 492 and research advisors are responsible for evaluating references and their use on the reports.

Outcome: SLO4: Orals Communication Skills in Chemistry

Student Learning Outcomes (SLO) 4

Effective oral communication skills to describe and interpret chemistry facts and concepts

Measure: Chem 441 & 442 - Instrumental Analysis

Course level Direct - Other

Details/Description:	Oral presentations are given either throughout (Chem 44x)
Target:	In Chem442 & 442, a developed rubric for these capstone courses will be used assessing oral communication skills At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Instructors are responsible for evaluating student presentations and providing the results of assessment to the Dept. Chair at the end of the semester.

Measure: Chem 495 - Chemistry Capstone

Course level Direct - Other

Details/Description:	Oral presentations are given at the end (Chem 495) of the course.
Target:	In Chem 495, a developed rubric for this capstone course will be used assessing oral communication skills At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Instructors are responsible for evaluating student presentations and providing the results of assessment to the Dept. Chair at the end of the semester.

Outcome: SLO5: Written Communication Skills in Chemistry

Student Learning Outcomes (SLO) 5

Effective written communication skills to describe and interpret chemistry facts and concepts

Measure: Chem 462 & 467 - Physical Chemistry lab

Course level Direct - Other

Details/Description: In Chem 462 and 467, student final percentages will be used to assess student writing skills. The percentages will be compared with those in previous years.

Target:

Implementation Plan (timeline): Instructors are to submit grade books, final grades (Chem 462 and 467)

Measure: Chem 495

Course level Direct - Student Artifact

Details/Description: Final research paper

Target: In Chem 495, a developed rubric for this capstone course will be used assessing written communication skills

At least 60% of the class are expected to be on level 3 and 4

Less than 30% of the class are expected to be on level 2

Less than 10% of the class are expected to be on level 1 or 0

Implementation Plan (timeline): Final research report, Drafts of Chem 495 papers are evaluated by the instructor and research advisor multiple times during the course. Final drafts of papers are evaluated at the end of the course.

Outcome: PO1: Student Success in Course Work

Program Outcomes (PO) 1

Student success in course work based on DFW rates

Measure: Chem 121 - General Chemistry I

Course level Direct - Other

Details/Description: Student grades will be used to assess student success in course work.

Target: DFW rate < 20%

Implementation Plan (timeline): DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Measure: Chem 221 - Fundamentals of Chemistry

Course level Direct - Other

Details/Description: Student grades will be used to assess student success in course work

Target:	DFW rate < 20%
Implementation Plan (timeline):	DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Measure: Chem 341 - Organic Chemistry I
Course level Direct - Other

Details/Description:	Student grades will be used to assess student success in course work
Target:	DFW rate <20%
Implementation Plan (timeline):	DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Outcome: PO2: Service to Other UND Programs

Program Outcomes (PO) 2

Service to other UND programs by offering modern and relevant chemistry courses based on curriculum needs

Measure: Chem 115 & 116 Enrollment & Grade Distribution
Program level Direct - Other

Details/Description:	Evaluate enrollment in Chem 115 & 116 based on grade distributions, DFW for each major
Target:	DFW rates < 20% for each major
Implementation Plan (timeline):	The instructor will provide upon completion of these courses gradebooks including analysis by the major

Measure: Chem 333 Enrollment & Grade Distribution
Program level Direct - Other

Details/Description:	Evaluate enrollment in Chem 333 based on grade distributions, DFW for each major
Target:	DFW rates < 20% for each major
Implementation Plan (timeline):	The instructor will provide upon completion of this course a gradebook including analysis by the major

Measure: Chem 466 Enrollment & Grade Distribution
Program level Direct - Other

Details/Description:	Evaluate enrollment in Chem 466 based on grade distributions, DFW for each major
Target:	DFW rates < 20% for each major
Implementation Plan	The instructor will provide upon completion of this course a gradebook including

(timeline): analysis by the major

Outcome: PO 3: Number of Chemistry Majors

Program Outcomes (PO) 3.

Optimize the number of chemistry majors and ensure their multidisciplinary knowledge of chemistry

Measure: Maintain and increase the number of chemistry majors

Program level Indirect - Other

Details/Description: Number of Chemistry majors

Target: >55

**Implementation Plan
(timeline):**

Measure: Maintain and increase the number of chemistry majors in ACS track

Program level Indirect - Other

Details/Description: Number of students in ACS track

Target: 10-12

**Implementation Plan
(timeline):**

Measure: Maintain and increase the number of chemistry minors

Program level Indirect - Other

Details/Description: Number of students working towards the minor

Target: >60

**Implementation Plan
(timeline):**

ASSESSMENT FINDINGS

Finding per Measure

Chemistry (B.S.) Outcome Set

Outcome

Outcome: SLO1: Critical Thinking in Chemistry

Student Learning Outcomes (SLO)1: Application of critical thinking skills to understand different chemistry concepts and the relationships among them

Measure: Chem 121 - General Chemistry

Course level Direct - Exam

Details/Description:	ACS certified exam for the First Semester of General Chemistry
Target:	45–55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in most Chemistry lecture courses, including Chem 121, as a final examination. Chem 121 is offered in the fall, spring, and summer semesters. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 121 - General Chemistry

Summary of Findings:	In AY 2019–20, 867 students were enrolled in face-to-face and online Chem 121; 625 of them took face-to-face classes. Because of the security issue, ACS exams are given in face-to-face classes only. In the fall semester of 2019, 518 students were enrolled in four face-to-face sections of Chem 121. 475 students took the ACS exam as a final test and achieved the average score corresponded to the national 63%-ile, the highest number in the department's recent history. For comparison, in the fall of 2018, the average score on the same exam was at 56%-ile (n = 586). In the fall semesters of 2015–17, the score was at 49–51%-ile. In the spring semester of 2020, the non-secure ACS exam was offered to students; however, there are no national data for that exam, and we cannot compare the results of our students with national. According to the rubric for evaluation of SLO 1, the 63%-ile achieved in the fall of 2019 indicates that the level of student learning is significantly above the national average.
Results :	Target Achievement: Met
Action Plan:	The results of the spring semester will be compared to the results of the current AY and described in the next year's report.

Measure: Chem 221 - Fundamentals of Chemistry

Course level Direct - Exam

Details/Description:	ACS certified exam for two semesters of General Chemistry
Target:	45- 55 percentile
Implementation Plan (timeline):	The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 221, as a final examination. Chem 221 is offered in the fall semester only. The results of the tests

are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 221 - Fundamentals of Chemistry

Summary of Findings: Chem 221 is offered for freshman students with good high school chemistry background. In the fall of 2019, the ACS exam covering two semesters of General Chemistry was given as a final examination in the course. The class average score achieved by the class of 16 students corresponded to the national 78%-ile. For comparison, during the three previous years, the class average score was in a range of 64–85%-ile. According to the rubric for evaluation of SLO 1, the percentile achieved in the fall of 2019 indicates that the level of student learning in Chem 221 is significantly above the national average.

Results : Target Achievement: Exceeded

Action Plan:

Measure: Chem 333 - Analytical Chemistry *Course level Direct - Exam*

Details/Description: ACS certified exam for Analytical Chemistry

Target: 45-55 percentile

Implementation Plan (timeline): The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 333, as a final examination. Chem 333 is offered in the fall semester only. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 333 - Analytical Chemistry

Summary of Findings: Chem 333 is offered in fall semesters. In AY 2019–2020, 81 students were enrolled in Chem 333 and 79 of them took the ACS exam. The class achieved the average score corresponding to the national 49%-ile. For comparison, In the falls of 2016–18, the scores were at 36–44%-ile. According to the rubric for evaluation of SLO 1, the percentile achieved in the fall of 2019 indicates that the level of student learning in Chem 121 meets the national average.

Results : Target Achievement: Met

Action Plan:

Measure: Chem 341 - Organic Chemistry I

Course level Direct - Exam

Details/Description: ACS certified exam for the First Semester of Organic Chemistry

Target: 45–55 percentile

Implementation Plan (timeline): The standardized, nationally normed American Chemical Society (ACS) tests are given in the majority of the Chemistry lecture courses, including Chem 341, as a final examination. Chem 341 is offered in the fall, spring semesters. The results of the tests are submitted to the Chair at the end of each semester. Averages and trends in exam scores are used to determine student knowledge and adjust a) material presented in lectures, b) textbook selection, and c) teaching methods. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 341 - Organic Chemistry I

Summary of Findings: Chem 341 is offered in the fall and spring semesters. In AY 2019–2020, 184 students were enrolled in Chem 341; 149 of them in the fall semester. 115 students took the ACS exam in the fall and achieved the average score at the national 60%-ile. For comparison, in the fall of 2018, the average score on the same exam was at 62%-ile (n = 139). In the falls of 2015–17, the score was at 46–51%-ile. In the spring semester, the non-secure ACS exam was offered to students; however, there are no national data for that exam, and we cannot compare the results of our students with national. According to the rubric for evaluation of SLO 1, the percentile achieved in the fall of 2019 indicates that the level of student learning in Chem 341 is above the national average.

Results : Target Achievement: Met

Action Plan:

Outcome: SLO2: Laboratory Techniques and Instrumentation Skills

Student Learning Outcomes (SLO)2:

Use of modern laboratory techniques and instrumentation to perform chemistry experiments

Measure: Chem 115L / 116L - General / Organic, Biochemistry Laboratories

Course level Direct - Other

Details/Description: Comparison of Student Final Course Percentage

Target:	At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Chem 115 lab and chem 116 lab is offered in the fall, spring, and summer semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 115L / 116L - General / Organic, Biochemistry Laboratories

Summary of Findings: According to the rubric for evaluation of SLO 2, At least 60% of the class are expected to be on level 3 (B) and 4 (A). For the last three academic years (2019-2020, 2018-2019 and 2017-2018) the combined percent of A's and B's are well above the minimum of 60% (range of 82% – 93 %) for both chem 115 and 116 lab. In-addition, the level 2 (% of C's) should be less than 30% and level 1 (% of D's) / 0 (% of F's) is less than 10%. Both chem 115 and 116 lab meet these requirements for the last three academic years.

Results : Target Achievement: Met

Action Plan:

Measure: Chem 121L / 122L - General Chemistry I and II Laboratories *Course level Direct - Other*

Details/Description:	Comparison of Student Final Course Percentage
Target:	At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Chem 121 lab and Chem 122 lab is offered in the fall, spring, and summer semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 121L / 122L - General Chemistry I and II Laboratories

Summary of Findings: According to the rubric for evaluation of SLO 2, At least 60% of the class are expected to be on level 3 (B) and 4 (A). For the last three academic years (2019-2020, 2018-2019 and 2017-2018) the combined percent of A's and B's are well above the minimum of 60% (range of 87% - 90%) for both chem 121

and 122 lab. In-addition, the level 2 (% of C's) should be less than 30% and level 1 (% of D's) / 0 (% of F's) is less than 10%. Both chem 121 and 122 lab meet these requirements for the last three academic years.

Results : Target Achievement: Met

Action Plan:

Measure: Chem 341L / 342L - Organic Chemistry I & II Laboratories

Course level Direct - Other

Details/Description: Comparison of Student Final Course Percentage

Target: At least 60% of the class are expected to be on level 3 and 4
Less than 30% of the class are expected to be on level 2
Less than 10% of the class are expected to be on level 1 or 0

Implementation Plan (timeline): Chem 341 lab and Chem 342 lab is offered in the fall, and spring semesters. The results of experiments, exams and the final course grades are to be submitted to the Chair at the end of each semester. Student percentages are to be used to: a) assess student lab skills, b) adjust experiments, and c) modify instructions to enhance student learning. Results are used in annual program assessments and evaluations of individual instructors.

Findings for Chem 341L / 342L - Organic Chemistry I & II Laboratories

Summary of Findings: According to the rubric for evaluation of SLO 2, At least 60% of the class are expected to be on level 3 (B) and 4 (A). For the last three academic years (2019-2020, 2018-2019 and 2017-2018) the combined percent of A's and B's are well above the minimum of 60% (range of 78% - 93%) for both chem 341 and 342 lab. In-addition, the level 2 (% of C's) should be less than 30% and level 1 (% of D's) / 0 (% of F's) is less than 10%. Both chem 341 and 342 lab meet these requirements for the last three academic years

Action Plan:

Substantiating Evidence:

 Chem 341I & 342 L - grade distribution (Word Document (Open XML)) (See appendix)

Outcome: SLO3: Information Literacy in Chemistry

Student Learning Outcomes (SLO)3

Use of multiple sources of information to critically analyze chemistry problems

Measure: Chem 495 - Chemistry Capstone

Course level Direct - Other

Details/Description:	Specific learning goal References are relevant to the chosen topic. References have at least 4 papers published within 3 years. Bibliography includes the studies of at least three different groups. References are given in the proper ACS format.
Target:	75% of students achieve levels 4 (Agree) and 5 (Strongly Agree) for specific learning goals in the rubric for SLO 3.
Implementation Plan (timeline):	Chem 495 is offered in the spring semester only. Final drafts of Chem 495 student papers with bibliography are submitted at the end of the course to the Chemistry office. Instructors of Chem 492 and research advisors are responsible for evaluating references and their use on the reports.

Findings for Chem 495 - Chemistry Capstone

Summary of Findings:	<p>In order to assess information literacy in chemistry, student bibliographies from Chemistry Capstone, Chem 495, were analyzed according to the following criteria listed below:</p> <ol style="list-style-type: none">11. References are relevant to the chosen topic.12. References have at least 4 papers published within 3 years.13. Bibliography includes the studies of at least three different groups.14. References are given in the proper ACS format. <p>In Spring 2020, 10 students completed Chem 495 and submitted their final paper with bibliography. The results of the students' bibliographies according to the assessment criteria are summarized below on a scale of 0 to 5. In the scale, the number correlates to the response to each statement, where 0 is not applicable, 1 is strongly disagree, 2 is disagree, 3 is neutral, 4 is agree, and 5 is strongly agree.</p> <p>In the attached table, 100% of students met the target for criteria 11 and 13; 70% of students met the target for criteria 12; 50% of students met the target for criteria 14. Therefore, the target was met for criteria 11 and 13. Criteria 12 and 14 still need improvement.</p>
Results :	Target Achievement: Not Met
Action Plan:	The instructors of Chem 495 in the spring of 2021 are expected to spend more time explaining students the significance of criteria 12 and 14.

Substantiating Evidence:

 Information literacy student results (Word Document (Open XML)) (See appendix)

Outcome: SLO4: Orals Communication Skills in Chemistry

Student Learning Outcomes (SLO) 4

Effective oral communication skills to describe and interpret chemistry facts and concepts

Measure: Chem 441 & 442 - Instrumental Analysis

Course level Direct - Other

Details/Description:	Oral presentations are given either throughout (Chem 44x)
Target:	In Chem442 & 442, a developed rubric for these capstone courses will be used assessing oral communication skills At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Instructors are responsible for evaluating student presentations and providing the results of assessment to the Dept. Chair at the end of the semester.

Findings for Chem 441 & 442 - Instrumental Analysis

No Findings Added

Measure: Chem 495 - Chemistry Capstone

Course level Direct - Other

Details/Description:	Oral presentations are given at the end (Chem 495) of the course.
Target:	In Chem 495, a developed rubric for this capstone course will be used assessing oral communication skills At least 60% of the class are expected to be on level 3 and 4 Less than 30% of the class are expected to be on level 2 Less than 10% of the class are expected to be on level 1 or 0
Implementation Plan (timeline):	Instructors are responsible for evaluating student presentations and providing the results of assessment to the Dept. Chair at the end of the semester.

Findings for Chem 495 - Chemistry Capstone

No Findings Added

Outcome: SLO5: Written Communication Skills in Chemistry

Student Learning Outcomes (SLO) 5

Effective written communication skills to describe and interpret chemistry facts and concepts

Measure: Chem 462 & 467 - Physical Chemistry lab

Course level Direct - Other

Details/Description: In Chem 462 and 467, student final percentages will be used to assess student writing skills. The percentages will be compared with those in previous years.

Target:

Implementation Plan (timeline): Instructors are to submit grade books, final grades (Chem 462 and 467)

Findings for Chem 462 & 467 - Physical Chemistry lab

No Findings Added

Measure: Chem 495

Course level Direct - Student Artifact

Details/Description: Final research paper

Target: In Chem 495, a developed rubric for this capstone course will be used assessing written communication skills

At least 60% of the class are expected to be on level 3 and 4

Less than 30% of the class are expected to be on level 2

Less than 10% of the class are expected to be on level 1 or 0

Implementation Plan (timeline): Final research report, Drafts of Chem 495 papers are evaluated by the instructor and research advisor multiple times during the course. Final drafts of papers are evaluated at the end of the course.

Findings for Chem 495

No Findings Added

Outcome: PO1: Student Success in Course Work

Program Outcomes (PO) 1

Student success in course work based on DFW rates

Measure: Chem 121 - General Chemistry I

Course level Direct - Other

Details/Description: Student grades will be used to assess student success in course work.

Target: DFW rate < 20%

Implementation Plan (timeline): DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Findings for Chem 121 - General Chemistry I

Summary of Findings:

In AY 2019–20, Chem 121 was offered in the fall, spring, and summer semesters. Overall, 867 students were enrolled in Chem 121 during the AY. In the fall, four face-to-face sections were offered. Out of 518 students in those sections, 23.6% got DFW. In the spring semester, 25% out of 107 students in two face-to-face sections were in that category. In the summer of 2020, 15% out of 70 students were given DFW. For comparison, in AY 2018–19, face-to-face sections' DFW rate was 33.3%. Therefore, the Chemistry Department made progress in decreasing the DFW rate by almost 10% in face-to-face sections. In the fall, spring, and summer semesters, the Chemistry Department offered online sections of Chem 121. The DFW rate in those sections was the same in both semesters: 50% out of 84 students in the fall and 50% of 88 students in the spring. These high DFW rates were seen despite the consistent use of Starfish and working with students individually to accommodate their needs. In the summer semester, only 15% out 70 students in the online section received a DFW.

Results :

Target Achievement: Not Met

Action Plan:

There was significant improvement due to the implementation of recitation in labs. We will continue to monitor DFW rates while ensuring rigorous program and consider developing strategies to remediate students knowledge prior to taking the course

Measure: Chem 221 - Fundamentals of Chemistry

Course level Direct - Other

Details/Description:

Student grades will be used to assess student success in course work

Target:

DFW rate < 20%

Implementation Plan (timeline):

DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Findings for Chem 221 - Fundamentals of Chemistry

Summary of Findings:

Chem 221 is offered for freshman students with good high school chemistry background. In the fall of 2019, out of 16 students enrolled in the class, 1 student got an F and one student withdrew from the course. These two students constituted 12.5% of DFW. For comparison, in AY 2018–19, the DFW rate in Chem 221 was 25%.

Results :

Target Achievement: Not Met

Action Plan: There was significant improvement due to the implementation of recitation in labs. We will continue to monitor DFW rates while ensuring rigorous program and consider developing strategies to remediate students knowledge prior to taking the course

Measure: Chem 341 - Organic Chemistry I

Course level Direct - Other

Details/Description: Student grades will be used to assess student success in course work

Target: DFW rate <20%

Implementation Plan (timeline): DFW rates are used to determine student success in course work and to adjust teaching, e.g., a) teaching methods, b) textbook selections, c) grading scale and cut-offs, and d) the number of exams.

Findings for Chem 341 - Organic Chemistry I

Summary of Findings: In AY 2019–20, 184 students were enrolled in Chem 341 in the fall and spring semesters. The DFW rate was about the same in both semesters: 24% out of 149 students in the fall semester and 22.9% out of 35 in the spring semester. It is important to note that 20% of the students (30) in the fall semester withdrew from the course, and only 4% got either a D or F. 25 out of 30 of withdrawn students were premed students, who often want to get only an A in their classes. For comparison, in AY 2016–19, the DFW rate in Chem 341 varied significantly from 17 to 45%.

Results : Target Achievement: Not Met

Action Plan: Action plan: There was a significant improvement. The analysis revealed the high W rate is due to the high enrollment of premed students who aim to have only an “A” grade. 17% premed students dropped the course.

Outcome: PO2: Service to Other UND Programs

Program Outcomes (PO) 2

Service to other UND programs by offering modern and relevant chemistry courses based on curriculum needs

Measure: Chem 115 & 116 Enrollment & Grade Distribution

Program level Direct - Other

Details/Description: Evaluate enrollment in Chem 115 & 116 based on grade distributions, DFW for each

	major
Target:	DFW rates < 20% for each major
Implementation Plan (timeline):	The instructor will provide upon completion of these courses gradebooks including analysis by the major

Findings for Chem 115 & 116 Enrollment & Grade Distribution

No Findings Added

Measure: Chem 333 Enrollment & Grade Distribution

Program level Direct - Other

Details/Description:	Evaluate enrollment in Chem 333 based on grade distributions, DFW for each major
Target:	DFW rates < 20% for each major
Implementation Plan (timeline):	The instructor will provide upon completion of this course a gradebook including analysis by the major

Findings for Chem 333 Enrollment & Grade Distribution

No Findings Added

Measure: Chem 466 Enrollment & Grade Distribution

Program level Direct - Other

Details/Description:	Evaluate enrollment in Chem 466 based on grade distributions, DFW for each major
Target:	DFW rates < 20% for each major
Implementation Plan (timeline):	The instructor will provide upon completion of this course a gradebook including analysis by the major

Findings for Chem 466 Enrollment & Grade Distribution

No Findings Added

Outcome: PO 3: Number of Chemistry Majors

Program Outcomes (PO) 3.

Optimize the number of chemistry majors and ensure their multidisciplinary knowledge of chemistry

Measure: Maintain and increase the number of chemistry majors

Program level Indirect - Other

Details/Description: Number of Chemistry majors

Target: >55

**Implementation Plan
(timeline):**

Findings for Maintain and increase the number of chemistry majors

No Findings Added

Measure: Maintain and increase the number of chemistry majors in ACS track

Program level Indirect - Other

Details/Description: Number of students in ACS track

Target: 10-12

**Implementation Plan
(timeline):**

Findings for Maintain and increase the number of chemistry majors in ACS track

No Findings Added

Measure: Maintain and increase the number of chemistry minors

Program level Indirect - Other

Details/Description: Number of students working towards the minor

Target: >60

**Implementation Plan
(timeline):**

Findings for Maintain and increase the number of chemistry minors

No Findings Added

Overall Reflection

During the AY 2019-2020, the Chemistry Department continued providing outstanding chemical education for a large fraction of UND students through service courses and specialized courses for chemistry majors. Implementation of high impact practices such as experiential learning through active participation in research by all undergraduate chemistry majors continues to be a significant hallmark of our department.

After AY 2018-19, we lost two faculty positions and hired one tenure-track faculty member, Dr. Yu, who contributed to teaching one of the upper-level courses. The department also welcomed a new lecturer, Dr. Meyer, who taught two service classes, Chem 115 and 116 with corresponding labs.

In the spring of 2020, the department created a new Undergraduate Program Assessment Plan for the present annual assessment. According to the data provided in the assessment, the department continued to:

- a) achieve the level of student chemistry knowledge that meets or exceeds the national norms;
- b) decrease the DFW rate in all courses;
- c) teach students how to use modern laboratory techniques and instrumentation to perform chemistry experiments;
- d) provide service to other UND programs by teaching a variety of undergraduate classes;
- e) attract a good number of chemistry majors and provide them with specialized courses and research opportunities.

After the transition from face-to-face classes to online in March 2020, chemistry instructors continued providing students with learning opportunities. However, because of security concerns, we could not give standardized ACS tests with known norms as final examinations in all classes and, therefore, compare students' learning in the spring semester with that of previous semesters and other universities.

The chemistry faculty continue learning the best practices for providing outstanding learning opportunities in hybrid and online courses. COVID-19-related restrictions made teaching all chemistry classes more challenging; however, teaching chemistry labs became even more difficult. Instructors of chemistry labs implement and exchange various ideas on how to teach labs under present health-related restrictions without compromising chemistry education with an anticipated decrease in hands-on experience.

Appendix

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- A. **BS in Chemistry** (Curriculum Map)
 - B. **Chem 341I & 342 L - grade distribution** (Word Document (Open XML))
 - C. **Information literacy student results** (Word Document (Open XML))
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