Assessment Cycle 2024 – 2025

Program: (BS) Bachelor of Science in Physical Science (637)

Department of Physical Sciences

College of Arts and Sciences

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Northwestern Mission. Northwestern State University is a responsive, student-oriented institution committed to acquiring, creating, and disseminating knowledge through innovative teaching, research, and service. With its certificate, undergraduate, and graduate programs, Northwestern State University prepares its increasingly diverse student population to contribute to an inclusive global community with a steadfast dedication to improving our region, State, and nation.

College of Arts and Sciences' Mission. College of Arts and Sciences' Mission. The College of Arts & Sciences, the largest college at Northwestern State University, is a diverse community of scholars, teachers, and students, working collaboratively to acquire, create, and disseminate knowledge through transformational, high-impact experiential learning practices, research, and service. The College strives to produce graduates who are productive members of society equipped with the capability to promote economic and social development and improve the overall quality of life in the region. The College provides an unequaled undergraduate education in the social and behavioral sciences, English, communication, journalism, media arts, biological and physical sciences, and the creative and performing arts, and at the graduate level in the creative and performing arts, English, TESOL, and Homeland Security. Uniquely, the College houses the Louisiana Scholars' College (the State's designated Honors College), the Louisiana Folklife Center, and the Creole Center, demonstrating its commitment to community service, research, and preservation of Louisiana's precious resources.

School of STEM. The School of Science, Technology, Engineering, and Math (STEM) at Northwestern State University serves to create a collaborative environment for natural and applied science education that inspires students and faculty to engage in an interdisciplinary approach to developing strong analytical skills in interpersonal communication, critical and creative thinking, research, and data literacy as they become lifelong learners who are prepared for an ever-changing, global STEM community. The school delivers Associate degrees in Veterinary Technology, Engineering Technology (with concentrations in Electronics, Industrial, and Advanced Manufacturing), Bachelor of Science degrees in Biology (with concentrations in Biomedical, Clinical Laboratory Science, Forensic Science, Natural Science, and Veterinary Technology), Applied Microbiology (with concentrations in Environmental and Applied Microbiology and Medical and Health Profession), Physical Sciences (with concentrations in chemistry, forensic laboratory science, physics, and biochemistry), Industrial Engineering

Technology, Electronics Engineering Technology (with concentrations in Electronics and Biomedical), and Mathematics (with concentrations in Healthcare Informatics, Actuarial Mathematics, Applied Mathematics, Sports Analytics, and Computer Science). The school also offers minors in Biology, Microbiology, Wildlife Management, Mathematics, Engineering Technology, Industrial Engineering Technology, Physics, and Chemistry. The school also offers Post Baccalaureate certificates in Quality Control and Project Management.

Physical Science Program Mission Statement. The mission of the Northwestern State University Physical Science program is to provide a comprehensive education in chemistry and physics for all our majors and to create a unique training environment for students wishing to pursue graduate or professional education.

Purpose (optional): The primary goal of the Physical Science program is to prepare students to enter the job market competitively at the bachelor level or to further their education in either graduate or professional school.

Methodology: The assessment process for the Physical Science program is as follows:

(1) Data from assessment tools (both direct – indirect, quantitative and qualitative) are collected and returned to the program coordinator;

(2) The program coordinator will analyze the data to determine whether students have met measurable outcomes;

(3) Results from the assessment will be discussed with the program faculty;

(4) The program coordinator, in consultation with the director of the School of Biological and Physical Sciences as well as the faculty of the school, will propose changes to measurable outcomes and/or assessment tools for the next assessment period and, where needed, curricula and program changes.

Student Learning Outcomes:

NOTE: The Bachelor of Science in Physical Science is a relatively new program with low enrollment. Therefore, data collection was limited to only 1 – 4 students who took one of required, major courses assessed.

SLO 1. Students will identify the basic components of the atomic structure.

Course Map: Tied to the course syllabus objectives.

CHEM1030: General Chemistry I

Measure 1.1. (Direct – knowledge)

Throughout the course, students will learn the structure of atoms and the importance of each subatomic particle. Each student is required to pass a quiz covering these concepts. The target is to have 75% of students attain a quiz grade of ≥70%.

Findings: Target was met

Analysis: In AC 2023-2024, 50% (2/4) of the Physical Science students assessed obtained a quiz grade of ≥ 70%. The target for AC 2023 – 2024 was not met. The faculty rotated between the courses of CHEM 1030/1031 and CHEM 1040/1041 to ensure the content presented was current and aligned with pre-requisite content for future courses; however, the students still struggled to demonstrate appropriate knowledge of the structure of atoms and the importance of each subatomic particle.

Based on the analysis of the AC 2023-2024 results, the faculty implemented the following changes in AC 2024-2025. The director and program assessment coordinator met with the faculty of the physical science department prior to the beginning of AC 2024–2025. As a measure to drive improvement, the faculty reviewed the assessment questionnaire to better reflect the course objectives and material. The faculty also offered the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). All (100% or 4/4) of the Physical Science students assessed obtained a quiz grade of ≥ 70%. This performance is above (+25%) the goal of 75% of students earning a score of ≥ 70% on this assessment. This implies that the students were able to successfully demonstrate appropriate knowledge of the structure of atoms and the importance of each subatomic particle. When comparing the results from AC 2023- 2024, there was an increase in the percentage of students meeting the target (+25%).

As a result of these changes, in AC 2024-2025, the target was met.

Decision: In AC 2024-2025, the target was met. Based on the analysis of the AC 2023 – 2024 assessment results, in AC 2025 – 2026, the faculty will offer a higher number of exams throughout the semester, with each exam covering a smaller amount of material. Increasing frequency of testing while decreasing the amount of material being assessed will provide more opportunities for students to engage with the instructors and will address potential deficiencies with lower stakes assessments. The faculty will also offer the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). At the start of AC 2025–2026, the Physical Science assessment coordinator, in consultation with the Department Head of Physical Science, will meet with the instructors and discuss the delivery of content and the timing of assessments. These changes will improve the students' ability to demonstrate appropriate knowledge of the structure of atoms and the importance of each subatomic particle.

Measure 1.2. (Indirect – survey)

At the end of the course, a survey is administered to students to gauge their appraisal of their understanding of the basic concepts of atomic structure covered in the course. The

target is to have 75% of the students report above average or excellent knowledge of the indicated concepts.

Findings: Target not met

Analysis: In AC 2023 – 2024, the target was not met. One half (50% or 2/4) of the Physical Science students assessed gauged their understanding of the basic concepts of atomic structure covered in the course as above average or excellent. The faculty rotated between the courses of CHEM 1030/1031 and CHEM 1040/1041 to ensure the content presented was current and aligned with pre-requisite content for future courses. However, the students still struggled with gauging their understanding of the basic concepts of atomic structure as above average or excellent.

Based on the analysis of the AC 2023-2024 results, the faculty implemented the following changes in AC 2024-2025. The director and program assessment coordinator met with the faculty of the physical science department prior to the beginning of AC 2024–2025. As a measure to drive improvement, the faculty reviewed the assessment questionnaire to better reflect the course objectives and material. The faculty also offered the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). As a result of these changes, one quarter (25% or 1/4) of the Physical Science students assessed gauged their understanding of the basic concepts of atomic structure covered in the course as above average or excellent. This performance is below (-50%) the goal of 75% of students earning a target of ≥ 70% gauging their understanding as above average or excellent. This implies that the students struggled with gauging their understanding of the basic concepts of atomic structure as above average or excellent. When comparing the results from AC 2023- 2024, there is a decrease in the percentage of students meeting the target (-25%).

As a result of these changes, in AC 2024-2025, the target was not met.

Decision: In AC 2024-2025, the target was not met. Based on the analysis of the AC 2023 – 2024 assessment results, in AC 2025 – 2026, the faculty will offer a higher number of exams throughout the semester, with each exam covering a smaller amount of material. Increasing frequency of testing while decreasing the amount of material being assessed will provide more opportunities for students to engage with the instructors and address potential deficiencies with lower stakes assessments. This will, in turn, lead to more confidence among the students in Physical Science. The faculty will also offer the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). At the start of AC 2025–2026, the Physical Science assessment coordinator, in consultation with the Department Head of Physical Science, will meet with the instructors and discuss the delivery of content and the timing of assessments. These changes will improve the student's ability to appropriately gauge their knowledge and understanding of the structure of atoms and the importance of each subatomic particle.

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SLO 2. Students will be able to classify the natural laws of thermodynamics and mechanics.

Course Map: Tied to the course syllabus objectives

CHEM 1040: General Chemistry II
PHYS 2510: General Analytical Physics I.

Measure 2.1. (Direct – knowledge)

Throughout the course, students will learn about the various natural laws of thermodynamics. Each student is required to pass a quiz covering the concepts of thermodynamics (CHEM 1040). The target is to have 75% of students attain a quiz grade of ≥70%.

Findings: Target not met

Analysis: In AC 2023 – 2024, the target was not met. None (0% or 0/1) of the physical science students assessed earned a quiz grade of ≥70%. The student struggled with demonstrating their knowledge of the natural laws of thermodynamics. The faculty rotated between the courses of CHEM 1030/1031 and CHEM 1040/1041 to ensure the content presented was current and aligned with pre-requisite content for future courses. However, the student still struggled with understanding the various natural laws of thermodynamics.

Based on the analysis of the AC 2023-2024 results, the faculty implemented the following changes in AC 2024-2025. The director and program assessment coordinator met with the faculty of the physical science department prior to the beginning of AC 2024–2025. As a measure to drive improvement, the faculty reviewed the assessment questionnaire to better reflect the course objectives and material. The faculty also offered the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). One half (50% or 1/2) of the Physical Science students assessed obtained a quiz grade of ≥ 70%. This performance is below (-25%) the goal of 75% of students earning a target of ≥ 70% on this assessment. This implies that the students struggled to successfully demonstrate appropriate knowledge of the various natural laws of thermodynamics. When comparing the results from AC 2023- 2024, there is an increase in the percentage of students meeting the target (+50%).

As a result of these changes in AC 2024-2025, the target was not met.

Decision: In AC 2024-2025, the target was not met. Based on the AC 2024-2025 results analysis, the following changes will be made to drive improvement in AC 2025-2026. The faculty will offer a higher number of exams throughout the semester, with each exam covering a smaller amount of material. Increasing frequency of testing while decreasing the amount of material being assessed will provide more opportunities for students to engage with the instructors and address potential deficiencies with lower stakes assessments. This will, in turn, lead to better understanding of the various natural laws of

thermodynamics among the students in Physical Science. The faculty will also offer the students supplementary instruction in general chemistry courses (1030/1031/1040/1041). At the start of AC 2025–2026, the Physical Science assessment coordinator, in consultation with the Department Head of Physical Science, will meet with the instructors and discuss the delivery of content and the timing of assessments. These changes will improve the student's ability to learn about the various natural laws of thermodynamics.

Measure 2.2. (Direct – knowledge)

Throughout the course, students will learn about the various natural laws of mechanics. Each student is required to pass a quiz covering the concepts of mechanics (PHYS 2510). The target is to have 75% of students attain a quiz grade of ≥70%.

Findings: Target not met

Analysis: In AC 2023 – 2024, the target was met. All (100% or 2/2) of the physical science students assessed earned a quiz grade of ≥70%. Students were able to articulate via written quiz, the natural laws of mechanics. A new instructor was assigned to teach PHYS 2510. The difference in teaching pedagogy would lead to an improvement in student perception, and outcomes for the course. The students were able to successfully articulate the natural laws of mechanics in a written quiz.

Based on the analysis of the AC 2023-2024 results, the faculty implemented the following changes in AC 2024-2025 to drive the cycle of improvement. The faculty improved informational delivery in the PHYS 2510 course by modifying the course content to better align with course objectives. The changes included the addition of differential and integral calculus and exercises in computer programming. One quarter (25% or 1/4) of the students assessed were able to successfully articulate the natural laws of mechanics via a written quiz. This performance is below (-50%) the goal of 75% of students earning a target of ≥ 70% on this assessment. This implies that the students struggled to successfully articulate the natural laws of mechanics via a written quiz. When comparing the results from AC 2023- 2024, there was a decrease in the percentage of students meeting the target (-75%).

As a result of these changes in AC 2024-2025, the target was not met.

Decision: In AC 2024-2025, the target was not met. Based on the analysis of the AC 2024-2025 results, in AC 2025-2026, the faculty will implement the following changes to drive the cycle of improvement. The order in which the general analytical physics course is offered will change (PHYS 2510/2520). This means that PHYS 2510 will be offered in the Spring semester, instead of the Fall semester. This will allow students entering the course the opportunity to complete the necessary math course before taking PHYS 2510 helping them feel more confident and better prepared. In addition, both PHYS 2510 and PHYS 2520 course material will be updated to include all the topics recommended by the American Physical Society. These changes will improve the students' ability to learn

about the various natural laws of mechanics and how to identify and apply these concepts in real-life situations.

SLO 3. Students will be able to communicate scientific information.

Course Map: Tied to the course syllabus objectives

CHEM 4920: Scientific Communication
PHYS 4940: Scientific Communication

Measure 3.1. (Direct – ability)

Throughout all sections of the Scientific Communication courses, students will learn about the various aspects of communication in the sciences. Each student will write a scientific article and will be assessed using a standard rubric. The target is to have 70% of students earn a final score of ≥ 70% on the assignment.

Findings: Target met

Analysis: In AC 2023 – 2024, the target was met. All (100% or 3/3) of the physical science students attained a score of ≥70% on the assignment. The students were able to successfully write a scientific article under the supervision of an instructor. The students struggled with summarizing literature and performing literature reviews.

Based on the analysis of the 2023 – 2024 results, the faculty implemented the following changes in AC 2024 – 2025 to drive the cycle of improvement. The faculty provided a lecture and discussion session for students covering the topic of scientific literature review. This was decided because (a) performing a scientific literature review is critical to writing a scientific article, and (b) students struggled with this topic. All (100% or 1/1) of the students were able to successfully write a scientific article. This performance is above (+30%) the goal of 70% of students earning a final score of ≥ 70% on the assignment. This implies that students were able to successfully write a scientific article. When comparing the results from AC 2023- 2024, there is no change in the percentage of students meeting the target.

As a result of these changes in AC 2024-2025, the target was met.

Decision: In AC 2024-2025, the target was met. Based on the analysis of the AC 2024 – 2025 assessment results, in AC 2025 – 2026, the faculty will provide an additional lesson centered on the use of Artificial Intelligence (AI) in Scientific Communication. This was decided because the new technologies and methodologies provided by AI will improve efficiency in the search of scientific literature and in writing techniques. These changes have the potential to improve the students' ability to write a scientific article.

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Measure 3.2. (Direct – ability)

Throughout all sections of the Scientific Communication courses, students will learn about the various aspects of communication in the sciences. Each student will give an oral presentation of a scientific article/project developed by the student; the presentation will be assessed using a standard rubric. The target is to have 70% of students attain a final score of ≥ 70% on the assignment.

Findings: Target met

Analysis: In AC 2023-2024, the target was met. All (100% or 3/3) of the physical students attained a score of ≥70% on the assignment; therefore, the target was met. All students were able to successfully give an oral presentation of a scientific article/project developed by the student.

Based on the AC 2023 – 2024 results, the faculty implemented the following changes in AC 2024 – 2025 to drive the cycle of improvement. The faculty provided an additional lecture and discussion for students covering the topic of scientific literature presentation for CHEM 4920/PHYS 4940. These changes were intended to improve the students' ability to give an oral presentation of a scientific article/project developed by the students. All (100% or 1/1) of the students were able to successfully give an oral presentation of a scientific article. This performance is above (+30%) the goal of 70% of students earning a final score of ≥ 70% on the assignment. This implies that students were able to successfully present the findings of a scientific article. When comparing the results from AC 2023- 2024, there is no change in the percentage of students meeting the target.

As a result of these changes in AC 2024-2025, the target was met.

Decision In AC 2024-2025, the target was met. Based on the analysis of the AC 2024 – 2025 assessment results, in AC 2025 – 2026, the faculty will provide an additional lesson centered on the use of Artificial Intelligence (AI) in Scientific Communication and presentation of linear narratives in science. These changes have the potential to improve the students' ability to present a the contents of a scientific project/article to a general audience.

SLO 4. Students will employ critical thinking to interpret scientific literature.

Course Map: Tied to the course syllabus objectives

CHEM 4910: Capstone Course for Chemistry
PHYS 4930: Capstone Course for Physics

Measure 4.1. (Direct – Ability)

Throughout all sections of the capstone courses, students will read scientific articles from the primary literature and be required to pass quizzes over the material. The target is to have 70% of students earn a final average quiz grade of ≥ 90%.

Findings: (No students were assessed on this course)

Analysis: In AC 2023-2024, the target was met. All (100% or 3/3) of the physical science students attained a quiz grade of ≥ 90%. All students read scientific articles from the primary literature and passed quizzes over the material. Some students struggled to identify key ideas in a peer-reviewed scientific article.

Based on the analysis of the AC 2023-2024 results, the faculty implemented the following changes in AC 2024-2025. instructors provided a lecture and discussion session for students covering the topic of scientific literature review for CHEM 4910/PHYS 4930. This session was designed for students to work on ways to identify key ideas in peer-reviewed scientific articles. The faculty were able to meet with the students one-on-one to discuss what areas they were struggling in and provide assistance. In AC 2024-2025, no students were physical science majors registered for CHEM 4910 / PHYS 4930.

Decision: Based on the analysis of the AC 2023 – 2024 assessment results (as there were not results in AC2024-2025), in AC 2025 – 2026, the faculty intended to provide a lecture and discussion session for students covering the topic of scientific literature review. Students assessed in the 2023 – 2024 cycle struggled with determining the central topic for a research article. These changes will improve the students' ability to read scientific articles from the primary literature and be required to pass quizzes over the material.

Measure 4.2. (Direct – Ability)

Throughout all sections of the capstone courses, students will write a proposal about their capstone project. The target is to have 70% of students earn a final written assignment grade of ≥ 90% using a standard rubric.

Findings: (No students were assessed on this course)

Analysis: In AC 2023–2024, the target was met. All (100% or 3/3) of the Physical Science students scored ≥ 90% on the assignment based on a standard rubric. This indicated that the students assessed were able to follow a structure given for a science-based proposal, determine a proper timeframe and budget for their proposed project, and justify the experiments proposed. Students struggled with the literature search process, identifying primary sources, and the main topic of a research article.

Based on the analysis of the AC 2023–2024 results, the faculty implemented the following changes in AC 2024-2025, to drive the cycle of improvement. The faculty implemented new course materials. The faculty also included a presentation on the components of a proposal and effective writing techniques. This was intended to benefit the students as it

allowed them to break down what was needed for this assignment and how to build their proposals. These new lectures/activities were also designed to provide students that were struggling with one-on-one discussions. In AC 2024-2025, no students were physical science majors registered for CHEM 4910 / PHYS 4930.

Decision: Based on the analysis of the AC 2023 – 2024 assessment results (as there were not results in AC2024-2025), in AC 2025 – 2026, the following changes will be made to drive the cycle of improvement. The faculty will design new course material, including delivering presentations on the components of a proposal and effective writing techniques. These changes will be designed to improve the students' ability to write a proposal about their capstone project.

SLO 5. Students will demonstrate professional development.

Course Map: Tied to the course syllabus objectives

CHEM 4910: Capstone course for Chemistry
PHYS 4930: Capstone course for Physics.

Measure 5.1. (Direct – Skill)

Students will be required to give a final presentation assessed using a standard rubric across all sections of capstone classes. The target is to have 100% of students give a final presentation that meets ≥70% of the prescribed guidelines.

Findings: (No students were assessed on this course)

Analysis: In AC 2023–2024, the target was met. All (100% or 3/3) of students gave a final presentation that met ≥70% of the prescribed guidelines. This indicated that the students could successfully present the results of their capstone project to an open audience, correctly answering most of the questions posed by the public and within a timeframe specified by the course instructor. Students struggled with presenting a linear narrative and with deriving from the results of their experiments.

Based on the analysis of the AC 2023–2024 results, the faculty implemented the following changes in AC 2024-2025. The faculty developed new course materials that covered the topic of effective scientific communication and the delivery of a presentation to the public. At the start of AC 2024–2025, the Physical Science assessment coordinator, in consultation with the Department Head of Physical Science, met with the instructors and discussed the delivery of content and the timing of assessments. It was decided that additional instruction regarding how to properly present a scientific project to the community was necessary to drive improvement. In AC 2024-2025, no students were physical science majors registered for CHEM 4910 / PHYS 4930.

Decision: Based on the analysis of the AC 2023 – 2024 assessment results (as there were not results in AC2024-2025), in AC 2025 – 2026, the faculty will developed new

course material that cover the topic of effective scientific communication and presentation to the public. The materials developed will be aimed at addressing the challenges of timing, linear narrative, and delivering results in a way that the public understand both the topic and its importance. These changes are intended to improve the students' ability to successfully present their capstone projects to the general public.

Measure 5.2. (Direct – Skill)

Students will be required to relate their project to a specific entry-level job that conforms to guidelines set forth in the course. The target is to have 100% of students relate their capstone projects to available workforce opportunities that meets ≥ 90% of the prescribed guidelines.

Findings: Target met

Analysis: In AC 2023–2024, the target was met. All (100% or 3/3) of students related their capstone projects to available workforce opportunities that met ≥ 90% of the prescribed guidelines. Students struggled with finding statistical data regarding entry-level careers in their respective fields.

Based on the analysis of the AC 2023–2024 results, the faculty implemented the following changes in AC 2024-2025. The faculty rotated between the Fall and Spring semester offerings of CHEM 4910/PHYS 4930 to ensure that the content presented was current and relevant to the course. In AC 2024-2025, no students were physical science majors registered for CHEM 4910 / PHYS 4930.

Decision: Based on the analysis of the AC 2023 – 2024 assessment results (as there were not results in AC2024-2025), in AC 2025 – 2026, the faculty will design an additional lesson that covers the topic of entering the job market with their current degrees and areas of expertise. These changes will improve the students' ability to relate their capstone projects to available workforce opportunities.

Comprehensive summary of key evidence of improvements based on analysis of results. The following reflects all the changes implemented to drive the continuous process of seeking improvement in AC 2024-2025. These changes are based on the knowledge gained through the analysis of AC 2023-2024 results.

- The SLO 1 and SLO 2 targets were not met for AC 2024 – 2025.
    - SLO 1.1 target was met
- The SLO 3 was met for AC 2024 – 2025.
- The SLO 4 and SLO 5 were not assessed for AC 2024 – 2025.

- No physical science majors registered for CHEM 4910 / PHYS 4930.

- Prior to the start of AC 2024-2025 year, the Department Head met with the instructors and discussed delivery of the content and the timing of the assessment processes, goals, and requirements.

- The faculty improved the assessment process for CHEM 1030/1031 and CHEM 1040/1041 by increasing frequency of testing while decreasing the amount of material being assessed. This was intended to provide more opportunities for students to engage with the instructors and address potential deficiencies with lower stakes assessments.

- The faculty improved the delivery of PHYS 2510 by implementing the following: the order in which the general analytical physics course was offered was changed (PHYS 2510/2520). This means that PHYS 2510 was offered in the Spring semester, instead of the Fall semester. This allowed students entering the course the opportunity to complete the necessary math course before taking PHYS 2510, helping them feel more confident and better prepared. In addition, both PHYS 2510 and PHYS 2520 course material was updated to include all the topics recommended by the American Physical Society.

- The faculty reviewed the assessment questionnaire to better reflect the course objectives and material.

- The faculty offered supplementary instruction across general chemistry courses (1030/1031/1040/1041).

- The faculty reviewed the assessment and made sure that it was representative of the core classes within the physical science degree and that the assessments were distributed through a variety of course classifications.

Plan of action moving forward:

- The faculty will increase the frequency of testing while decreasing the amount of material being assessed to provide more opportunities for students to engage with the instructors and address potential deficiencies with lower stakes assessments.

- The faculty will offer the students supplementary instruction in general chemistry courses (1030/1031/1040/1041).

- PHYS 2510 will be offered in the Spring semester instead of the Fall semester, providing an opportunity for students to take Mathematics pre-requisite courses in prior semesters.

- The faculty will review the assessment questionnaire to ensure that it reflects the course objectives and material.