Physics Bachelor of Science and Bachelor of Arts
Assessment Report 2021-2022

1. SUMMARY OF ASSESSMENT

A. Program Learning Outcomes (PLO)

*Physics B.S. Program Learning Objectives:*

1. *Explain* the fundamental principles of Physics and be able to apply these core ideas to analyze physical processes *(ILO 2: Communication)*
2. *Apply* quantitative reasoning and critical thinking to solve complex problems, both theoretical and experimental in nature; *(ILO 1: Thinking and Reasoning)*
3. *Independently* learn new technical subjects and skills; *(ILO 1: Thinking and Reasoning)*
4. *Design*, construct, assess and troubleshoot experiments, quantitatively analyze the results using appropriate statistical procedures and tests of systematic errors, and draw meaningful conclusions; *(ILO 1: Thinking and Reasoning)*
5. Effectively discuss scientific ideas, both theoretical and experimental, to diverse audiences through written and oral presentations, both formal and informal; *(ILO 2: Communication)*
6. Work professionally, effectively, and inclusively as a member of diverse collaborations to solve problems. *(ILO 3: Diversity & ILO 4: Collaboration)*

*Physics B.A. Program Learning Objectives:*

1. *Describe* the fundamental principles of Physics and be able to apply these core ideas to analyze physical processes; *(ILO 1: Thinking and Reasoning)*
2. *Use* quantitative reasoning and critical thinking to solve problems, both theoretical and experimental in nature; *(ILO 1: Thinking and Reasoning)*
3. *Learn* new technical subjects and skills; *(ILO 1: Thinking and Reasoning)*
4. *Construct*, assess and troubleshoot experiments, quantitatively analyze the results using appropriate statistical procedures and tests of systematic errors, and draw meaningful conclusions; *(ILO 1: Thinking and Reasoning)*
5. *Effectively explain* scientific ideas, both theoretical and experimental, to diverse audiences through written and oral presentations, both formal and informal; *(ILO 2: Communication)*
6. Work professionally, effectively, and inclusively as a member of diverse collaborations to solve problems. *(ILO 3: Diversity & ILO 4: Collaboration)*

The CSUEB Institutional Learning Outcome (ILO) numbers referred to above correspond to the following:
(1) **Thinking and Reasoning:** think critically and creatively and apply analytical and quantitative reasoning to address complex challenges and everyday problems.

(2) **Communication:** communicate ideas, perspectives, and values clearly and persuasively while listening openly to others.

(3) **Diversity:** apply knowledge of diversity and multicultural competencies to promote equity and social justice in our communities.

(4) **Collaboration:** work collaboratively and respectfully as members and leaders of diverse teams and communities.

(5) **Sustainability:** act responsibly and sustainably at local, national, and global levels.

**B. Program Learning Outcome(s) Assessed**

*List the PLO(s) assessed. Provide a brief background on your program’s history of assessing the PLO(s) (e.g., annually, first time, part of other assessments, etc.)*

Due to the shift into online modality for the COVID-19 pandemic, normal assessment measures were disrupted and were not be made in the 2021-2022 school year in a way that is reliably comparable to other years. The department has assessment results dating back to 2011, usually used to note trends. We will focus here on the plans for the coming year, as we have returned to in-person teaching.

During the 2022-2023 year the department plans to join the university focus on ILO 4: Collaboration and Teamwork and Leadership. The department will also follow the assessment of the Diversity and Social Justice ILO being undertaken by the college and university this year, and review where updates can be made in the department assessment and curriculum.

**C. Summary of Assessment Process**

**Instrument(s):**

We utilize standardized tests (Force Concept Inventory (FCI), Brief Electricity and Magnetism Assessment (BEMA) and an ETS (Educational Testing Service) Major Field Tests Physics Exam) to assess PLOs 1 and 2. These exams have multiple choice questions on introductory and advanced physics concepts, and are accepted as standard measures of content within the physics field. For example, the FCI is designed to assess student understanding of the most basic concepts in Newtonian physics. This forced-choice instrument has 30 questions and looks at six areas of understanding: kinematics, Newton's First, Second, and Third Laws, the superposition principle, and types of forces (such as gravitation, friction). Each question offers only one correct Newtonian solution, with common-sense distractors (incorrect possible answers) that are based upon student's misconceptions about that topic, gained from interviews. The BEMA assesses what students know about the most basic and central concepts of Electricity and Magnetism. It is comprehensive, covering topics from the Coulomb force law to magnetic induction, but omitting radiation because it is very common for the introductory course not to get that far. It has been used by various instructors in various settings and has been judged an appropriate assessment of introductory E&M by physicists experienced in teaching E&M at various levels. It is not aimed at any particular curriculum but contains only those elements common to all calculus-based introductory courses.
In order to assess PLOs 3 and 5 we have utilized writing and oral presentation rubrics that have been created by CSU East Bay Physics faculty and have been adopted as standard within the Physics Department. The Rubrics allow a scaling of specific measures of quality written problem solutions, written research papers and presentations. The rubrics, each of which is provided to the students as part of the introduction to the assignment, were developed by the physics faculty independently, through a collaborative comparison of assessment criteria utilized within their own grading policies.

**Sampling Procedure:** The standardized testing assessments are given to the students in class with scantrons provided. The rubric assessments are applied to the student final presentations and research papers at the end of the term. It is important to note that the students have access to these rubrics ahead of the assignment deadline, but do not have any access to the standardized tests in any form aside from when given during the class meeting.

**Sample Characteristics:** The standardized testing sample is a specific percentage of correct answers at the end of the term as compared to correct answers at the beginning of the term. The overall improvement is used as an assessment of the effectiveness of the teaching methodologies utilized to communicate the specific PLOs.

**Data Collection:** The data is collected on scantron for the standardized tests, and recorded in rubrics.

**Data Analysis:** An assessment of whether students have mastered the PLOs is made based on the results of the rubrics. Comparison of improvements from one year to the next year is also reviewed.

**D. Summary of Assessment Results**

**Main Findings:** No assessments were performed in AY 2021-22

**Next Step(s) for Closing the Loop:** *(recommendations to address findings, how & when)*

**Other Reflections:** None

**Recommendations for Program Improvement:** Continue to bring active learning into the classroom for basic concepts, allowing the student to interact with the material more directly than the traditional lecture-style course allows. As these changes occur, the instructor is advised to note any significant changes to teaching methodology when so that if large change occurs to the gain between post-and pre-test, the reason behind the gain can be isolated. Additionally, departmental meetings at the start of each semester should review assessments from previous semesters. If students are not meeting specific PLOs, more focus can be made to emphasize those skills during the semester.
E. Assessment Plan for 2022/2023 Academic Year:

The department has a 5-year assessment plan in which the 2022-2023 academic year focus is PLO6, to be assessed in advanced lab for both the BS and BA programs. This is described in the table below.

<table>
<thead>
<tr>
<th>Year 3: 2022-2023</th>
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<tbody>
<tr>
<td>1. Which PLO(s) to assess</td>
<td>PLO 6</td>
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<tr>
<td>2. Is it aligned to an ILO?</td>
<td>Yes</td>
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<td>3. If yes, list ILO:</td>
<td>ILO4: Collaboration</td>
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<tr>
<td>4. Course name and number</td>
<td>Phys 381: Advanced Lab II</td>
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<td>5. SLO from course</td>
<td>Effectively communicate scientific ideas</td>
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<td>6. Assessment activity</td>
<td>Group project – written report on laboratory experiment by student group</td>
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<td>7. Assessment Instrument</td>
<td>Department accepted standard rubric for grading group written lab report</td>
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<td>8. How data will be reported</td>
<td>Quantitative</td>
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<tr>
<td>9. Responsible person(s)</td>
<td>Dr. Kathryn Grimm (Department assessment coordinator)</td>
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<td>10. Time (which semester(s))</td>
<td>Spring 2023</td>
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<td>11. Ways of closing the loop</td>
<td>This data will be reported within the assessment portion of the Physics Department annual report and compared to scores from this same course from previous years.</td>
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Additionally, PLOs will be assessed during 2022-2023 in the following classes:

Physics 135 (Fall 2022: Dr. Kathryn Grimm) – Will assess PLO 1 and 3 with modernized questions from the FCI Exam, given before and after specific topics are taught. This will be repeated in subsequent semesters/years.

Physics 380 (Fall 2022: Dr. Arran Phipps) – Assess PLO 6 through the grading of a group research project using a dedicated department rubric. This is done bi-annually within this course. Assess PLO 5 with department-approved oral communication rubric. PLO 5 will be assessed in each of the 4(2) semesters of Advanced lab for the BS(BA) program.

Physics 450 and 451, Electromagnetism (Fall 2022 and Spring 2023: Dr. Ryan Smith) - Assess PLO 1 & PLO 2 with the standardized BEMA Exam, given both at start and end of the academic year. This is done bi-annually within the course, as the course is only offered every two years.

Physics 381 (Spring 2023: Dr. Kathryn Grimm) – Assess PLO 3 and 5 through the grading of an individual research project using a Physics 381- specific Computational Research Paper Writing Rubric. This is done bi-annually within this course. Assess PLO 5 with department-approved oral communication rubric.

Graduating seniors will also be given the ETS Major Field Tests Physics Exam, assessing PLO1 and PLO2.