

CSM

Physics/BS

**Student Outcomes Assessment Plan (SOAP)**

Revision 3: October 1, 2017

**I. Mission Statement**

The mission of the Department of Physics at California State University, Fresno, is to provide students with a rigorous and thorough understanding of the ideas and methods of physics, as well as the crucial role of the findings of physics as they relate to society in terms of technology, engineering, medicine, energy policy, and our collective understanding of the fundamental nature of the universe.

**II. Goals and Student Learning Outcomes**

**Program Goals:**

A graduate with a BS in physics would be fully prepared to continue their education to Masters or Doctoral programs in Physics or related fields, would be ready to engage in a career in industry or government alongside engineers and applied scientists, be qualified to become a teacher of science, or be competitive and competent for all appropriate physics and science related career paths including medicine.

**Goal 1: Knowledge of Physics**

Physics majors will develop a strong foundation in *essential core disciplines* identified as fundamental in physics such as classical mechanics, electricity and magnetism, thermodynamics, statistical mechanics, optics, special relativity, and quantum mechanics.

**Student Learning Outcomes:** Graduates will be able to:

1.1 Identify, analyze, and solve problems within the core disciplines described in textbooks that are universally recognized as standards in undergraduate physics education:

Classical Mechanics at the level of

*Classical Dynamics of Particles and Systems by Stephen Thornton and Jerry Marion,*

Electricity and Magnetism at the level of

*Introduction to Electrodynamics by David J. Griffiths,*

Thermodynamics at the level of

*Thermal Physics by Ralph Baierlein,*

Optics at the level of  
*Optics by Eugene Hecht,*  
Quantum Mechanics at the level of  
*Introduction to Quantum Mechanics by David J. Griffiths,*  
and Relativity and Modern Physics at the level of  
*Modern Physics for Scientists and Engineers by Stephen Thornton and Andrew Rex.*

**Goal 2: Experimental Techniques in Physics**

Physics majors will develop an appreciation of the application of the concepts and theories and will be able to conduct experiments and write scientific papers in a format and manner appropriate to publishing in leading journals of physics.

**Student Learning Outcomes:** Graduates will be able to:

- 2.1 Conduct laboratory work in physics in a safe and socially responsible manner, keeping accurate and complete records of their work, properly using standard laboratory equipment and instruments.
- 2.2 Students will be able to evaluate the reliability and significance of laboratory data.

**Goal 3: Integration of Elective Courses in Physics**

Physics majors will be able to integrate and synthesize knowledge from the core disciplines through study of specialized areas including: astrophysics, condensed matter physics, health physics, biomedical physics, high energy physics, and theoretical physics among others.

**Student Learning Outcomes:** Graduates will be able to:

- 3.1 Demonstrate working knowledge of specialized areas by analyzing and solving problems in some of these sub-disciplines through the elective courses.

**III. Curriculum Map (Matrix of Courses X Learning Outcomes)**

This table provides information regarding how the outlined student learning outcomes (SLO) are introduced (I), emphasized (E), reinforced (R) and mastered (M) as students advance through the curriculum.

	SLO1.1	SLO2.1	SLO2.2	SLO3.1
Phys 4A, 4AL	I	I	I	
Phys 4B,4BL	I	E	E	
Phys 4C	E			
Phys 102	R			I
Phys 104	E	R	R	E
Phys 105A	R			
Phys 105B	R			
Phys 107A	M			E
Phys 110	M	M	M	R
Phys 115	M			
Phys 140	R			R
Phys 107B (Elective)	M			M
Phys 135 (Elective)	R	R	R	R
Phys 136 (Elective)	R			R
Phys 137 (Elective)	R	R	R	R
Phys 150 (Elective)	R			R
Phys 151 (Elective)	R			R
Phys 155 (Elective)	R			R
Phys 156 (Elective)	R	R	R	R
Phys 157 (Elective)	R	R	R	R
Phys 158 (Elective)	R			R
Phys 162 (Elective)	M	M		M
Phys 163 (Elective)	M			M
Phys 168S (Elective)	R	M		M
Phys 170A (Elective)	M			M
Phys 171 (Elective)	R			R
Phys 180 (Elective)	R			R
Phys 190 (Elective)	M	M	M	M

#### IV. Assessment Methods

##### A. Direct Measures: (A minimum of three are required.)

1. **Common Final Exams in Phys 4AB:** Outcome 1.1 will be assessed via validated common final exams. For each specific course (e.g. Phys 4A), final exams will be identical but the numerical values will be different and will be shared by all section offerings of these two courses.

Benchmark: It is expected that students passing the course will score above 50% correct responses on the embedded questions. The results will be used to identify weaknesses in the curriculum of the courses.

2. **Force Concept Inventory (FCI) and Conceptual Survey of Electricity and Magnetism (CSEM):** Outcome 1.1 will also be assessed via Force Concept Inventory (FCI) and Conceptual Survey of Electricity and Magnetism (CSEM). FCI is a test measuring mastery of concepts taught in the first course in Physics. CSEM is used to survey students' conceptual knowledge of electricity and magnetism typically taught in a second Physics course. FCI and CSEM will be offered as pre-instruction and post-instruction modes in order to assess objectively the student learning outcomes.

3. **Physics Major Field Test (MFT):** Physics majors will take the Physics Major Field Test (MFT) as part of the required course, Phys 115. The MFT is a product of Educational Testing Services (ETS). According to the ETS website, "ETS offers comprehensive national comparative data for the Major Field Tests, enabling you to evaluate your students' performance and compare your program's effectiveness to programs at similar institutions nationwide." The MFT will be administered to all physics majors and will test Outcome 1.1 and 3.1.

Benchmark: The Fresno State institutional average should be at or above the 50<sup>th</sup> percentile of the Physics MFT institutional average scores for the 8 year running average supplied by ETS.

4. **Assessment of Scientific Writing:** Outcomes 2.1 and 2.2 will be assessed by two upper division courses that require significant writing in the form of laboratory reports that would be appropriate for assessment. The assessment procedure would be as follows:
- a) The instructor of the identified lab courses will select at the end of the semester one lab report from each student enrolled, and this lab report shall reflect the best work of the student (e.g. a report that earned the highest grade for the semester). Typical enrollments for these two courses are 8 to 20 students.
  - b) The collected laboratory reports will be scored with an appropriate rubric by a writing committee of not less than 2 physics faculty, and the committee will not include the instructor for the course from which the lab reports were collected.
  - c) The chair of the writing committee will collect the scored rubrics and provide analysis for the departmental assessment committee. The rubric uses the following scale: 1 (deficient), 2 (limited), 3 (competent), 4 (strong) and 5 (outstanding). Our benchmark is that the aggregate score should be above 3.0 (competent) for all students.

**B. Indirect Measure(s): (Departments are required to have one indirect measure. Examples of indirect measures are senior exit surveys, a focus group, written reflections by students, and of course alumni surveys which departments may choose to conduct.)**

- Existing Student and Faculty Feedback – At least once every five years, the department will hold a focus group with existing physics majors. This will provide an opportunity to identify emerging problems quickly before they show up in tracked data. The department will periodically collect feedback from permanent and temporary faculty and instructors on their perceptions of student strengths and weaknesses.

#### V. Student Learning Outcomes X Assessment Methods Matrix

	SLO1.1	SLO2.1	SLO2.2	SLO3.1
Common Final Exams in Phys 4AB	X			
FCI and CSEM	X			
Physics Major Field Tests	X			X
Assessment of Scientific Writing		X	X	
Existing Student and Faculty Feedback	X	X	X	X

#### VI. Timeline for Implementation of Assessment Methods and Summary Evaluations

Year 2015 to 2016

Method 1: **Embedded Questions in Final Exam in Phys 4AB**

Year 2016 to 2017

Method 1: **Physics Major Field Tests (MFT)**

Year 2017 to 2018

Method 1: **FCI and CSEM in Phys 4A and 4B**

## **VII. Process for Closing the Loop**

The Department of Physics will elect a committee every year to oversee, analyze, and write an assessment report. The members of the committee will be responsible for designing and carrying out assessment activities with the help of the entire faculty as needed. Assessment data and suggested program changes will be presented to the entire faculty during a regular faculty meeting, and the entire faculty will decide whether to implement any suggested or modified changes.