

CSM

Physics/BS

Student Outcomes Assessment Plan (SOAP)

Revision 2: November 1, 2015

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.

Physics majors will develop a strong foundation in **essential core disciplines** identified as fundamental in physics: 1) classical mechanics, 2) electricity and magnetism, 3) thermodynamics and statistical mechanics, 4) optics, 5) special relativity, and 6) quantum mechanics.

In addition, elective courses will have students integrate and synthesize knowledge from these core disciplines through study of specialized areas including: 7) astrophysics, condensed matter physics, health physics, biomedical physics, high energy physics, and theoretical physics among others.

The students will demonstrate the application of the concepts and theories in meeting these learning outcomes:

1. Students will develop mastery of problem solving in the following 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.

2. Students will demonstrate the ability to 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, and evaluating the reliability and significance of laboratory data.
3. Students will have an understanding of the basic principles, methods, and data analyses involved in conduct of scientific research in physics.
4. Students will be able to write scientific papers in a format and manner appropriate to publishing in leading journals of physics.
5. Students interested in experimental physics will develop firsthand knowledge of metal working and machine shop skills, and working knowledge of a wide variety of experimental apparatus.

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

BS Physics Program Curriculum Map

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

Outcomes	Chem 1A, B	Phys 4A,B,C	Phys 4AL, 4BL	Math 75.76.77	Math 81	CSI 40 or ECE 70	Phys 102	Phys 104	Phys 105A	Phys 105B	Phys 107A	Phys 110	Phys 115	Phys 140	Phys 171	Phys 190
1	I	I	I	I	E	I	E	E	R	R	R	E	R	E	R	
2	I		I					E				R				
3								I				E				R
4	I		I									E				R
5			I					R				E				R

IV. Assessment Methods

Direct Measures

- A. Physics majors will take the Physics Major Field Test (MFT) in their senior year. 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 within the required capstone course Analytical Methods, Phys 171, as the final exam, ensuring that all majors will take the MFT exam and be adequately prepared for it.

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

- B. Physics majors must complete the Analytical Methods capstone course (Phys 171), which will include assessment exams in each of the *essential core disciplines* outlined in Outcome 1. These exams will be reviewed by the instructor of Phys 171 and reported to the assessment committee. Performance on these exams will also be reported to the respective instructors responsible for each of the upper division courses relating to each core discipline. These instructors will also be consulted in the crafting of these assessment exams, so that the results can be informative on the retention of the skills and knowledge obtained by the students from these courses, including Phys 4ABC, 105A, 102, 107, 110, 140, and 115.

Benchmark: A standard will be sought after the first year of data collection, and trends in scores for each core discipline will be monitored. After a few years of data collection, longitudinal studies should be able to set benchmarks. Although initially firm benchmarks will not be available, any extremes in performance will be thoroughly investigated.

- C. Outcomes in Phys 4AB will be monitored via embedded questions in final exams. For each specific course (e.g. Phys 4A), final exams will contain three standardized embedded questions which will be shared across sections and from semester to semester. These questions will be identical in all but numerical values and will represent three areas of course specific essential knowledge as defined by committees of the prospective instructors of these courses.

Benchmark: Once again, standards will be sought after the first year of data collection, and trends in scores for each course will be monitored. Comparisons will be made both longitudinally, from semester to semester, and through cross-sectional analysis, via comparison of concurrent sections.

D. Assessment of Scientific Writing: We have identified two upper division courses that require significant writing in the form of laboratory reports that would be appropriate for assessment. The assessment procedure is 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 3 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 averaged over the 28 items on the rubric should be above 3.0 (competent) for all students.

Indirect Measures

E. A survey of alumni will be conducted every five years to obtain data concerning each graduate's career path and any further achievements towards educational goals. Alumni will also be solicited for feedback on the quality and adequacy of their physics education at Fresno State.

F. Existing Student 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.

G. Faculty Feedback – 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

Outcomes	Direct Measures				Indirect Measures		
	A	B	C	D	E	F	G
1	X	X	X			X	X
2			X			X	X
3					X	X	X
4		X		X	X	X	X
5						X	X

VI. Timeline for Implementation of Assessment Methods and Summary Evaluations

Assessment frequency: **Yearly**

The following assessment methods will be carried out on an annual basis:

At least one of the Direct Measures A through D

Indirect Measure G

Assessment Frequency: **Every five years**

The following assessment method will be carried out every 5-year period:

Indirect Measure E, F

VII. Process for Closing the Loop

The Department of Physics, will convene on an annual basis an Undergraduate Committee. The members of the Undergraduate Committee will be responsible for designing and carrying out assessment activities with the help of the entire faculty as needed. The Undergraduate Committee will also analyze the resulting data and suggest changes to the program as necessary. 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.