

CSM

Biomedical Physics Program

Student Outcomes Assessment Plan (SOAP)

I. Mission Statement

The mission of the Undergraduate Biomedical Physics Program at Fresno State is to provide students with a rigorous undergraduate-level introduction to the field of Medical Physics, including radiation physics, health physics, anatomy, physiology, medical imaging, and, at their option, radiation therapy. To accomplish this, the program offers courses to provide students with preparation for graduate instruction in Medical Physics and other areas of quantitative medicine (computational neuroscience, molecular imaging, etc.), as well as for other careers for which a broad-based, interdisciplinary scientific background is an asset.

II. Goals and Student Learning Outcomes

Program Goals:

The Biomedical Physics program's expectations for student learning are based on core **graduate** curriculum in the Standards for Accreditation of Graduate Educational Programs in Medical Physics (Revised July 2015) by the Commission on Accreditation of Medical Physics Educational Programs, Inc. (CAMPEP). This is to ensure that students graduating from this program are well prepared for graduate instruction in medical physics (M.S. or Ph.D.) or related fields. The core topic courses per CAMPEP Graduate Core Curriculum require as a minimum at least 18 semester credit hours. This program curriculum has over 30 credit hours devoted to the core topic courses. There is no accrediting body for **undergraduate** medical physics programs in the US. Fresno State is a pioneer in establishing the first undergraduate biomedical physics program in the nation.

Biomedical Physics students will develop competence in essential core disciplines identified as fundamental in physics such as classical mechanics, electricity and magnetism (E&M), thermodynamics, and quantum mechanics (QM). The students will develop an in-depth understanding of the physical and mathematical principles underlying medical imaging and health physics and demonstrate the application of these concepts and theories in meeting these learning outcomes:

1. Students will demonstrate a solid foundation of the core disciplines at the level defined by the textbook **Physics for Scientists and Engineers** by Serway and Jewett.
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 demonstrate a solid understanding of fundamental concepts, principles, and problem solving in medical physics as identified in textbooks used as standards in *graduate* medical physics education:
 - Introduction to Health Physics** by Cember
 - Fundamentals of MRI** by Berry and Bulpitt
 - The Essential Physics of Medical Imaging** by Bushberg, Seibert, Leidholdt, and Boone
 - Physics in Nuclear Medicine** by Cherry, Sorenson and Phelps
 - The Physics of Radiation Therapy** by Khan
4. Students will demonstrate practical understanding of medical imaging equipment through collection of data and analyses as part of a “hands-on” experience at the local medical centers.
5. Students will clearly, effectively, and professionally communicate their understanding and results from the “hands-on” laboratory experience in common written format.
6. Students will demonstrate core skills in applied statistics, error analysis, and experimental design and methods in radiation instrumentation.

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

BS Biomedical 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	Phys 4A,B,C	Phys 4AL, 4BL	Phys 102	Biol 65	Biol 144	Phys 135	Phys 136	Phys 137	Phys 155 (Seminar)	Phys 156	Phys 157	Phys 158	Phys 190 (Elective)
1	I	I	E			E	E	E		E	E	E	R
2		I				E		E		E	E		
3						I	I	I	I	E	E	R	R
4						I		I		E	E	E	R
5						R	R	E	I	R	R		R
6		I					E	R		E	E	R	

IV. Assessment Methods

Direct Measures

- A. Final Exam in Phys 4AB: Outcome 1 will be assessed via validated 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: It is expected that students passing the course will score above 50% correct responses on the embedded questions.

- B. Admission to Graduate School: Admission for Graduate study in Medical Physics is extremely competitive in schools in US and Canada. A longitudinal track of the rates of admission of our graduates into CAMPEP-accredited graduate programs across the US and Canada will serve as an unbiased, comprehensive, and direct measure of the strength of the program.

Benchmark: It is expected that at least 50% of the Fresno State students who apply for graduate school will be admitted to a graduate program in the US or Canada.

- C. Final Exam in courses Phys 135, 136, 137, 156, and 157: Biomedical Physics is a small program by its very nature and allows for one-to-one interaction with the student and the professor. As such, a comprehensive final exam with embedded questions serve as a good measure to assess learning outcomes. Phys 136 questions will be used to assess the initial understanding of students of basic math and physics of radiation. Embedded questions in Physics 135, 137, 156, and 157 will be used to assess student understanding of: the physical principles underlying each imaging modality, the physical properties that are visualized in each type image, the general types of medical and biological information that these properties can reveal, and the limitations of each imaging modality in acquiring clinical information thus, satisfying learning outcomes 3, 4, and 6.

Benchmark: It is expected that students passing the course will score above 50% correct responses on the embedded questions.

- D. The assessment of outcome 5 will be done primarily via the upper division course, Phys 135 which involves 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 would reflect the best work of the student (e.g. a report that earned the highest grade for the semester).

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 would use the following scale: 1 (deficient), 2 (limited), 3 (competent), 4 (strong) and 5 (outstanding).

Benchmark: The aggregate average score should be above 3.0 (competent) for all students.

Indirect Measures

- E. Alumni Feedback: A year after graduation, the alumni will be approached for a survey to provide feedback on the quality and adequacy of their medical physics education at Fresno State. This survey will also obtain data concerning each graduate's career path and any further achievements towards education goals. The duration of a year after graduation is to allow the formation of a perspective based on experience after graduation outside of Fresno State.
- F. Existing Student Feedback – At least once every five years, the department will hold a focus group with existing biomedical 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
2	X					X	X
3		X	X		X	X	X
4		X	X		X	X	X
5				X	X	X	X
6		X	X		X	X	X

VI. Timeline for Implementation of Assessment Methods and Summary Evaluations

Data for all direct measures will be collected on an annual basis and stored for future review by the assessment committee.

Amongst the indirect measures, method E and G will be done annually; G and F every five years.

The following timeline provides an outline of the schedule for review of that data by the department assessment committee.

First Year (AY 2014-2015)

- Review of Outcomes 3, 4, and 6 using Method B for the last several years since the inception of the program
- Review of Outcomes 3, 4, 5, and 6 using Method E for the last several years since the inception of the program.

Second Year (AY 2015-2016)

- Review of Outcomes 1 and 2 using Method A
- Faculty Discussion of Student Outcomes (Method G)

Third Year (AY 2016-2017)

- Review of Outcome 5 using Method D
- Faculty Discussion of Student Outcomes (Method G)

Fourth Year (AY 2017-2018)

- Review of Outcome 3 and 4 using Methods C
- Current Student Survey / Focus Groups (Method F)
- Faculty Discussion of Student Outcomes (Method G)

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 are responsible for designing and carrying out assessment activities with the help of the entire faculty as needed. The Undergraduate Committee also analyzes the resulting data and suggests changes to the program as necessary. Assessment data and suggested program changes are presented to the entire faculty during a regular faculty meeting, and the entire faculty will decide whether to implement any changes (and they are also free to suggest their own changes).