Physics Program Assessment Report 2018-2019

Learning Outcome #1: Demonstrate operational knowledge of the fundamental areas of physics

Assessment Methods	Benchmarks	Results	Action Taken
Assessment 1 (direct): Comprehensive **Physics Assessment and Results Test (PhART)**	Average score on each section of the exam is at least 60%	Mixed results. Benchmark **met in all but one category**. Intro 63% Modern 58% Classical 73% Thermo 82% E&M 63%	Determine whether collecting the final exam data is useful.
Assessment 2 (direct): **Final Exam** questions in each course.	60% of students in each course "Meet Expectations" on final exam questions	Mixed results. Benchmark **met in only one** category. Modern 38% Classical 40% Thermo 47% E&M 58% Quantum 86%	
Assessment 3 (indirect): **Course grades** in required major courses	60% of physics majors in each course earn a B- or higher	Mixed results. Benchmark **met in all but one** course. Modern 64% Classical 57% Thermo 88% E&M 75% Quantum 100%	

Discussion and Actions Taken: The performance on the PhART exam is similar to that of previous years. We removed the time constraint for students taking the exam this year. While the average PhART scores themselves didn't change much, the percentage of students meeting the 60% threshold did increase since everyone had an adequate opportunity to answer each question. For future sittings of the exam, we will not impose a time constraint.

This was the first year that we collected final exam data as an assessment of the mastery of the fundamental areas of physics. It is unclear whether the final exam data tells us anything useful. We will consider further whether this assessment is necessary and/or beneficial.

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Learning Outcome #2: Demonstrate mastery of quantitative skills.

Assessment Methods	Benchmarks	Results	Action Taken
Assessment 1 (direct): **Freshman Diagnostic** Mathematics Exam (Administered start of semester 1)	Average score is at least 60% on each section of the exam	Benchmark **met in all** categories. Basic Alg. 74% Adv. Alg. 69% Visual/Verbal 71% Geometry 60%	Administer Sophomore Diagnostic Exam later than the first week of the semester. Meet with Math Department to discuss content of the two advanced math courses, MATH 237 and MATH 238.
Assessment 2 (direct): **Sophomore Diagnostic** Mathematics Exam (Administered start of semester 3)	Average score is at least 60% on each section of the exam	Mixed results. Benchmark **met in 1 of 3** categories Derivatives 62% Integration 53% Advanced 29%	
Assessment 3 (direct): **Sophomore Comprehensive** Mathematics Exam (Administered end of semester 4)	Average score is at least 80% on Algebra section and 60% on the other sections of the exam	Mixed results. **Benchmark met in 2 of the 3** categories Algebra 76% Calculus 67% Advanced 61%	
Assessment 4 (indirect): **Course grades** in required math courses	60% of physics majors in each course earn a B- or higher	**Benchmark met in all** courses. Calc I 60% Calc II 70% Calc III 100% Math Meth 63% Diff Eq 75%	

Discussion and Actions Taken:
Advanced math skills were particularly low on the Sophomore Diagnostic Exam. The test is given in the first week of the fall semester, and, anecdotally, students claim that they are unprepared for the exam so close to the start of the semester. The exam will be administered in a later week so that students have time to regain and refresh their calculus skills at the start of the semester.

The mean score on the Advanced Category of the Sophomore Comprehensive Exam was higher than the mean score in previous years. The improvement is likely a result of the changes in MATH 237 for which we advocated last year.

In response to last year's assessment data, the Math department has agreed to reverse the order of MATH 237 and MATH 238. We will be meeting with the course instructor(s) about specific course content.

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Learning Outcome #3: Demonstrate an awareness of contemporary ideas in physics

Assessment Methods	Benchmarks	Results	Action Taken
Written Assessment 1 (direct): Modern Physics Research Paper	Average score is at least 3 out of 4 on **content portions** of the assignment	No Data.	Provide more writing instruction and opportunities in Modern Physics.
Written Assessment 2 (direct): Senior Seminar Research Paper	Average score is at least 3 out of 4 on **content portions** of the assignment	**Not met.** Rubric categories: Context 2.9 Physics 2.6 Commentary 2.6	
Oral Assessment 1 (direct): Senior Seminar Poster Presentation	Average score is at least 3.5 out of 5 on the **content** criterion.	**Target not met.** Rubric category: Phys. Content 3.4	
Oral Assessment 2 (direct): Senior Seminar Oral Presentation	Average score is at least 3.5 out of 5 on the **content** criterion.	**Target met.** Rubric category: Phys. Content 3.8	

Discussion and Actions Taken: This year we limited the scope of the research topics for the Senior Seminar projects and we required students to meet more regularly with their seminar advisor. Despite the increased guidance, the assessment results are similar to the results from previous years.

Students appear to have difficulty writing a paper that *explains* the physics of a topic rather than writing a paper *about* the physics. The development of this skill requires significant practice and feedback, preferably early in the curriculum. In the future, we will add writing assignments in the sophomore gateway course, Modern Physics, to provide deliberate practice in distilling physics concepts prior to the Senior Seminar course.

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Learning Outcome #4: Effectively communicate, in both written and oral form, results of physics research to members of the scientific community

Assessment Measures / Methods	Target Levels / Benchmarks	Results	Action Taken
Written Assessment 1 (direct): Modern Physics Research Paper	Average score is at least 3 out of 4 on the **writing portion** of the assignment	No data.	Provide more detailed feedback on Senior Seminar research paper drafts or require students to participate in writing conferences.
Written Assessment 2 (direct): Senior Seminar Research Paper	Average score is at least 3 out of 4 on the **writing portion** of the assignment	**Not met.** Rubric category: Writing 2.7	
Oral Assessment 1 (direct): Senior Seminar Poster Presentation	Average score is at least 3.5 out of 5 on the **communication criteria**	**Target met.** Rubric category: Poster Qual 3.9 Pres. Quality 4.0	
Oral Assessment 2 (direct): Senior Seminar Oral Presentation	Average score is at least 3.5 out of 5 on the **communication criteria**	**Target met.** Rubric category: Slide Quality 3.9 Pres. Quality 3.8	

Discussion and Actions Taken: Students were able to communicate effectively for both the oral and poster presentations but failed to meet the benchmark on the final research paper. We will work to provide more feedback on the written assignment either through multiple draft reviews or writing conferences.