Student Learning Outcomes PHYS 2021-2022

The physics department has identified five student learning outcomes for all students in physics-related programs (August 2010):[1]

1. Utilize scientific reasoning, mathematical techniques and conceptual understanding to solve problems in science.

This SLO is measured yearly via the following methods:

- **Experimental paper** (PHYS495; year 4), completed at "minimum" level or above. To meet this level, not only must the treatment of the topic reveal a satisfactory understanding of the phenomenon being studied, but the data and theory must adequately support the assertions made in the paper. This is also used for SLO's 2 and 4.
  Results: Out of 24 students who took PHYS495 in 2021-2022, about half completed this activity. Students find this activity to be challenging, although for 2021-2022 a significant issue had to do with access to experiment materials due to COVID.
  Actions: The department modified the structure of PHYS495 and converted it into a 3-credit course (rather than 1 credit). This seems to have improved the completion rate somewhat but it is hard to tell because of COVID.
- **ETS Major Field Test for Physics** or GRE Physics Subject Test at a satisfactory level (B.S. physics majors only years 3 and 4).
  Results: We were unable to administer this during COVID but prior to that the ETS physics scores continued to show that ESU students perform on par (or better) than students from other U.S. institutions.
  Actions: No changes.
- Passing score on **PRAXIS II content exam** for their content area (Secondary Education students only; year 4 or post-grad).
  Results: Physics majors routinely pass the physics exam without a problem but the Earth and Space Science majors occasionally have problems with the earth and space science exam.
  Actions: In the past, the struggle with the Earth and Space Science exam was attributed to the large amount of geology on the exam. For that reason, GEOG321 Geomorphology was made a requirement (rather than an elective), even though it is only offered as an independent study. Unfortunately, an entry error in DegreeWorks prevented that requirement from being implemented, so not only is it not possible to determine if the change will help performance on the PRAXIS exam but geomorphology is being returned to an elective because the major is being dropped due to pressure from PASSHE. Students seeking Earth and Space Science certification will instead major in General Science and add the Earth and Space Science minor. This may not end up being an issue since it seems that a poor performance on the Earth and Space Science exam is better-predicted by the student's performance in their content coursework more than whether the student has had geomorphology or not.

This SLO is also measured periodically via the following methods:

- A minimum of a C- in all **required courses** in their content area (all years).
  Results: The last time this was analyzed 79% of students met the target.

[1] Four additional learning outcomes apply to the secondary education concentrations within the science majors. The science education programs are accredited by NCATE and undergo their own periodic review. The last review was submitted in the spring of 2012 and received national recognition. Every standard was met.

Actions: The department has modified the course schedule for new first-time students to try to address the high DFW rate in PHYS161 (Physics I). This seems to have cut down on the DFW rate in Physics I by motivating students to change their major prior to taking PHYS161.

2. Apply scientific inquiry methods to testing, measurement, and analysis.

This SLO is measured yearly via the following methods:
- **Experimental paper** (PHYS495; year 4). See comments above.

3. Deal with issues involving scientific content in an equitable and scientifically valid way.

This SLO is measured yearly via the following methods:
- **Issue paper**, completed at "minimum" level or above (PHYS495; year 4). To meet this level, the student must demonstrate a satisfactory understanding of current (recent) knowledge of an issue in science, supported by data from various sources provided in an unbiased way (i.e., with arguments for both sides of an issue) and must provide a recommendation supported by logic, evidence, and research. This is also used for SLO 4.
  Results: Out of 24 students who took PHYS495 in 2021-2022, about two-thirds completed this activity. Students find this activity to be less challenging than the experiment paper (see above).
  Actions: The department modified the structure of PHYS495 and converted it into a 3-credit course (rather than 1 credit). This seems to have improved the completion rate, although it is still low, probably because of COVID-related issues.

4. Communicate scientific ideas clearly and succinctly.

This SLO is measured yearly via the following methods:
- **Issue paper**, completed at "minimum" level or above (PHYS495; year 4). See comments above.
- **Review of** a recently published, peer-reviewed **research article**, completed at "minimum" level or above (PHYS495; year 4). To meet this level, students must summarize, using language no more advanced than that found in introductory college science courses, the essential ideas contained in a contemporary research article in science.
  Results: Out of 24 students who took PHYS495 in 2021-2022, about two-thirds completed this activity. Students find this activity to be less challenging than the experiment paper (see above).
  Actions: The department modified the structure of PHYS495 and converted it into a 3-credit course (rather than 1 credit). This seems to have improved the completion rate, although it is still low, probably because of COVID-related issues.

5. Obtain suitable employment in their field of study (if desired), or enroll in graduate school in physics or a related field of study (if desired).

This SLO is measured periodically via the following methods:
- **Post-graduate enrollment and employment** history of graduates.
  Results: Students have not had difficulty unless they restrict their search area.

Actions: Now that our engineering coordinator has been here for five years, there is a greater awareness of internship opportunities. We have also enlisted those members of our faculty who have engineering experience (Dan Lewis and Maria Cohen) to help with identifying internships and shadowing opportunities.

- For engineering transfer majors, **successful matriculation as juniors** at Penn State or any other engineering college of their choice.
  Results: Our students continue being successful at transferring to an engineering school and succeeding once they are there.
  Actions: Due to pressure from PASSHE to drop this program, it has not been advertised and enrolled has dropped precipitously. We are in the process of shifting the transfer program from our B.A. to our B.S. It remains to be seen how that will impact this student learning outcome.