

The Department is involved in a multi-institution grant through the Ohio Department of Education to work with elementary education teachers to develop two physics courses that will transfer to Wright State University and University of Dayton. The project focuses on “teaching the teachers” the discovery technique of science instruction. The grant proposal includes ASE-145, PHY-245, MAT-110 and CHE-245.

The Department has developed a new course sequence in computer competencies for scientists. The sequence addresses fundamental and intermediate computer concepts and problem-solving.

The American Association of Physics Teachers is one of several professional associations which provides ideas and materials for physics instructors.

II. Program Learning Outcomes: A description of what you intend for students to know (cognitive), think/feel (affective), or do (psychomotor), when they have completed your degree program. A suggested manageable number of outcomes should be in the range of five to ten. Describe Program Learning Outcomes review activities.*

a. Program Learning Outcomes

The Liberal Arts and Sciences (LAS) program learning outcomes are under review but no changes have been approved at this time. Please refer to the section on the LAS degrees for more information on the review process.

The program learning outcomes for Liberal Arts and Sciences that are applicable to the physics sequences (PHY 201-202-203 and PHY 141-142-143) are:

- To demonstrate a problem-solving capability through analysis/synthesis.
- To recognize the ways in which a scientific approach can be used to formulate an understanding of the observable world.

b. End-of-sequence learning outcomes for Physics

Each course in PHY 201,202, and 203 and PHY 141,142, and 143 has a common set of learning outcomes used by each faculty member.

The end-of-sequence learning outcomes for PHY 141-142-143 are:

- Discuss the concept of the Coulomb force and the relationship between Coulomb force and the electric field intensity.
- Calculate the work done per unit charge by the electric field and show that it is a scalar potential function.
- Discuss the energy aspects (related to electric fields) of the capacitor and the function of a dielectric in a capacitor.
- Give a qualitative discussion of the current mechanism in a conductor.
- Apply Ohm’s Law and Kirchhoff’s rules to the analysis of DC circuits.
- Calculate the magnetic field of various current configurations.
- Apply Faraday’s law of electromagnetic induction.

- Discuss the energy aspects (related to magnetic fields) of the inductor and the function of magnetic materials in inductors.
- Analyze the behavior of resistors, capacitors and inductors in AC circuits.
- Apply Huygen's principle to analyze the behavior of light at the boundary between different media.
- Apply the principles of interference and diffraction to analyze the behavior of light through apertures.
- Discuss and apply the properties of mirrors and lenses to optical systems and instruments.

The end-of-sequence learning outcomes for PHY 201-202-203 are:

- Discuss the properties of electric charge.
- Discuss the properties of the Coulomb Force and relate it to the electric field.
- Apply the work-energy theorem to electrostatics and calculate the electric potential and electric potential difference in the vicinity of the distribution of charges.
- Discuss the properties of capacitors and the properties of a capacitor containing a dielectric.
- Discuss the microscopic origins of electric current.
- Apply Ohm's Law and Kirchhoff's Rules to the analysis of DC circuits.
- Describe the behavior of resistors, capacitors and inductors in AC circuits.
- Calculate the magnetic force on a moving charge and on a current-carrying wire.
- Calculate the electric field intensity in the vicinity of a distribution of charge and the magnetic field intensity in the vicinity of a distribution of current.
- Apply Faraday's Law of induction.

III. Assessment Method(s): A measurable indicator of success in attaining the stated learning outcome(s). The methodology should be both reliable and valid. Please describe in detail.

- a. **Formative Assessment Method(s) and Description:** a measurable indicator of student in-progress success in attaining the stated learning outcome(s).

The Physics faculty use a "problem of choice" embedded within course exams occasionally for assessment of student performance. A common grading template developed by the department based on a scale of 1 to 5 is used for assessment of the problems. This assessment technique is used in both the PHY 141-143 sequence and the PHY 201-203 sequence.

Instructors regularly follow the scientific method conducting pre and post-test measures to determine the impact of a particular teaching strategy or method. Improvements are made based on the results of such investigations.

- b. **Summative Assessment Method(s) and Description:** a measurable indicator of end-of-program success in attaining the stated program learning outcome(s).

Not applicable to end-of-sequence assessment.

Refer to the report at the beginning of the Liberal Arts and Sciences for information on summative assessment of the program learning outcomes for Liberal Arts and Sciences.

IV. Results: A description of the actual results of overall student performance gathered from the summative assessment(s). (see III.a.)

Data has been collected but not analyzed for all classes that are embedding a “problem of choice” on course exams. One section in PHY 141 shows a class average of 2.6 out of a possible 3. Informal observation indicates that students are doing above average. The problems used for testing are assessing difficult concepts.

The Physics department has been incorporating more hands on activities into the coursework. More laboratory time has been allocated for practice exercises. The Department thinks this is the reason why attrition has decreased from approximately 20% during Fall quarter in the past to 5 out of 24 in PHY 201 during Fall of 1999. Students are also coming into physics better prepared. MAT 201 is a co-requisite and the math department now requires students to achieve a “C” or higher before moving to a more advanced math course. The younger students that are coming to Sinclair straight out of high school are also entering physics better prepared.

The “Lecture No More” approach to physics that was developed through a Learning Challenge grant is being used throughout the department. The team-based learning technique is being incorporated into many PHY courses because it works to improve student learning and retention. The approach uses discussion groups and computer labs to actively involve students in the learning process.

In 1988 the Physics Resource Lab was added to the program and available for students. The Lab emphasizes student centered learning and is particularly suited for “at risk” students in Physics. Students bring problems into the Lab on a “drop in” basis. They can receive tutoring, use software, work in interactive collaborative groups, review tests, make up labs that were missed, re-construct labs for additional analysis, or do homework in groups of students. Computers are available to run labs. The utilization rates for the Lab are good. The predominant users of the Lab are students from the college-based physics courses. The department believes the Lab is helping to increase student performance on assignments. Students who utilize the Lab perform better on exams than those who chose to work alone.

Results from the recent external review suggest... *Add info here*

V. Analysis/Actions: From analysis of your summative assessment results, do you plan to or have you made any adjustments to your program learning outcomes, methodologies, curriculum, etc.? If yes, describe. If no, explain.

The Physics Resource Lab was developed in 1988 as a result of a need identified by the faculty. Improvements in lab staffing is believed to further improve student learning.

The integration of lectures and labs was a major change made to the physics classes in the PHY 141-142-143 sequence. Individual faculty vary the lecture portion anywhere from 25-50% of the class time. Combining lecture and lab has also decreased the class size. Faculty within the department are mentoring part-time instructors in using activity-based techniques. More "Master Teachers" would further enhance this process.

Actions being considered after the most recent external review include... *Add info here*

VI. General Education: Are you using any tool(s) to assess any of the three primary general education outcomes * (communication, thinking, values/citizenship)? If so, describe.

- a. Where within the major do you assess written communication? Describe the assessment method(s) used. Describe assessment results if available.

Every Physics class practices written communication through lab reports and written assignments along with essay questions on tests. ASE 145, a requirement in the elementary education teacher series, incorporates four writing assignments. While no assessment tool is used consistently to offer formative feedback, some faculty provide written suggestions to improve student writing.

- b. Where within the major do you assess oral communication? Describe the assessment method(s) used. Describe assessment results if available.

Team-based learning methods are used extensively in the PHY courses. This teaching method encourages student interaction, discussion and dialog. No effort is currently made to offer formative feedback to students in a systematic way with respect to their oral communication skills.

- c. Where within the major do you assess thinking? Thinking might include inventing new problems, seeing relationships and/or implications, respecting other approaches, demonstrating clarity and/or integrity, or recognizing assumptions. Describe the assessment method(s) used. Describe assessment results if available.

Physics courses require students to develop thinking by using the scientific method. Students look at examples of "flawed thinking" and re-do to eliminate the flaws. Students are "coached" to focus on process; they learn by making mistakes and then re-thinking the process to make it correct. Emphasis is on understanding and applying the scientific method.

- d. Where within the major do you assess values/citizenship/community? These activities might include behaviors, perspective, awareness, responsibility, teamwork, ethical/professional standards, service learning or community participation. Describe the assessment method(s) used. Describe assessment results if available.

Some values are addressed through class discussion such as the Greenhouse effect, ozone layer depletion, etc. Controversial issues (evolution, the Greenhouse effect) allow students to examine their values in relation to these issues. Class discussion often leads to examination of the relationship between science and theology. Students are exposed to the idea of collaboration between science and theology to take us further in understanding where we came from. Consideration of student work ethic is addressed through the lab activities.

e. Computer and information literacy:

Basic computer skills are required for all students completing the PHY program. Computer use is required in numerous PHY classes. Papers are to be completed on a word processor, many lab activities require the use of computerized lab equipment or technical calculators. Information literacy skills are utilized to access information, analyze the information for its usefulness and interpret findings.

VII. Recommendation(s)/Comment(s):

The Physics Department would like to track transfer students to gather specific information about the performance level of physics students.

- * Note: The oral communication checklist and the written communication checklist developed by the General Education Committee were adopted for college-wide use during the 1997-98 academic year by Academic Council. Thinking Guidelines developed by the General Education Committee are being piloted by faculty during the 1998-99 academic year.