DEPARTMENT REPORT
OF
PROGRAM LEARNING OUTCOMES ASSESSMENT

Department: Physics

Program (Degree): Physics Sequence Assessment for PHY 201,202, & 203 and PHY 141,142, &143

Type of Degree: ____ AAS __X__ AA __X__ AS ____ ATS ____ AIS

Chairperson: Art Ross Date: 4/18/2000

Person(s) Interviewed: Art Ross

I. Program Curriculum: A description of the basis for the program curriculum (i.e., how it is derived and validated). Include accreditation organizations, advisory committees or external groups that influence curriculum. Describe curriculum review activities including the review of course master syllabi.*

The curriculum/content in both Physics sequences has been developed over a long period of time. These sequences serve primarily SCC students whose intention is to transfer to a four-year institution. Thus, the sequences have been designed to be compatible with four-year institution's Physics courses across the state and nationally.

The Physics Department goes through an external review approximately every five years. The last one was completed in 1998 with the next one scheduled for 2002. The reviewer was from the Southern Ohio Section of the American Association of Physics Teachers. All reviewer suggestions have been incorporated in the department:

- The PHY 200 sequence did not transfer well to four-year colleges. The course sequence has been increased to six hours effective fall of 2000.
- PHY 151-153 was considered obsolete. That sequence has been replaced by PHY 100, 104 and offered through TV Sinclair.
- The department has passed the HAZMAT safety inspection.
- The department maintains its own computer lab image so that changes can be incorporated in a timely manner.

The Physics Department has been active in collaboratively working with other academic departments to develop new curriculum and instructional approaches through participation in the NSF grant and Advanced Technical Education. The new curriculum being developed uses competency-based modules.

The Department has also been incorporating more technical education into coursework. More hands on exercises are being used and real world projects for students to complete at the end of a course are being developed.

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 has been written and the department is waiting on a funding decision.

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

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

II. **<u>Program Learning Outcomes</u>:** 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. <u>Assessment Method(s)</u>: 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 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.

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 201during 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 technique is beginning to gain ground with most instructors 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 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.

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.

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.

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. PHY 297, a requirement in the elementary education teacher series, incorporates four writing assignments.

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

Teamwork (interpersonal communication) is practiced throughout the department but not assessed.

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.

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.

* 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.

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: These three general education outcomes were identified during the 1994-95 academic year through a prioritization process with faculty/students/staff.