Expected Outcome 1: Participation in Undergraduate Research

This is a non-student-learning-outcome category to track Physics student opportunity for, participation in and satisfaction with undergraduate research activities.

Assessment Method 1: University Administered Graduating Senior Survey

Graduating seniors at Auburn University are asked to complete a Graduating Senior Survey during their last semester. The survey is administered by the University Office of Institutional Research and Assessment. One of the questions on the survey is: “3. Did you participate in undergraduate research while at Auburn University?”. Ten of the 16 (62.5%) of the B.S. students from 2013-14 completed the survey.

Findings

Nine of the ten students (90%) who participated in the survey answered Yes.

Use of Findings for Improvement

The findings indicate that there was indeed ample opportunity for students to participate in undergraduate research, and that a large majority of students availed themselves of the opportunity. However, this assessment method gives no indication of the student’s satisfaction with their undergraduate research.

Assessment Method 2: Departmental Exit Interviews

The department chair conducted with exit interviews with students during their last semester. The interviews were clearly identified as exit interviews, and took place in the Department Chair’s office. The Chair took careful interview notes, and then scanned and summarized the notes for later use. Topics discussed in the interview included: reasons for attending Auburn, plans after graduation, courses and professors that the student found especially helpful, courses and professors that the student did not find especially helpful, participation in undergraduate research, and areas where the Physics department could improve. Exit interviews were completed with 14 of the 16 (87.5%) of the BS students from 2013-14.

Findings:

Of the 14 interviewed students, seven (50%) indicated that they had conducted undergraduate research. All seven were positive about the research experience, and several particularly mentioned the benefit when it came to applying for graduate school. Some of the research was done in other departments (Mechanical Engineering, Electrical Engineering), by students who had double majors.

One of the 14 students interviewed explicitly indicated they had not participated in undergraduate research, but there was no indication if the opportunity was
made known to the student. In six of the 14 interviews, there was no mention of undergraduate research in the Chair’s notes.

The exit interviews show substantial satisfaction with the research opportunities available.

**Use of Findings for Improvement**

The confidence in the conclusion that students show substantial satisfaction with their undergraduate research experience is decreased by the fact that undergraduate research was not mentioned in six of the 14 interviews. The interview process will be revised and improved for next year, so that student satisfaction with undergraduate research will be specifically addressed in all exit interviews.

One related observation from the exit interviews was that a substantial fraction of the students who planned to pursue graduate studies in physics indicated that they felt that their preparation in mathematical aspects of physics was not as strong as it might be. In some cases this impression was gained when the student participated in off-campus undergraduate research programs during which they had extensive conversations with physics students from other universities. Partly as a consequence of this finding from the exit interviews, the department plans to offer a class in Mathematical Methods of Physics in the Fall 2014 semester.

**Expected Outcome 2: Electricity and Magnetism**

Students will demonstrate an understanding of Electricity and Magnetism at the introductory and intermediate level. Representative topics include: Coulomb’s Law, Gauss’s Law, electric field, AC and DC Circuits, Biot-Savart Law, Faraday’s Law, electric and magnetic dipoles, electric scalar potential, magnetic vector potential, Maxwell equations in differential and integral form, conservation laws and electromagnetic waves.

**Assessment Method: ETS Major Field Test in Physics**

The ETS Major Field Test (MFT) in Physics is a comprehensive undergraduate outcomes assessment designed to measure the critical knowledge and understanding obtained by students in Physics. It consists of 70 multiple-choice questions taken over a two hour period. Scores are grouped by assessment indicators. One of the assessment indicators is “Electromagnetism”, and the topic areas included in the “Electromagnetism” assessment indicator agree well with the topics in this expected outcome. Students who were to receive the B.S. degree in the Fall of 2013 and the Spring of 2014 were requested to take the ETS MFT in Physics. The testing was administered by the Biggio Center for the Enhancement of Teaching and Learning. Each student scheduled the examination at a time of their choosing. One of the three students who received
the B.S. degree in Fall 2013 and five of the 13 students who received the B.S. degree in Spring 2014 took the ETS MFT.

Findings:

The ETS reports that between September 2012 and June 2014 the test was taken by 1137 students at 94 domestic institutions. The average Auburn student scores in Assessment Indicator 2 (Electricity and Magnetism) were compared with the institutional average score. Auburn’s average was 59.5. This is a better institutional average than 97% of the 94 institutions in the cohort.

Use of Findings for Improvement

An institutional average score better than 97% of the participating institutions for the Assessment Indicator 2 (Electricity and Magnetism) is a very positive result. However, it should be interpreted with caution. However, only six of 16, or 37.5% of the BS students from 2013-14 participated in the assessment. The small sample may not accurately represent the group of B.S. recipients. This reduces the confidence in the positive conclusion. In 2014-2015, the department will attempt to increase the fraction of graduating students who take the ETS MFT in Physics.

Expected Outcome 3: Quantum Mechanics

Students will demonstrate an understanding of Quantum Mechanics at the introductory and intermediate level. Representative topics include: Bohr model, Heisenberg uncertainty principle, Schroedinger equation and its solutions, interpretation and mathematical properties of wave functions, perturbative solutions, angular momentum, spin and the Pauli exclusion principle, atomic spectra, blackbody radiation, energy quantization, and atomic structure.

Assessment Method: ETS Major Field Test in Physics

The ETS Major Field Test (MFT) in Physics is a comprehensive undergraduate outcomes assessment designed to measure the critical knowledge and understanding obtained by students in Physics. It consists of 70 multiple-choice questions taken over a two hour period. Scores are grouped by assessment indicators. One of the assessment indicators is “Quantum Mechanics and Atomic Physics”, and the topic areas included in the “Quantum Mechanics and Atomic Physics” assessment indicator agree well with the topics in this expected outcome. Students who were to receive the B.S. degree in the Fall of 2013 and the Spring of 2014 were requested to take the ETS MFT in Physics. The testing was administered by the Biggio Center for the Enhancement of Teaching and Learning. Each student scheduled the examination at a time of their choosing. One of the three students who received the B.S. degree in Fall 2013 and five of the 13 students who received the B.S. degree in Spring 2014 took the ETS MFT.
Findings:

The ETS reports that between September 2012 and June 2014 the test was taken by 1137 students at 94 domestic institutions. The average Auburn student scores in Assessment Indicator 4 (Quantum Mechanics and Atomic Physics) were compared with the institutional average score. Auburn’s average was 51.3. This is a better institutional average than 92% of the 94 institutions in the cohort.

The ETS MFT has five Assessment Indicators. The Auburn institutional mean scores for all five are shown in the table below:

<table>
<thead>
<tr>
<th>Assessment Indicator</th>
<th>AI 1</th>
<th>AI 2</th>
<th>AI 3</th>
<th>AI 4</th>
<th>AI 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU Mean Score</td>
<td>71.8</td>
<td>59.5</td>
<td>52.5</td>
<td>51.2</td>
<td>60.</td>
</tr>
<tr>
<td>Institutional Mean – Percent Below</td>
<td>97</td>
<td>98</td>
<td>96.7</td>
<td>92</td>
<td>95</td>
</tr>
</tbody>
</table>

AI 1 – Classical Mechanics and Relativity
AI 2 – Electromagnetism
AI 3 – Optics/Waves, Thermodynamics
AI 4 – Quantum Mechanics and Atomic Physics
AI 5 – Special Topics

The results from each of the five Assessment Indicators is very positive. No one particular area of physics stands out as in need of special attention.

Use of Findings for Improvement

An institutional average score better than 92% of the participating institutions for the Assessment Indicator 4 (Quantum Mechanics and Atomic Physics) is a very positive result. However, it should be interpreted with caution. However, only six of 16, or 37.5% of the BS students from 2013-14 participated in the assessment. The small sample may not accurately represent the group of B.S. recipients. This reduces the confidence in the positive conclusion. In 2014-2015, the department will attempt to increase the fraction of graduating students who take the ETS MFT in Physics.