

Assessment Report for BGES Undergraduate Programs in BIOLOGY: 17 June, 2010

1. Goals

Biology majors will possess a broad general knowledge of the fundamental facts and principles in all of the major areas of Biology by the end of their senior year, as well as advanced knowledge in the major areas of Biology, as defined by the GRE Advanced Biology subject test.

This goal was developed by the Department: initially by the chair and associate chairs, undergraduate program directors, and the Undergraduate Committee on Curriculum & Academic Standards [UCCAS], then discussed and approved by a formal vote at a faculty meeting. The decision to use the subject areas based on the areas of the Graduate Record Examination was made in 1996, when the first steps in Departmental assessment evaluations were begun. No changes in the goals have been made since that time.

2. Outcomes

The Department decided to define outcome measures as *satisfactory improvement in performance on a standardized test from entry to completion of the program*. This outcome measure was adopted by the Department in the same way and at the same time as the determination of the goals.

3. Research Methods

The current testing procedure (since Fall, 2001) uses an objective exam of 100 multiple-choice questions (randomly selected from a test bank of 900 questions), divided into 6 areas in the following proportions: 17% Biochemistry & Cell Structure/Function; 17% Genetics & Molecular Biology; 17% Evolution; 16% Ecology; 18% Botany; 15% Zoology. The first two areas were further subdivided. The questions used in the pool were selected from faculty input and then subsequently approved by faculty in each area.

In the first versions of the exam (administered through WebCT), the random sampling from the pool of questions for each category was done for each student. Severe problems with system backup/recovery in older versions of WebCT, which resulted in significant losses of data, forced us to revert to a simpler paper-based approach with a constant test version. The random sampling from the test bank has been dropped, so that all students write the same exam at present. Renewed sampling can be done if deemed necessary.

The exam is administered at three time points (entry, early, and late) in a student's career: at entry, operationally defined as the beginning of the first required course for majors (BIO 200, Introductory Biology I), at the end of the introductory sequence (BIO 202, Introductory Biology II), and just before graduation. The last point is administered by requiring all majors to complete before graduation a zero-credit course (BIO 499, Exit Evaluation) that consists solely of the assessment examination. In the introductory biology sequence (BIO 200 & BIO 202), students are exposed to concepts in each of the six major areas, taken from the Biology GRE subject

exam, into which the exam is subdivided. This allows us to attempt to assess both overall outcomes and performance in each of the subject areas. The six core courses (BIO 300-BIO 311), of which students take at least four, are also roughly aligned with these six areas.

All of these direct measures are collected as aggregate values for the entire set of students writing the exam in each semester.

In addition to these direct outcome measures, indirect evidence sometimes comes in the course of informal exit interviews that arise during the last meeting before graduation that each major has with the Biology Undergraduate Program Director [in the BGES Department, all Biology majors are advised by the same person]. The suggestion by the assessment review panel for us to consider *systematic* indirect measures (such as a simple student survey) now has been implemented. When students take the exit examination, they also complete an anonymous survey; in addition, they are provided the opportunity to write any comments they wish. This survey was modified at the end of 2006; the current survey instrument is attached to this document. Various changes in office staff have resulted in inconsistent collection of results in the past: this year we report the first results, although a copy error led to omission of a part of the survey.

4. Findings

A set of standard statistics are calculated for each set of data and appropriate comparisons are made. In particular, overall average scores always are compared among the entry, early, and late categories as new data accumulate each semester. The latest data (from Fall, 2001, through Spring, 2010) show an appropriate increase in average (percentage) score from 27.7+/-7.8 at entry (based on data for N = 2342 students), to 35.5+/-13.1 at the end of the introductory sequence (N = 1075 students), and 49.6+/-17.2 at exit (N = 266). The distributions of scores for 2009-10 are plotted in the attached graphs along with those over all years and averages by year (Fig.1 a-d). Both the increase from the beginning to the end of the introductory sequence, and from then until exit are statistically significant (at a 95 % confidence level). Scores for the 499 assessment show the most variability.

The sampling period now provides data from some of the same students over the course of their study. Scores of biology majors increased an average of 17.7% +/- 8.0% from the BIO 200 to BIO 499 tests (N=76). Over the course of the BIO 200-202 sequence, scores increased an average of 5.7%+/-12.0% (N=718).

In order to evaluate the level of difficulty of the assessment test, we collected MCAT scores of biology majors who also took the assessment. Of the twenty available scores, three were from postbac students just taking BIO 200-202; the rest were from biology majors taking BIO 499. The average on the assessment test was 48%; the average percentile for the MCAT biology part is 51%. The regression is weak, perhaps because the MCAT is scored on a very compressed range with large percentile ranges but also because of considerable variance in the MCAT scores. These results imply that there are measurable improvements in at least objective knowledge of

biological facts and principles over the course of the introductory sequence, and that additional knowledge is acquired by Biology majors who graduate. Please note that the decrease in sample size at exit is a consequence of the fact that many students besides Biology majors take the introductory course sequence, while the exit exam is taken only by graduating Biology majors. Furthermore, there is non-trivial attrition of students from the first course in the introductory sequence to the second (a phenomenon that the Department is continuing to probe).

Summary results of the scores in each of eight subject areas (and also grouped by the six GRE categories as well as three broader categories) for all data and for the last academic years are given in the attached spreadsheet (Table 2). Exit test results for 266 Biology seniors who graduated in the last five academic years indicate that the lowest percentage scores occur in questions related to Cell Biology (42 % correct), Animal Biology [Zoology] (43 % correct), and Plant Biology [Botany] (44 % correct). Overall, graduating seniors performed more poorly (42.3%) on questions related to Organismal Biology (45%) than on those related to Ecology & Evolution (50%) and Cell & Molecular Biology (51%). The disparities for this and last year were smaller due to increases in organismal scores but also to a large decrease in cell and molecular scores (41%, 51%, and 49% for cell and molecular, organismal, and ecology/evolution, respectively). The reason for this change, which continues a trend from last year, is unclear.

Summary results for anonymous exit surveys are attached based on 48 completed surveys. On the five questions that attempt to solicit performance ratings, the mean values indicate that these graduating Biology seniors give the best ratings (1.92, 2.00, 2.19, and 2.29, respectively — closer to “good” than “very good”) to the program’s contribution to improving their career prospects, to their own perceived knowledge and to their instructors’ and TA’s abilities (Table 3). These represent declines from the previous year. The lowest rating (2.56 — between “good” and “adequate”) was given to the quality of laboratory exercises. Of possible improvements, “more hands-on research” was first or second choice of 30; “better lab courses” was selected by 17; “more modern or exciting lecture courses” was noted by 30 (Table 4).

Further, most of our graduates are planning careers in the health and biomedical science (Table 3); most are planning further graduate or professional training (not shown), most expect to remain in Northeast Ohio initially, but more than half expect to be elsewhere in the US in five years (Table 6). Besides the internet for information, personal contacts and recommendations are the major factor guiding choice of institution for further education (not shown).

Anonymous comments range from observations about individual instructors (both good and bad, sometimes for the same instructor). Many found the program a good experience and profited from various professors. They found the program challenging and a good preparation. However, many comments list complaints or irritations or wishes, including “meager advanced course offerings”, “poor lab exercises”, an old building, “aging facilities and lab equipment” worse than local “community colleges”. One mentions a need for more training in the original literature. Others suggest more courses besides the biomedical orientation.

5. Review

Results of the data analysis are reviewed each Fall by the Undergraduate Program Director, Associate Chairs, and Chair, as well as by members of the Department's undergraduate committee (UCCAS). Any significant findings are reported to the faculty generally for discussion and action. Furthermore, all faculty receive copies of this report annually.

6. Actions

The results of both the direct and indirect assessment of student outcomes initially (in the early years of the Department's assessment program) suggested a general performance weakness in the area of genetics. After discussion within the UCCAS, the Department discussed and adopted a curricular change involving the creation of two new courses (BIO 310, Genetics, and BIO 311, Genetics Recitation) that now (since Fall, 2004) form part of the allowable core requirements for Biology majors.

An effort was made these past two summers to add another summer course from the group of second year core courses. Enrollment was encouraging although just over the College minima. Some students have taken the opportunity to use the summer to take two such courses, which may not be advisable for all but the best students. The department will monitor performance. Similarly, introductory courses and the core courses continue to be routinely offered both evening and day on at least a two-year cycle. Efforts to add to the evening offering of electives will continue. College requirements for minimum enrollments and staff limitations hamper this effort.

Anticipated difficulties in ensuring student compliance with taking the outcome assessment exam just before graduation resulted in the creation of the Exit Evaluation course requirement for the major, adopted in Fall, 2002 [after reluctant approval by the Arts & Sciences Curriculum Committee]. We now have very good compliance, and assessment instruments are administered routinely. Some individuals, particularly in the BIO 203 assessment, obviously take little care with the exam; failure to catch instances may contribute to the variability of this score.

The newest finding from the last two years, that of possible weaknesses in the areas of animal and plant biology and the apparent recent decline in cell and molecular scores, will remain a subject for continuing faculty review and discussion. Results from this year show less of a deficit in organismal biology compared to the two other areas. Possibly this difference is just a question of lower student interest for the more than half of our students with a preprofessional or cell and molecular focus and the paucity of higher level courses in botanical and other organismal areas that students typically take closer to the exit exam. Since the death of Dr. Mal, the sole faculty member with training and a research focus on plants, the department has identified a replacement in plant biology as a key need and hopes to add a tenure-track staff member a year from now. Similarly, some attention will be devoted to a focused review of laboratory exercises. Cell biology is a current focus and has undergone a major change. For many students, participation in faculty research, often as part of the biology honors program, is a major part of their biology training and this does give them deep experience in lab methods that are important for jobs or further education but may not show up as a significant increase in the general assessment test

scores. Addition of a new upper-level course in animal cell culture was well-received by students and serves a similar function: it is not quite hands-on “research” but certainly hands-on exposure to modern techniques. Unfortunately, staffing shortages limit its offering.

Several problems with the assessment routine in previous years involved maintaining routine administration of the exit survey. Data for the current year are reasonably complete except for some responses on sources of information for future graduate programs.

Specific actions taken in Academic Year 2009-2010 include: 1) further implementation of Structured Learning Assistance (SLA), 2) some pruning of some courses no longer regularly offered or in line with current faculty interests as a way of making catalog listings more in line with regular offerings, 3) additional offerings of core and intro Bio out of the normal schedule in response to increasing numbers and student wishes, and 4) a proposal to expand the list of suitable electives on the one hand but limit the general number of non-biology courses allowed. With GenEd08 affecting more and more students, our Writing Course is providing a more systematic training in reading and summarizing the original scientific literature.