

5-16-11

UNIVERSITY OF DAYTON DEPARTMENT OF BIOLOGY
ASSESSMENT PLAN AND REPORT

The Department of Biology Assessment Plan establishes learning outcomes and multiple measures for assessing these outcomes for our curricula. These outcomes are intended to clearly reflect the “overarching learning outcomes” contained in the *Habits of Inquiry and Reflection*.

Our assessment is centered on these HIR/CAP outcomes: Scholarship, Critical Evaluation of our Times, Practical Wisdom, and Vocation.

Scholarship: All undergraduates will develop and demonstrate advanced habits of academic inquiry and creativity through the production of a body of artistic, scholarly or community-based work intended for public presentation and defense.

Critical Evaluation of our Times: Through multidisciplinary study, all undergraduates will develop and demonstrate habits of inquiry and reflection, informed by familiarity with Catholic Social Teaching, that equip them to evaluate critically and imaginatively the ethical, historical, social, political technological, economic, and ecological challenges of our times.

Practical Wisdom: All undergraduates will develop and demonstrate practical wisdom in addressing real human problems and deep human needs, drawing upon advanced knowledge, values, and skills in their chosen profession or major course of study. Starting with a conception of human flourishing, students will be able to define and diagnose symptoms, relationships and problems clearly and intelligently, construct and evaluate possible solutions, thoughtfully select and implement solutions and critically reflect on the process in light of actual consequences.

Vocation: Using appropriate scholarly and communal resources, all undergraduates will develop and demonstrate ability to articulate reflectively the purposes of their life and proposed work through the language of vocation. In collaboration with the university community, students’ developing vocational plans will exhibit appreciation of the fullness of human life, including its intellectual, ethical, spiritual, aesthetic, social, emotional, and bodily dimensions, and will examine both the interdependence of self and community and the responsibility to live in service of others.

Goals:

1. Students will achieve an understanding of the following core concepts of biology:
 - Genetics
 - Energy Flow

- Evolution
 - Systems organization/Complexity/Diversity inter-relationships of human activity and impact
 - Stress response (at organismal and system levels)
 - Critical/Analysis of Biological Data
2. The student will achieve the following skills/outcomes/abilities:
- Scientific writing/communication skills (oral, presentation)
 - Data analysis/Hypothesis testing (ability to analyze data, synthesize arguments, pose questions, generate hypotheses).
 - Keep pace with Emerging Technologies (laboratory courses are essential)
 - Integration of biological principles and demonstration/understanding of interconnectedness – Systems and diversity

Student Learning Outcome 1: Content Knowledge.

Students will demonstrate knowledge of the core concepts of biology identified in Goal 1.

Measure 1. A Pre-test containing questions representing core concepts will be given to all students at the beginning of BIO 151. A post-test will be administered to all students at the end of BIO 151. A Pre- and Post-test will be developed for BIO 152.

Measure 2. The use of the ETS Major Fields Test (MFT) in Biology as an assessment tool for content knowledge in targeted core areas identified above in Goal 1 will be piloted in the 2011-12 academic year. Students will be selected at random from BIO 420 to participate in this pilot. The pilot will be limited to seniors. The results of this test will be used to evaluate content knowledge in the core areas of biology identified in Goal 1.

The cost per student for this test is estimated to be between \$25.00-27.00 per student (online vs. paper respectively) plus approximately \$200.00 for reports that ETS prepares. We are requesting that the College support the cost of this pilot as listed in the RESOURCE REQUEST at the end of this document.

Measure 3. Data will be collected, as available, on students' performance on the biological sciences component of the MCAT and the GRE exams.

This Learning Outcome will provide support for the HIR/CAP outcomes of *Scholarship*, *Practical Wisdom*, and *Critical Evaluation of our times*.

Student Learning Outcome 2: Communication (oral, visual and written).

Students who graduate from the Department of Biology will be able to effectively communicate biological concepts through writing, oral presentation and visual representations.

Measure 1. Capacity for oral and visual communication: Each student enrolled in BIO 299 (sophomore-level) and BIO 420 (senior) Seminar Courses discusses and critiques a primary scientific journal article of their choice in a 15 minute PowerPoint presentation. Students are critically assessed by a faculty member and peers for content, organization, style, delivery.

Measure 2. Capacity for written communication: Students will demonstrate their ability to write in a scientific manner by composing an abstract for a scientific paper as a part of ASI 150, BIO 299 and BIO 420. The assessment methodology is described below. The objective of this measure of student learning outcome #2 is to provide a longitudinal examination of student development and maturation in scientific inquiry and critical thinking and their ability to communicate this understanding via their writing. Students enrolled in ASI 150, BIO 299, and BIO 420 will be given a research paper at the end of the term, selected by the Biology Department Assessment committee, in which the abstract has been deleted. The students will be asked to read the paper and generate a written abstract for the paper as a requirement for each course. Ungraded abstracts will be forwarded by the course instructor to the Assessment Committee, which will once yearly, assess a random sampling of an equal number of abstracts generated in each course based on an agreed upon rubric. The origin and author of each abstract will be unknown to the Assessment Committee member at the time of assessment. Post-review, the abstract assessments will be collated by course. The assessment outcomes for each of the courses will be collated and compared. A longitudinal examination of student performance in these tiered and sequential courses will be used to assess student development.

Measure 3. Capacity to communicate their own scholarly work: More than 50% of the graduating majors will have given a public presentation which may include one or more of the following: a poster at the Stander Symposium, an oral presentation at the Honors Symposium, presentation at a regional, national or international scientific meeting. Data on the number and type of student presentations will be provided by yearly faculty reports on scholarship made available through Digital Measures. These student presentations necessarily involve written, oral and or visual communication skills. Acceptance of a peer reviewed abstract for presentation at a regional, national or international scientific meeting is evidence of an advanced capacity for communication in the sciences.

This Learning Outcome will provide support for the HIR/CAP outcomes of *Scholarship, Critical Evaluation of our Times, Practical Wisdom, and Vocation.*

Student Learning Outcome 3: Scientific investigation and critical thinking.

Students who graduate from the Department of Biology will be able to effectively apply the Scientific Method in their research experience.

Measure 1. Every student will have a research experience. All students will be required to take BIO 299 and BIO 420. In each of these courses students will be evaluated as to their comprehension of the primary scientific research literature. Students in these courses will be assessed for their ability to critically assess a primary scientific journal article. The methodology used for assessment of this is outlined above in Student Learning Outcome 2, measure 2.

Measure 2. Approximately 1/3 of the graduating majors will have had field and/or laboratory research experience (BIO 421, BIO477 &478, EVB Internship).

This Learning Outcome will provide support for the HIR/CAP outcomes of *Scholarship, Critical Evaluation of our Times, Practical Wisdom, and Vocation.*

RESOURCE REQUEST: To support the Student Learning Outcomes articulated here we have defined the following resources and needs.

- 1) Faculty Development: We operate on the Scholar-Teacher model therefore faculty development is critical to meeting the goals of student learning. In order to deliver pedagogically sound and up to date information faculty must remain active in their own scholarship. The department provides up to \$1,000 per faculty member to toward travel to professional meetings and workshops. Teaching loads are commensurate with the research expectations to ensure faculty have the time to engage in their research programs and to learn and develop new techniques that can be incorporated in their teaching.
- 2) Curriculum Monitoring: Continual monitoring of our curriculum by the department's undergraduate curriculum committee and program coordinator. We will monitor the course offerings and course syllabi, as well as hold periodic retreats to review the effectiveness of the curriculum.
- 3) Resource support for Research Experiences: Addition of lab fees for BIO 421, BIO 477 and 478. These are needed to support the research activities of these courses. Currently faculty without grants who mentor students in these substantial and lengthy research projects struggle to support students and the department does not have the resources to fund all the students who wish to do a thesis (BIO 477,478) or an independent research project (BIO 421).
- 4) Resource support for the Major Fields Test: The Major Fields Test is provided as a fee for service. The Biology department requests the funds to pilot the Major

Fields Test for two years, after which we will determine whether to implement the test as part of assessment of Student Learning Outcome 1, measure 2.

2010 ASSESSMENT REPORT

Data were collected for the following Student Learning Outcomes and measures. For the remaining SLOs we plan to institute and collect data in the coming years.

68 BIO and 6 EVB majors graduated in Sp 2011. We administered an online survey and 30 graduating seniors completed the survey.

Student Learning Outcome 1: Content knowledge.

Measure 1: A Pre- and Post test were administered in BIO 151 in FA 2010. The Pre-test was given on the first day of BIO 151 in all eight sections of the course before instruction began. Students were instructed to complete the Pre-test and informed it was anonymous. The conditions of the Pre-test were identical in all sections of the course. The Post-test was administered by individual faculty at different times but in all cases the questions were embedded in the final exam. The students were not informed that the questions are included in the exam.

(see results at the end of this report, pgs 5-7)

Measure 3: According to our senior survey a total of 12 students took the MCAT. Of these students 11 scored greater than 9 which is above the 50th percentile.

Student Learning Outcome 2: Communication (oral, visual and written)

Measure 3: A total of 51 Stander poster presentations (up from 39 the previous year) were from students who were conducting research in a biology faculty member's research program; the students majors were BIO, EVB as well as some MED and BCM majors. This year we added faculty review of presentations and awards were given for the best presentations in order to address issues raised in last year's report.

Student Learning Outcome 3: Scientific investigation and critical thinking.

Measure 1: According to our senior survey a total of 61% of our majors participated in a faculty member's research program. In addition, there were 12 honors theses (up from 8 in the previous year), 6 BIO 421 research projects and 6 EVB internships.

PILOT ASSESSMENT FOR:

Student Learning Outcome 2(measure 1): Communication (oral, visual and written).

Students who graduate from the Department of Biology will be able to effectively communicate biological concepts through writing, oral presentation and visual representations.

Measure 2. Capacity for written communication: Students will demonstrate their ability to write in a scientific manner by composing an abstract for a scientific paper as a part of ASI 150, BIO 299 and BIO 420. The assessment methodology is described below. The objective of this measure of student learning outcome #2 is to provide a longitudinal examination of student development and maturation in scientific inquiry and critical thinking and their ability to communicate this understanding via their writing. Students enrolled in ASI 150, BIO 299, and BIO 420 will be given a research paper at the end of the term, selected by the Biology Department Assessment committee, in which the abstract has been deleted. The students will be asked to read the paper and generate a written abstract for the paper as a requirement for each course. Ungraded abstracts will be forwarded by the course instructor to the Assessment Committee, which will once yearly, assess a random sampling of an equal number of abstracts generated in each course based on an agreed upon rubric. The origin and author of each abstract will be unknown to the Assessment Committee member at the time of assessment. Post-review, the abstract assessments will be collated by course. The assessment outcomes for each of the courses will be collated and compared. A longitudinal examination of student performance in these tiered and sequential courses will be used to assess student development.

Summary of the Spring 2011 Pilot:

A pilot assessment was conducted in the Spring 2011. The pilot involved three sections of BIO 299 Sophomore Seminar. A total of 34 students participated. The purpose of the pilot was to evaluate the design and utility of the assessment tool, and to determine whether modifications of the instructions, tool design, or methods of evaluation were needed. BIO 299 students were given a copy of a peer-reviewed published paper in which all citation information and the abstract were removed, and were directed to do the following:

Carefully read the scientific research article that has been given the title "Symbiosis and Coral Bleaching" for the purposes of this assignment. Write a 200-250 word abstract for this article that is based on the information provided in the paper.

Your written abstracts will be evaluated using the following guidelines:

- Announces the objective of the investigation or statement of the problem
- Summarizes materials and methods without including specific details
- Summarizes results
- Summarizes conclusions
- Writing quality

Results:

The abstract was a requirement of the course; submission constituted 5% of the overall grade. The abstracts were not graded by the course instructors. The abstracts were submitted to the Undergraduate Curriculum Committee (comprised of 4 faculty) for evaluation for the purpose of curricular assessment. 34 students submitted abstracts. Three students prepared abstracts for papers other than the one assigned—these were not included in the evaluation. There was strong evidence that an additional three students modeled their abstracts on the original article, which presumably they found using a database search. These abstracts were not used in the evaluation.

The committee evaluated the remaining 28 abstracts for the following:
“Please score (out of 2 points) each category listed. For writing quality: Use the terms Content, Clarity, or Completeness (and combinations thereof) to indicate problems in these areas. If there are no problems with written quality, leave blank.”

- Followed instructions (0-2 pts)
- Announces the objective of the investigation or statement of the problem (0-2 pts)
- Summarizes materials and methods without including specific details (0-2 pts)
- Summarizes results (0-2 pts)
- Summarizes conclusions (0-2 pts)
- Writing quality

Results of Committee Evaluation:

Table 1: Average scores for each assessment category. (n=28)

Follows Instructions	Objective Stated	Summarizes M&M	Summarizes Results	Summarizes Conclusions	Overall Score
1.6/2.0	1.4/2.0	1.5/2.0	1.6/2.0	1.25/2.0	7.25/10

Writing Quality:

- 25% (7/28) had problems with Clarity
- 35% (10/28) had problems with content
- 43% (12/28) had problems with completeness

Recommendation: This tool is designed to provide a longitudinal assessment of the student learning outcome identified above. As such, the assessment tool, using the same journal article, will be used in ASI 150 for Biology Majors in the Fall, 2011.

ASSESSMENT AY 2011-2012

In the 2011/12 AY we will:

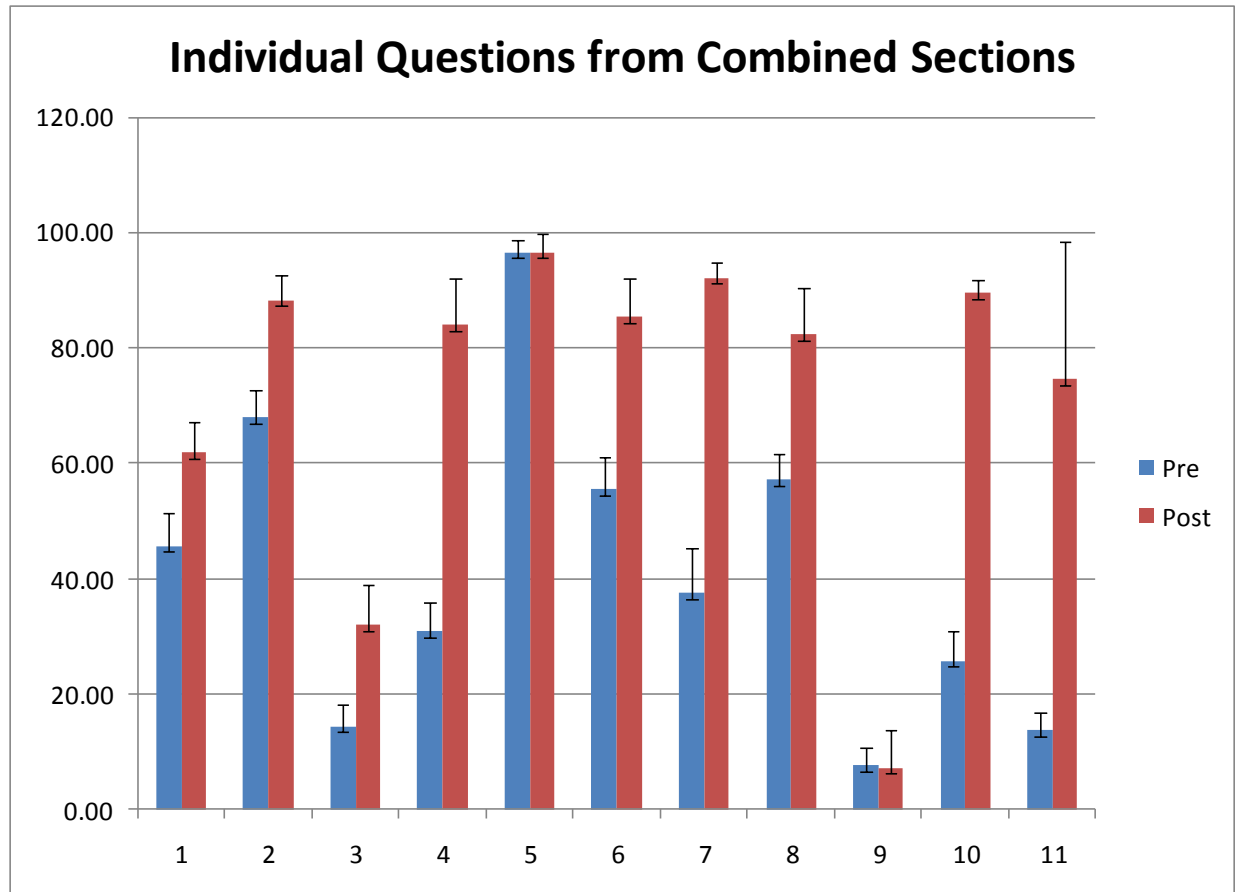
1. Continue with Pre- and Post-tests in BIO 151 using the methodology employed this year and incorporate more in-class active learning components.
2. Follow the recommendations from the Pilot SLO 2 (measure 1), and
3. Pilot the use of the ETS Major Fields Test in SLO 1, Measure 3. This will require funds from the CAS.

Pre- and Post-Test of BIO 151

Objectives:

- What level of understanding did students begin course with?
- What level of understanding did students leave course with?
- What was the impact of the course?
- Connect this assessment to program-level assessment.
- Help identify areas that need improvement.
- Provide benchmark data for long-term studies.
- Compare results from 2009 and 2010... Were there changes to either the incoming student population or with the impact of the course on student knowledge levels?
- What does the addition of two new questions to the 2010 survey add to our understanding of student background knowledge and the pedagogical approaches used in the classroom?
Did embedding the post-course questions in the final exam make a difference

Methodology: see above (p 5). A total of 11 questions covering a range of key concepts and information in the course were administered to students on the first day of the course to assess background knowledge. The same questions were embedded in the final exam without the student's knowledge. The graph below shows the aggregate data from all sections; % correct pre- and post-test.



What we learned:

- Students appeared to take the test seriously (high score on Q5, a question about the scientific method) but were stumped by the deeper questions.
 - This suggests the results are reliable across all questions and can help guide our work
- Surprised at how much they knew at start (especially: amino acid, scientific method).
 - We may need to spend less time on subjects students are already comfortable with.
- Pleased to see 151/151L did improve student knowledge.
- Improvement was not even across all topics:
 - Low performance: Cytoskeleton, cytochrome.
 - Low increase: Chemistry, cytoskeleton, cytochrome.
 - Most dramatic improvements came from learning the Hershey and Chase experiment (possibly a subject not covered in detail in high school).
- Students in 2010 demonstrated 3% lower background knowledge skills going into the class compared to 2009 students.
- Students in 2010 demonstrated an “equivalent” level of knowledge to the 2009 students at the end of the class, but there is an approximate 10% increase in the

- scores of the 2010 students – which is most likely caused by the positive effect of embedding the post-course questions into the final exam.
- The increase in scores in the Hershey and Chase experiment (question 11) were greatest in sections that used a designed in-class activity.
 - Results indicate we need to expand the use of in-class activities to deepen learning
 - Future surveys should use the format deployed in 2010... ungraded pre-course survey questions at the start of the course, and graded post-course questions embedded in the final exam.