

Department of Biology

***Proposal: PRAC  
Assessment Grant***

Assessment of Domain Knowledge Based Student  
Learning Outcomes (SLOs) in Biology for Curriculum  
Enhancement

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10/21/2011

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Project Title: "Assessment of Domain Knowledge Based Student Learning Outcomes (SLOs) in Biology for Curriculum Enhancement"

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Project Dates: Project to begin Spring 2012 and continuing through Fall 2012, Results will be delivered by December 2012.

#### Project Checklist

Statement of support from the department chair or school dean by e-mail to [tbanta@iupui.edu](mailto:tbanta@iupui.edu) - as a separate file not included in the proposal.

Simple budget: A detailed budget is not necessary. Nevertheless, please include a brief paragraph/details indicating how you intend to spend the grant money.

\*  IRB (Institutional Review Board) approval.

**\*Please note: IRB approval documents were submitted on 10/21/11 by Brittiney Reese.**

## **Abstract**

The department of Biology has defined a set of student learning outcomes (SLOs) that should be mastered by the completion of either the B.S. or B.A. degree. Evaluation of these metrics is crucial in determining the overall quality of the student learning experience. To assess the domain knowledge based SLOs, the ETS Major Field Test (MFT) will be utilized to gauge subject specific knowledge at the national level and in comparison to IUPUI's peer schools. Administration of the MFT will occur during senior capstone. Knowledge deficiencies and strengths will be identified and reviewed by the Biology curriculum committee. The information attained from this study will allow for curricular enhancement of both the Biology B.S. and B.A. degree.

## **Project Description**

### **Purpose of Project**

The purpose of this project is to use the Major Field Test (MFT) by ETS to evaluate the students' achievement of the SLOs at the conclusion of their senior year. Data gathered for the cohort will be analyzed for areas of strengths and weaknesses, as well as general patterns of performance. Once these areas are identified, work on curricular enhancement can progress to better prepare our students for post graduation endeavors.

Student learning outcomes (SLOs) have been set as a foundation for producing high-quality, well rounded students, as they describe the knowledge, skills, abilities, or attitudes that a student can demonstrate upon completion of his or her program of study (Suskie, 2004; Palomba and Banta, 1999). Student Learning Outcomes statements specify

actions that are observable, measurable, and capable of being demonstrated by the student, and typically begin with action verbs. In the department of Biology, eight SLOs are stated that reflect the ideal learning experience acquired by a B.S. or B.A. student. These statements represent the knowledge and skills students should have acquired during the completion of their degree. SLOs can also serve as an evaluation metric for curricular competencies and deficiencies. The Biology Major Field Test is an ideal tool to measure all of the domain knowledge based SLOs defined by the Biology Department.

***SLO #1***

***Demonstrate knowledge of how biological molecules such as DNA, RNA, proteins, lipids, and carbohydrates contribute to the structure and function of prokaryotic and eukaryotic cells.***

Around 41% of the MFT falls into either the subcategory Cell Biology or Molecular Biology & Genetics. Tested areas include biochemistry and cell energetics; cellular structure, organization, and function; molecular genetics; and heredity. Questions in these categories allow for assessment of students' understanding of biological molecules that compose organisms. They also will have the opportunity to demonstrate their knowledge of how structure and function of biomolecules affect both prokaryotic and eukaryotic cells.

***SLO #2***

***Integrate the cellular, molecular and physiological basis of how organisms develop structure, carry out functions, sense and control their environment, and respond to external change.***

Organismal biology represents 33% of the material covered on the MFT. Diversity of organisms; comparative structure and function of organ systems; and reproduction, growth, and development are represented in this section.

***SLO 3) Describe how genetic principles associated with natural selection contribute to the functioning of an organism and the evolutionary diversity of life on earth.***

Population biology, evolution, and ecology account for 26% of the knowledge base being tested on the MFT. This section tests students on principles such as population genetics and natural selection, patterns of evolution, environmental impacts, and population ecology.

***SLO #4***

***Exhibit problem solving and critical thinking skills needed to design and implement laboratory projects, and gather, analyze and draw conclusions from data.***

***AND***

***SLO #5***

***Apply basic principles of chemistry, math, and other disciplines to the functioning of living systems.***

SLO's 4 and 5 are encompassed by questions posed in the analytical skills subcategory.

Throughout the test, questions are posed to challenge students' analytical skills. ETS further defines this subcategory into three units, "Science as a Way of Knowing; Experimental Design; and Interpretation, Data Analysis, Inductive Reasoning, and Drawing Conclusions from Data." This section challenges students' critical thinking skills essential to the field of science. Students demonstrate their knowledge of hypothesis testing, experimental parameters, and their ability to analyze results through probability, statistics, and interpretation.

**Intended Outcomes of the Project**

The expected outcome of this project is a better understanding of the quality of the biology core curriculum and overall student learning experience. Data gathered from the MTF will be used to assess the departmental expectations and SLOs. When areas of strengths and weaknesses are identified, curricular enhancement can be considered to better prepare biology students for post graduation success.

**Assessment Methods**

Quantitative data of student performance will be collected at the completion of the senior year. Seniors are required to take Senior Capstone (K490), or Research and Senior Thesis (K493 and K494). Administration of the test will occur in K490 and K493. The Biology MFT consists of 150 multiple choice questions, with an additional 50 locally authored questions. The locally authored questions are written by the administering institution to gather further data on their students. In total, the test takes approximately two hours and can be completed in an on-line format. Students will be expected to take the MFT before their completion of K490 or K493. The scores of the test will in no way effect the students' course grade.

### **Data Analysis Approach**

Data for the Major Field Test in Biology is tabulated and analyzed as an institutional mean for the cohort of students taking the exam by ETS. The data is evaluated at both a national level and within a group of peer schools (Custom Comparative Report). A departmental summary illustrates the percentile distribution of total scores and subscores. Subscores include Cell Biology; Molecular Biology and Genetics; Organismal Biology; and Population Biology, Evolution, and Ecology. Subscores are comparative to national data.

The subcategories are further broken down into assessment indicators. These cluster areas are composed of approximately 15 questions and represent areas of Biochemistry and Cell Energetics; Cellular Structure, Organization, and Function; Molecular Biology and Molecular Genetics; Diversity of Organisms; Organismal (Animals); Organismal (Plants); Population Genetics and Evolution; Ecology; and

Analytical Skills. The assessment indicators are reported as mean percentage answered correctly for the cohort.

### **Evaluation and Dissemination**

Faculty and the curriculum committee of the Biology Department will review the findings of the test. Areas of deficiencies and strengths will be identified, and value to these areas in our program will be assessed. Achievement of Student Learning Outcomes (SLOs) will be determined based on the criteria in each MTF section and the associated SLO. Curricular enhancement will be based on these assessments.

The results of this test will be published internally for departmental use. A final report will be written at the end of the project for PRAC review.

### **Use of Findings**

The current biology core consists of Concepts of Biology I and II, Genetics and Molecular Biology, and Principles of Ecology and Evolution. No defined sequence is required for the core, except Concepts of Biology I and II being prerequisites. The MTF subscores and assessment indicators will allow for identification of concepts that are missing in the core. These findings, along with comparison to the core curriculum of peer institutes, will lead to the refinement of the Biology B.S. and B.A. degrees. With fine grain assessment and qualitative improvement, IUPUI will lead the way with a top-notch Biology program.

### **Budget**

In the spring semester of 2011, there were 46 students enrolled in K490 and 17 in K494. For this spring semester of 2012, it is estimated that 75 students will be enrolled in K490 and K494.

On-Line Test: \$25.00 each	x 75 students = \$1875.00
Custom Comparative Reporting:	<u>x 1 session = \$ 300.00</u>
Total:	= \$ 2175.00

### **References**

Palomba, C.A., & Banta, T.W. (1999). Assessment essentials: Planning, implementing, and improving assessment in higher education. San Francisco: Jossey-Bass.

Suskie, L. (2004). Assessing student learning: A common sense guide. Bolton, MA: Anker Publishing Company.