Assessment of Student Learning
School of Science
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

General Context

The 2004 report is the seventh in a series of annual reports forming a layered narrative of the assessment of student learning in the School of Science. The 1998 seminal report detailed general education and discipline specific learning outcomes. The 1999 report presented an assessment plan of action. The 2000 report tracked the status of assessment activities and added a history of student learning projects occurring between the 1992 North Central Association visit and the 1998 report. The 2001 report listed the progress on assessment and a new initiative to link School and department level assessments. The 2002 report provided an update of assessment activities in anticipation of the North Central Association accreditation visit. The 2003 report continued to explicate the status of assessment activities related to previous and new initiatives. The current report is another layer in the evolving story of the commitment to assessment and student learning in the School of Science.

School Level Assessment Activities

Prepared by Joseph E. Kuczkowski, Ph.D.
Associate Dean for Academic Programs and Student Development
(Edited by Joseph L. Thompson)
June 21, 2004

General Education Curriculum

Upon revising the guidelines for junior/senior integrator courses as mentioned in last year's report, the Core Curriculum Committee of the School of Science and the School of Liberal Arts approved a generous list of courses that students may now take to fulfill the junior/senior integrator requirement.

Senior Reflection Survey

As part of the School-level assessment program, graduating seniors are requested to write a reflection paper on their experiences with the IUPUI Principles of Undergraduate Learning during their academic journeys at IUPUI. Members of the Teaching and Learning Committee applied the assessment rubric to 94 reflection papers this year. Overall, approximately two-thirds of the seniors gave strong positive or positive responses to their experiences with the

Principles as a whole. There were some papers in which students did not adequately address certain items in terms of providing salient examples of their experiences with the Principles. How to elicit better responses will be on the agenda of the School of Science Teaching and Learning Committee this fall.

Capstone Assessment Template

This year's data from the departmental rubrics applied to capstone courses has been incorporated into the School template to achieve a School-level overview of the capstone experience. Items on the School template relate to the IUPUI Principles of Undergraduate Learning. The assessment revealed that two of the greatest strengths of the graduating students were in the areas of overall comprehension of their disciplines and efficient use of technological tools. Better abilities in writing and problem solving were identified as areas for improvement for a smaller segment of the students. This issue will be discussed at a meeting of the Teaching and Learning Committee.

Note: The above assessment projects provide both soft and hard assessments of the IUPUI Principles of Undergraduate Learning at both departmental and School levels. Especially for departments, these projects address overall undergraduate program assessment.

Graduating Student Questionnaire

The Graduating Student Survey incorporates both a self-assessment of academic skills and a satisfaction appraisal of academic/student services. The items on the instrument reflect similar items on institutional surveys of IUPUI continuing students and alumni. On a 5-point scale, with 5 listed as excellent, students rated their abilities on all of the items listed as above 4.0. Quality of education and quality of teaching rated highest of all the academic service indicators.

Academic Advising Survey

The Academic Advising Survey provides an opportunity for graduating seniors to identify advisors who have had a positive influence on their academic journeys and to rate quality interactions with their advisors. The latter is a means for assessing what students value in the advising process. Data was compiled from the August 2003, December 2003, and May 2004 surveys. The students rated the following three qualities as most valued in their interactions with advisors: (1) Provides accurate information; (2) Is knowledgeable about degree requirements for my major; (3) Treats me with respect. The overall results of the survey will be shared with the advising corps.

School of Science Teaching and Learning Committee

The School of Science Teaching and Learning Committee, whose focus has been on the assessment of student learning, has been an ad hoc committee in the School for several years. It has been determined that the Committee should be recognized as a standing committee of the School of Science. Faculty approval of the status of this Committee will be placed on the agenda of the School of Science Steering Committee of the Faculty Assembly in fall 2004.

Assessment of Student Learning
Department of Biology
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Kathleen Marrs, Ph.D.
(Edited by Joseph L. Thompson)
June 17, 2004

Introduction

The teaching mission remains as stated in the previous reports from 2000-2002. The Department currently has 25 full-time faculty, including four who hold the title of Lecturer. Departmental teaching responsibilities for all faculty include a large service component, and a substantial undergraduate program with two degree options (Bachelor of Arts and Bachelor of Science), and graduate instruction for the 80 – 85 students enrolled in Masters of Science (M.S.) and doctorate (Ph.D.) programs each year.

Enrolment patterns indicate that two-thirds of the course credit hours (lectures, labs, and recitations) are in courses for non-Biology majors. These service courses satisfy specific or area requirements for students in pre-nursing, allied health, physical education, liberal arts, science, dental hygiene, and a few other programs. Several of the courses for undergraduate majors are also used by students in other programs or students who have aspirations that do not include a degree in Biology. Thus, some of those enrollments belong in the service category and a reasonable estimate is that 75% of our enrollments are in service courses.

The Department offers both a Bachelor of Arts (B.A.) and a Bachelor of Science (B.S.) degree in Biology. The former is utilized predominantly by students with an interest in professional school and offers sufficient science training for most purposes while allowing students a wider breadth of educational experiences across other disciplines. The B.S. degree is elected by students who see themselves as working biologists and by students who wish to pursue graduate training in Biology.

The M.S. degree in Biology offers several options. The M.S. with thesis is a two-year degree for full-time students that involves original research and culminates with a written thesis that must be defended. Students earning this degree typically gain employment in industry as research scientists or go on to Ph.D. study. The program has an excellent record for industrial placement most of which occurs with Indiana companies. A unique one-year non-thesis M.S. is offered for students who are just below the standard for professional schools and are seeking to upgrade their academic credentials and knowledge base for another application round. This program has also been highly successful in its placement of students in professional schools such as medicine, dentistry, optometry, and, more recently law. Finally, the department offers a non-thesis degree over a varying time frame mostly for students who are already employed and can study only on a part-time basis. The Ph.D. degree is typical in that it is research intensive and leads to a substantial thesis.

In the process of addressing the teaching needs of such diverse programs, Biology offers instruction in the traditional lecture and laboratory, recitations with some unique components, and most importantly, in the form of individualized instruction. At the undergraduate level, the senior capstone experience for B.A. students is available through individual faculty on a one-on-one basis. Bachelor of Science students satisfy the capstone experience by enrolling in undergraduate research and senior thesis. This allows the student to do a limited research project with a faculty member and write the results as a formal thesis. Many students have given presentations of their work at local and national conferences and symposia and some have been listed as co-authors on peer-reviewed publications. Graduate students in thesis programs also receive considerable one-on-one instruction from faculty.

Learning Outcomes in the Department of Biology

1) Outcomes Related to General Education Principles (for more detail, see report dated 07/19/2000

Principle 1: *Graduates will have knowledge of, and proficiency in, core communication and quantitative skills (writing, speaking, and quantitative reasoning).*
Principle 2: *Graduates will be proficient in analytical, critical, and creative thinking.*
Principle 3: *Integration of Knowledge.*
Principle 4: *Achievement of intellectual depth, breadth, and adaptiveness.*
Principle 5: *Understanding Society and Culture.*
Principle 6: *Values and Ethics.*

2) Discipline-Specific Outcomes (for more detail, see report dated 07-19-2000,

I. Basic Knowledge

A. ***Molecular Biology:*** All topics relating to DNA, proteins, techniques relating to biotechnology and genetic engineering, etc.

B. ***Cell and Developmental Biology:*** All topics relating to cell structure and function, cell biology and biochemistry, development of cell types during growth of the embryo, use of cells and cell types to manufacture drugs, etc.

C. ***Physiology:*** All topics relating to the biochemical and physiological workings of a cell, tissue, organ, or organ system within a living plant, animal, or other organism.

D. ***Ecology:*** All topics relating to the effect of the environment and the ecosystem on the living organism.

E. ***Evolution****:* All topics relating to the descent with modification of organisms from common ancestors through the mechanism of natural selection.

II. Applied Skills:

A. **Application of the Scientific Method**: All topics that require a student to apply scientific process skills (questioning, development of a testable hypothesis, experimentation) to a particular problem and devise a way to test or solve that problem. Students must analyze background literature, interpret data, possibly modify a hypothesis or idea, and present their findings in a written or oral report.

B. **Laboratory Skills**: All techniques and protocols pertinent to lab safety, use of laboratory equipment, collection and analysis of data, interpretation of findings, development of a laboratory report or notebook, and proper protocol for disposal of hazardous materials if appropriate.

Assessment Activity within the Department of Biology

For course descriptions, please see the IUPUI Online Catalog at
http://www.indiana.edu/~enrolctr/iniupui/biol/
or at the Department of Biology website at
http://www.biology.iupui.edu/courses.html.

Courses for Biology Majors:

BIOL K101 Concepts of Biology I (Dr. Keck)

Student Learning is currently assessed by the following measures:

4 Lecture exams – multiple choice;

2 Laboratory exams – short answer;

3 Microessays;

Weekly concept maps;

Biomath problem solving.

For detailed description, see report dated 07-19-2000

BIOL K103 Concepts of Biology II (Dr. Yost)

Student Learning is currently assessed by the following measures:

4 lecture exams;

3 lab exams;

2 papers;

1 oral presentation;

Group projects (recitation);

6 Quizzes;

Mini-exam: an introduction to a typical laboratory practical exam.

For detailed description, see report dated 07-19-2000

BIOL K322 / K323 Genetics and Molecular Biology Lecture / Lab (Dr. Bard / Dr. Marrs)

Student Learning is currently assessed by the following measures:

3 Lecture exams – ~40% short answer, 60% problem solving;
Assigned genetics problems;
3 Laboratory exams – ~40% short answer, 60% problem solving;
1 Lab report – written in scientific publication format;
1 Genetics Case Study – open-ended investigation of a human genetic disease gene. Both a research and writing component are emphasized in this project.

Additional explanation by Dr. Bard:

In lecture there are three exams, approximately 40% of which is of the short answer variety (multiple choice, true-false, matching, etc) and 60% is problem solving. Generally, there are at least one and usually two review sessions before each exam. In order for students to learn how to solve problems in genetics, there are three kinds of problems assigned for each topic and these problems appear in the text. There are chapter integration problems (one to two) and solved problems (one to two) that appear at the end of each text chapter. These problems are followed by a more extensive number of problems at the end of each chapter. A solutions' manual is required for the course and the solutions' manual solves each assigned problem in great detail. The review sessions are designed to clarify lecture material and questions regarding problems that are still unclear. Review sessions are held the Thursday or Friday before the exam. During the review session, it is often obvious that students have not done their assignments. This formative assessment allows for both students and faculty to become aware of student difficulties BEFORE the exam.

In lab there are three exams and again the bulk of each exam emphasizes problems and problem-solving skills. Students are asked to write two lab reports, one on an experiment in which the entire class participates. This experiment spans two-thirds of the semester; the second lab report requires students to access a genomic database to identify a gene from a partial nucleotide sequence.

The instructors grade all lecture and lab exams. This allows us to interpret exactly what students are able to do and what concepts are difficult.

The new textbook contains a CD disk with videos that will make learning particular concepts easier. We intend to increase the use of handouts and transparencies to improve understanding and retention.

For detailed description, see report dated 07-19-2000

BIOL K356 / K357 Microbiology Lecture / Laboratory

Student Learning is currently assessed by the following measures:

4 Lecture exams – mixed format with some **objective** questions (multiple choice, fill-ins, matching, identification) and some **written** questions that may include compare & contrast, essay, data interpretation and analysis, and problem solving. These instruments evolve more to the written / essay questions as the semester progresses.

Assigned "Problem Sets" (oxidation/reduction balancing, growth rates, genetic mapping) designed to assess mastery of the subject matter and the skills associated with its application.

3 Laboratory exams – mixed format with some **objective** questions (multiple choice, fill-ins, matching, identification) and some **written** questions that may include compare & contrast, essay, data interpretation and analysis, and problem solving. Final exam is cumulative.

3 Performance Assessment assignments – require students to demonstrate mastery of a specific technique. These assessments require students to demonstrate the isolation of individual bacterial colonies from a mixed culture, successful differentiation of bacteria using the Gram Stain technique, and successful identification of Mycobacterium by the Acid Fast Stain.

2 "Bacterial Unknown" identification laboratories – students are given two cultures of bacteria and, using knowledge they have gathered over the semester as well as numerous bacteriological media, design an identification protocol that allows them to "key out" a bacterial genus and species.

BIOL K388 Immunology (Dr. Ruth Allen)

Student Learning is currently assessed by the following measures:

Exams (summative) – varied questions ranging from multiple choice to half-page essay answers requiring students to develop a coherent summary of a complex question.

BIOL K490 Senior Capstone Experience (All Faculty)
BIOL K493 Senior Independent Research (All Faculty)
BIOL K494 Senior Research Thesis (All Faculty)

Student Learning is currently assessed by the following measures:

- Written thesis of substantial length and result of extensive research;
- Survey instrument to assess the degree of success in achieving outcomes related to the Principles Of Undergraduate Learning and biology-specific outcomes;

- This survey instrument has been expensively described in the assessment reports dated July 2000 and June 2001 and was used by the Teaching and Learning Committee as a template for developing a School of Science-wide assessment instrument for senior capstone courses.

Courses for Non-Science Majors:

BIOL N100 Contemporary Biology (Dr. Marrs)

Student Learning is currently assessed by the following measures:

14 Warm-Up exercises (formative assessment);

14 What is Biology Good For? Assignments (scientific reading, research and writing);

14 Cooperative Learning assignments (in-class group work, formative assessment);

4 Exams – multiple choice, scan-tron.

Assessment of N100 using Just-in-Time-Teaching has been extensively described in the Assessment Report dated June 2001

BIOL N217 Human Physiology (Dr. Pflanzer)

Student Learning is currently assessed by the following measures:

4 Lecture exams (objective / scan-tron);

2 Laboratory exams;

5 Laboratory quizzes (unannounced; lowest quiz dropped, formative assessment);

30 Lab reports.

For detailed description, see report dated 07-19-2000

Graduate Level Courses:

BIOL 507 Principles of Molecular Biology (Dr. Dring Crowell)

Student Learning is currently assessed by the following measures:

Written examinations, in an essay format, that emphasize problem solving, data interpretation, and experimental design.

BIOL 516 Molecular Biology of Cancer (Dr. Pamela Crowell)

Student Learning is currently assessed by the following measures:

3 exams: short answer, short essay, critical thinking;

1 paper summarizing 3 cancer research journal articles.

BIOL 540 Topics in Biotechnology (Dr. Marrs)

Student Learning is currently assessed by the following measures:

3 Exams (objective plus short answer / problem solving questions);

14 Warm Up assignments (formative assessment);

1 Group Project (collaborative research, written report and oral presentation).

What is Biotechnology Good For? Assignment: Each student is given guidelines on developing a web page featuring a useful application of biotechnology to modern life. Graduate students must research and write an essay on a topic of their choice, develop a web page with visuals and links to background material, and include end-of-essay questions to be answered by non-science majors taking N100.

Biotechnology Stock Portfolio Project: Each student is given two stock ticker symbols and, using a free website stock portfolio manager, "invest" $10,000 in their stocks to chart the progress of biotechnology stocks over the course of a semester. The description and results of this project, including assessment, are included in a manuscript written by Dr. Marrs recently submitted for publication (available upon request).

Assessment of BIOL 540 using Just-in-Time-Teaching has been extensively described in the Assessment Report dated June 2001

BIOL 548 Techniques in Biotechnology (Dr. Dring Crowell / Dr. Steve Randall)

Student Learning is currently assessed by the following measures:

Written reports of a series of laboratory exercises that together form a larger research project. Reports are expected to be equivalent in format and content to a published scientific paper;

Written examinations, in an essay format, that emphasize problem solving, data interpretation, and experimental design;

Students' lab notebooks are evaluated for content and quality.

BIOL 556 Physiology I (Dr. Pamela Crowell)

Student Learning is currently assessed by the following measures:

3 exams: short answer, short essay, critical thinking;

1 paper on scientific and ethical aspects of human stem cell research.

BIOL 559 Endocrinology (Dr. Simon Rhodes)

Course Goal: Comprehensive examination of the biology of endocrine organs, the hormones that they release, and the roles and target organs of these hormones. Both normal endocrine function and diseases associated with endocrine glands and target tissues are examined. This course is aimed at upper-level undergraduates and graduate students.

Student Learning is currently assessed by the following measures:

3 examinations (33.3% of grade each);
a combination of essay, fill-in-the blanks, matching, and multiple-choice type questions.

BIOL 561 Immunology (Dr. Ruth Allen)

Student Learning is currently assessed by the following measures:

Exams (summative) – varied questions ranging from multiple choice to half-page essay answers requiring students to develop a coherent summary of a complex question.

BIOL 564 Molecular Genetics of Development

Course Goal: To examine how key regulatory genes and signaling pathways regulate development in lower eukaryotic organisms and mammalian organ systems.

Mechanism: The expanding volume of information in this field makes it impossible to examine the molecular pathways that regulate the development of every organism or organ system in detail. Students, therefore, concentrate on **one topic in detail** and should try to elucidate the general principles underlying the molecular development of this subject and the others covered in the course.

Student Learning is currently assessed by the following measures:

Presentations: Students select a research area from a list by a random drawing. On the assigned day, the student presents a ~45 min. review of the chosen subject and then lead a ~30 min. critical discussion of one or two relevant, recent research (not review) papers. On the day of class, students distribute a "top ten" list that lists the most important concepts to be discussed in the presentation to the class.

Paper: A ~2500 word written review of the research area due at the end of the semester. This paper should be written in scientific style with citations.

Examination: One examination during finals week.

Grades are assigned based upon the following:

Participation in-class discussion	10%
Presentation	45%
Written paper	35%
Final Exam	10%

BIOL 571 Developmental Neurobiology (Dr. Teri Belecky-Adams)

Student Learning is currently assessed by the following measures:

3 exams: all short answer essay/multiple choice, T/F;

1 paper: 10-20 pages in length on a topic of their choosing;

6 journal clubs – responsible for leading the discussion for 1 journal club and participating in the others;

1 Panel Discussion: responsible for research and presenting a topic of my choosing related to stem cell research.

BIOL 697 Topics in Plant Biology (Dr. Dring Crowell / Dr. Steve Randall)

Student Learning is currently assessed by the following measures:

2 Oral presentations of recent research reports in plant biology;

Final exam – both written in-class exams and take-home exam formats have been used in previous years. Take-home exams are in the format of writing assignments in which students are asked to write a 1-2 page summary of each of several topics.

BIOL 697 Sensory Systems (Dr. Teri Belecky-Adams)

Student Learning is currently assessed by the following measures:

3 exams – multiple choice;

14 journal clubs – responsible for leading the discussion for 1 journal club and participating in the others.

Assessment of Student Learning
Department of Chemistry
Indiana University-Purdue University Indianapolis

Addenda to Chemistry Department Assessment Report for the Academic Year 2003-2004

Prepared by Barry B. Muhoberac, Ph.D.
(Edited by Joseph L. Thompson)
June 2004

Course Assessments, Modifications and Improvements

CHEM C100 The World of Chemistry

This non-majors course provides an introduction to chemical elements and their reactions followed by a topically oriented, non-mathematical survey of chemical subjects of general interest including the environment, nuclear chemistry and energy. The course is taught in multiple sections aimed at two different target audiences. The first audience has a general interest in chemistry and includes a large number of nursing students. These sections integrate current scientific news stories into the course, pointing out relevance of material and connection to our daily lives. A major reexamination of texts with respect to student expectations was undertaken for these sections. The second audience seeks state certification in science education. Special "block" sections with a maximum enrollment of 30 were created for the latter audience with a separate text and combined course content from Chemistry C100 and Geology G110 *Physical Geology*. Faculty from the chemistry department taught two sections during the fall semester and one section in spring semester of 2002-2003. The Drop+Fail+Withdraw (DFW) rate was 10-15%, which was an improvement over the rate for the original chemistry-only format. The schedule for 2004-2005 includes two "block" sections in the fall semester and one section in the spring semester.

CHEM C101 Elementary Chemistry I

1. Assessment of the "second chance exam" strategy that was implemented in C101 in spring 2002 is underway. With the help of a capstone chemistry major student, preliminary results of our experience with second chance exams were presented at the 36th Central Regional Meeting of the American Chemical Society (Indianapolis, Indiana, June 3, 2004) and will also be presented at the 18th Biennial Conference on Chemical Education (BCCE 2004) in Ames, Iowa, on July 19. Although further analysis is needed, this strategy clearly shows promise for improving DFW rates, student performance and student satisfaction in C101.

Abstract of the talk for BCCE in 2004:
Second chance exams in introductory chemistry: Why and how
Anliker, Keith S. and Kough, Ryan J.

From my course syllabus: "For exams 1 and 2, an opportunity will be offered that will allow you to improve your score by taking a similar exam approximately one week after the exam is first taken. If your score on the 'second chance exam' (SCE) is better than your score on the original exam, 80% of *this difference* will be added to your *original score*. This opportunity will not exist on exam 3 or the comprehensive final."

A primary motivation for SCE implementation was giving students incentive to restudy and master material from early in the term—a key to later success. Other motivations were to improve overall student performance and to lower the proportion of students receiving grades of D, F or W.

The implementation has been successful. As expected, students are very appreciative of this approach. The impact on certain individuals has been remarkable, with best-case improvements on an exam as high as 40 percentage points (from 60/160 to 124/160). Average improvements are in the range of 5 to 15 percentage points—still enough to impact students' grades substantially. These positive results have occurred across all grade ranges, yet we have not seen a decline in performance on our comprehensive final exam when we look at scores received by students earning course grades of A, B, or C during terms prior to and since adding SCEs.

The talk will focus on the logistics of this approach and on data from the six terms since implementation.

2. "Just in Time Teaching" (JiTT) has now been in use for four terms in C101. At the end of each term, students responded to a survey asking them to tell us about their C101 experience. Included on the survey were questions related to the web assignments. Some of the results have been analyzed and were presented at the 36th Central Regional Meeting of the American Chemical Society (Indianapolis, Indiana, June 3, 2004). Additional results will also be presented at the 18th Biennial Conference on Chemical Education (BCCE 2004) in Ames, Iowa, on July 19.

Abstract of the talk for BCCE in 2004:
Weekly web-based assignments in introductory chemistry
Holladay, Susan R. H., Anliker, Keith S., Query, Terra E., Bhargav, Shilpi

We had many goals in mind when we began to assign weekly assignments via the course web page. One was to encourage students to think about chemistry more often than simply in lecture. We wanted our students to take the lecture material and apply it to more complicated examples so they could discover what they did not understand before taking the exam.

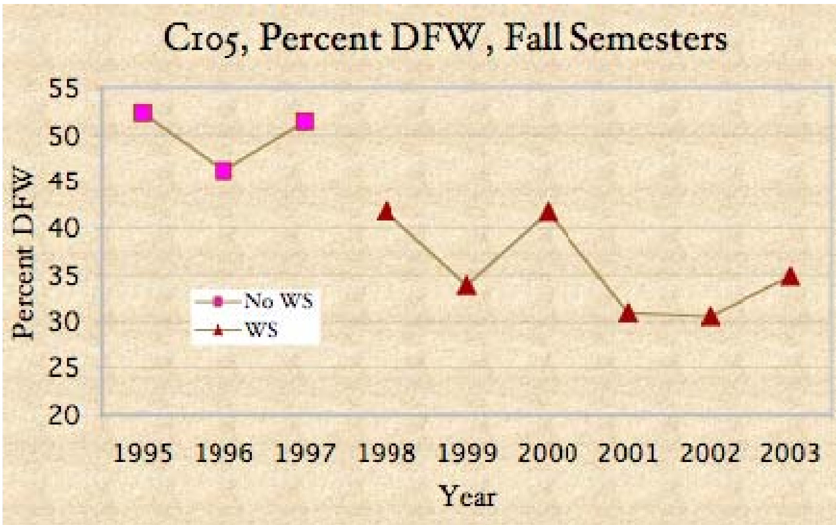
Students accessed the assignments via the course web page in order to submit assignments electronically. We also wanted to have links available within the assignments so that students could have access to other web pages related to the topic. We developed 14 assignments with 5-10 questions each and three extra credit assignments. For example, one assignment, posted before spring break, had the students determine the bond angles in a component of sunscreen. Another assignment culminated in the students justifying why they thought concrete hardening was a chemical or physical change.

Several questions concerning the effectiveness of the assignments were scrutinized. How did the final grade in the course correlate with the number of assignments completed? Why didn't all students do these assignments? Did the web assignments improve performance on specific final exam questions on our comprehensive final exam?

3. Two new types of web-based assignments were introduced on a trial basis in C101 in Spring 2004. Critical thinking was the focus of one of these. Students were asked to describe concepts that they found initially difficult, but later found to be easy, and to provide details about lecture and to analyze the lecture and examples that were used in lecture to clarify concepts. They were also asked to dissect (and even to write their own) multiple choice exam questions, hopefully to enhance their understanding of the concept involved in the question, but also to better understand the testing process. The second type of new exercise involved focusing on the "easy" questions that are an inherent part of any exam. Here the goal was to improve performance on this type of question by ensuring that students were able to recognize and respond correctly to questions that as instructors we think of as "gimmees." Further implementation of these types of assignments is anticipated and necessary in order for us to gauge their usefulness. (This work was supported by the IUPUI Office for Professional Development and the Center for Teaching and Learning as part of my participation in the Faculty Learning Community on the Scholarship of Teaching and Learning and the Impact of Instructional Technology.)

CHEM C105 Principles of Chemistry I

Major continuing innovation: Peer-Led Team Learning (PLTL) is a continuing program with sustained improvements in reducing DFW rates. The figure below shows the most recent results achieved in fall semester C105 sections:



Continuing innovation: Examinations are offered on the computer over a multi-day period. This intervention responds for the need of flexibility for students who have outside expectations and activities. The system also provides immediate feedback.

A web page was created to enhance communication between the students and the instructors. The page is accessed through the schedule tab in Oncourse.

On-line homework was added to the course (required work). This intervention gives students the opportunity to get targeted and immediate feedback as they work through the course material.

In-class response devices: A pilot program was run for the spring 2004 semester where students could respond to class questions and their answer/selection would be recorded. Again, this provided immediate feedback to faculty on topical difficulties. This feedback improves student participation and attendance.

Publications on C105 Interventions

David J. Malik, "Peer-led Team Learning in an Urban University", *Chinese Journal of Chemical Education*, **24**, 37-39 (2003)

Abstracts and presentations related to C105 Interventions

David J. Malik, *Peer-Led Team Learning in a Large Urban University*, 17th IUPAC International Conference on Chemical Education, Beijing, China (August, 2002).

David J. Malik, *Improving the Transition from Secondary to Higher Education in a Large Urban Public University: Recognizing the Role of PLTL* in “Recent Developments in Student-Centered Teaching Methods: Problem-based Learning, Peer-led Team Learning, etc.”, American Chemical Society 224th National Meeting, Boston, MA (August, 2002).

David J. Malik, *PLTL: Issues in Sustainability*, Peer-led Team Learning National Leadership Conference, City College of New York, October 9-12, 2003. Invited Panel Member.

David J. Malik, *Peer-led Team Learning in an Urban Institution: Improving the Transition from Secondary to Higher Education*, PLTL National Leadership Conference, City College of New York, October 10, 2003

David J. Malik, *Understanding Student Success using PLTL*, Department of Chemistry, Boston University, February 23, 2004. Invited.

David J. Malik, *Peer-Led Team Learning: An Urban University Success Story*, Department of Chemistry, Providence College, Providence, RI, February 26, 2004. Invited.

David J. Malik and Susan Holladay, *Maximizing Student Success via Peer-led Team Learning*, Moore Symposium, Indiana University - Purdue University, Indianapolis, IN, March 5, 2004

David J. Malik, *Creating a culture for PLTL: Selling the faculty and administration*, in “Peer-led Team Learning - New Approaches, Different Results? Symposium”, American Chemical Society 227th National Meeting, Anaheim, CA, March, 2004

Susan R. H. Holladay, *An analysis of PLTL leaders’ reflections*, in “Peer-led Team Learning - New Approaches, Different Results? Symposium”, American Chemical Society 227th National Meeting, Anaheim, CA, March, 2004

David J. Malik, *Maximizing Student Success using Peer-led Team Learning*, DePauw University – Wabash College, Phi Lambda Upsilon Award Program, April 2, 2004

Mark S. Sage and Susan Holladay, *Motivation and Goals of Workshop Leaders at IUPUI*, American Chemical Society Central Regional Meeting, June 2 – 4, 2004

David J. Malik and Susan Holladay, *Peer-led Team Learning in an Urban Public Institution: Demographic Challenges*, with Susan Holladay, 18th Biennial Conference on Chemical Education, Ames, IA, July, 2004. Invited.

Susan R. H. Holladay, *An analysis of PLTL leaders’ reflections*, 18th Biennial Conference on Chemical Education, Ames, IA, July, 2004. Invited.

David J. Malik, Maximizing Student Success through Peer-le*d Team Learning*, IUPAC Conference on Chemical Education, Istanbul, Turkey, August, 2004

CHEM C106 Principles of Chemistry II

Assessment is supplemented in this course through the use of short topic questions asked, answered (first by the students individually and then worked together in class), and turned in during class. These are then returned to the students at the next class meeting having been checked that they were attempted and then recorded. This serves two purposes: the students have to come to class to receive the points and they have to think during class. Typically, there are 20 different questions asked out of 30 class sessions and the question that is asked concerns material currently under discussion in the class session.

The final that is given in C106 is the American Chemical Society (ACS) standardized final exam. This exam covers topics from the first full year of General Chemistry. The students are thus responsible for the material they learned in the first semester of General Chemistry, C105, along with the new material in C106. Thus, long-term retention of the material presented in these two courses is one of the goals of the year of General Chemistry.

CHEM C110 The Chemistry of Life

CHEM C110 ("The Chemistry of Life," 3 credit hours) and the optional C115 "Laboratory for the Chemistry of Life," 2 credit hours) were created to replace C102 ("Elementary Chemistry II," 5 credit hours). CHEM C102 suffered a severe drop in enrollment (from 200 students down to 20 students) during the early 1990's due in part to the School of Nursing removing this course as a requirement for their students. The prerequisite for the course was changed from C101 to one year of high school chemistry, C101, or consent of instructor. The course content has been adjusted to reflect the growing interest in the health sciences. The course now has an enrollment of 80-90 students during the fall semester and 40-50 students during the spring semester. Students who take the course as an elective are from a variety of backgrounds: University College, School of Nursing and other allied health programs, Department of Psychology, Physical Education, etc.

The C110 lecture provides a non-mathematical introduction to organic molecules and their transformation to useful materials such as drugs and polymers. An emphasis is placed on the chemical features of biomolecules including hormones and neurotransmitters; proteins; lipids (fats); carbohydrates (sugars); and nucleic acids (DNA/RNA). The chemistry of enzymes, carcinogens, vitamins, antihistamines, anesthetics, genetic engineering, mental health and other health-related topics is covered.

CHEM C115 Laboratory for The Chemistry of Life

The optional C115 laboratory, which is typically taken by approximately 20 students per semester, consists of one 3-hour laboratory and one 1-hour laboratory recitation per week. Thirteen experiments are conducted during the semester. These include in-lab experiments on Techniques, Hydrocarbons, Trimyristin from Nutmeg, Alcohols and Ethers, Aldehydes and Ketones, Esters, Aspirin and Oil of Wintergreen, Chromatography, Enzymes, Triglycerides and Soaps, and Vitamin C in Fruit Juice. In addition, three special “In-Class” experiments are conducted: Organic Structures and Molecular Models, Molecules in 3D, and an Internet/Writing Experiment entitled “An Important Drug in My Life.”

CHEM C121 Elementary Chemistry Laboratory I

This laboratory is taught in conjunction with C101. We have continued to use (and make minor modifications to) the curriculum introduced in C121 during spring 2002. Entirely new materials were created at that time when the 5 cr. CHEM C101 course was split into C101 (3 cr. lecture/recitation) and C121 (2 cr. lab). Although we are paying attention to additional need for innovation, no significant changes are anticipated in the near future. The approach taken in C121 will be presented at the upcoming 18th Biennial Conference on Chemical Education (BCCE 2004) in Ames, Iowa, on July 19.

> **Abstract of the talk for the BCCE in 2004:**
> **More than a collection of discreet experiments: Changing our approach to introductory chemistry labs**
> **Anliker, Keith S. and Kelley, Cynthia G.**
>
> Many lab manuals used in introductory chemistry courses consist of a collection of one-period experiments where each experiment covers a few basic concepts or techniques. Once the period ends, the experiment is over and there is little likelihood of any continuing discussion—even if students have lingering questions about the concepts involved in the experiment. Not surprisingly, this approach can be very frustrating for students at the introductory level.
>
> In an attempt to improve the lab experience for our introductory students, we created a series of two to four day projects where the work each week is connected to the work in previous and future weeks. Our goal is to bring students along on the important concepts—always allowing them another opportunity to clarify their understanding as we move forward. One key aspect of this approach is a guided discussion at the start of the next lab period that focuses students on the work from the previous week and connects it to the next part of the experiment. The questions are conceptually challenging and are intended to make the students stretch their understanding of the current project. Another key aspect of this approach is a final report that requires students to integrate concepts from each week’s work and to demonstrate their level of understanding once the project is finished.
>
> Examples of the experiments, discussion questions, final report questions and the way we implement this approach to lab will be described.

CHEM C125 Experimental Chemistry Laboratory I

This laboratory is taught in conjunction with CHEM C105. A course website was created in order to put information needed by students in one central location that could be accessed anywhere. Examples of information provided are: sample calculations, sample formal lab reports, report sheets, exam review, TA office hour schedules, and a question and answer drop box. Writing is an important part of the C125 experience: 2 formal reports are written with expectations of content, organization, and writing.

CHEM S125/S126 Experimental Chemistry Laboratory - Honors I & II

Separate honor's sections (C125/C126) have been created for the Principles of Chemistry (C105/C106) laboratory course. The first semester laboratory is linked to SCI I120 *Windows on Science*, providing a learning community environment for promising freshman students in Chemistry and related sciences. The S125/S126 classes have been scheduled in a different area than the C125/C126 sections, which has greater access to chemical instrumentation and provides a unique and stimulating environment for honor students. The S125/S126 curriculum has been designed specifically for honor students and is taught by a full-time faculty member. The laboratory experience is interactive, non-routine, and provides promising students with a realistic exposure to the spirit of scientific experimentation. Student response to the curriculum has been extremely positive.

CHEM C311 Analytical Chemistry Laboratory

The current course combines much of the previous content in the CHEM C310 (theory) and CHEM C311 (laboratory) analytical courses into a new format with a heavy focus on the laboratory work. This was done to streamline the analytical component in chemistry degree. An additional experiment was introduced at the start of the course because of observed deficiencies in laboratory skills. The new experiment was also designed to ease the introduction of error analysis, which has always been a difficult topic. General feedback from students indicates that much of the titration work is repetitive and seems disconnected from modern instrumental chemistry. In order to remove the tedium and bring the course into line with modern practice, electronic recording and analysis of data have been proposed for introduction in 2004. Weekly homework assignments were introduced to help provide the theoretical background to each experiment. These were initially burdensome, but were refined to be in accordance with the credit hours. Surveys have not been issued in the past, but are proposed for introduction in 2004. Use of the ACS Analytical exam may also help assess student learning in 2004.

CHEM C341 Organic Chemistry Lecture I

The first semester of the organic chemistry curriculum represents an important gateway course for the Department. Because of this, and because a large number of other science majors enroll in C341, efforts have been made to make course material more accessible and to include biochemical topics into the curriculum. To make the course more accessible, all course announcements, sample tests, test keys, problems sets, class notes (PowerPoint format) and lectures (audio stream, mp3 format), and supplementary materials were placed on the official Oncourse web site. In addition, significant efforts were made to utilize the Oncourse mail server to communicate with students. To introduce biochemical topics for the course, a review of several organic and biochemical textbooks was made, and from this, a compendium of biochemical topics and sample questions was organized for distribution to all lecturers involved in the C341/C342 curriculum.

The method of assessment of student performance in C341 is based primarily on in-class examinations. Because course topics are more conceptual and visual than elementary chemistry courses (C105/C106), a multiple choice format for testing is not used. Instead written (e.g., essay) and pictorial (e.g., mechanism) questions are typically used for assessment. Because of the documented problems associated with molecular visualization, molecular models are permitted during all examinations. Finally, for those students who have test-taking difficulties, an alternate grading option is provided to include assessment of assigned problem sets. All tests are scored on a 100 point scale, problem sets are scored on 4-tier ranking: ✓++ = essentially completely correct, detailed answers; ✓+ = very good, some mistakes and/or lack of detail; ✓= shows an understanding of the bulk of the material; however, some significant mistakes noted; ✓- = poor/superficial responses to questions.

To assess the success of the use of technology in the classroom, a questionnaire was developed. An important question that remains to be determined is whether enhanced access to course material impedes learning by discouraging the rewriting of chemical structures, reactions, and mechanisms. Analysis of student responses to this questionnaire, and correlation with student performance is planned during summer 2004.

CHEM C343 Organic Chemistry Laboratory I

The C343 curriculum was completely re-vamped during summer 2002 and was introduced in the fall 2002 semester. Compared to the old curriculum, the new curriculum gives students more experience performing laboratory procedures used daily by practicing organic chemists. The new curriculum also gives students more training with several instrumental methods of analysis. During the course, students perform gas chromatographic (GC) analysis of experimentally-obtained products four times, proton NMR analysis three times, infrared spectroscopy analysis three times, and HPLC analysis one time. Two of the NMR analyses require students to obtain both qualitative and quantitative information from their spectra. While much of the curriculum remains constant from term to term, some aspects are updated each term to keep the learning experience as current as possible.

CHEM C344 Organic Chemistry Laboratory II

The C344 curriculum was re-tooled during the fall 2002 semester and was introduced as a new set of experiments in the spring 2003 semester. Treated as a continuation of C343, students are expected to enter C344 with a sound knowledge base from C343 and build on it immediately. Techniques learned in C343 are used repeatedly and the expectation is that the students will require little or no “review” before performing these techniques. New techniques are introduced as well. The instrumental methods of product analysis started in C343 continue, with students performing proton NMR and IR analysis on almost every experiment. In addition, C344 students learn and use variable-temperature proton NMR and mass spectrometry. Though not performed by the students, carbon-13 NMR and two-dimensional NMR are also introduced. Students completing both semesters of organic lab should be well versed in the basics of organic synthesis as well as have a sound knowledge and experience base with many instrumental analysis methods commonly used by an organic chemist on a daily basis.

CHEM C495 Capstone in Chemistry

The Department of Chemistry's Capstone in Chemistry course (C495) was introduced to the IUPUI curriculum in spring 1999. The goals of the Capstone in Chemistry course are:

(i) to provide a capstone experience that emphasizes the inter-relationship of Chemistry to Science and Society;

(ii) to ensure that students have adequate conceptual and presentation skills; and

(iii) to provide substantive guidance and direction with regards to future professional planning.

These goals are evaluated throughout the semester by the following activities:

Independent project presentations – students are required to engage in an independent project, which is under the guidance of a PhD-level scientist. They are to report on the status of their project several times during the semester. Each presentation increases in complexity, with students being required to prepare a formal presentation at the end of the semester that summarizes the project goals and outcome.

Literature presentation – students must report on the results of a recent scientific paper. Papers are derived from such journals as *J. Am. Chem. Soc.*, *Science*, and *Nature*.

Résumé – All students must prepare résumés and mock cover letters for the capstone course.

Academic Portfolio – Students are to prepare an academic portfolio, which ideally, is a comprehensive summary of all chemistry and related courses that the student has taken while at IUPUI. For each course, a detailed description of course content and reflection statement are required, as well as samples of work generated from that course. The portfolio may also include other subjects of interest to the student, which need not be directly related to Chemistry or Science. Copies of these portfolios are archived within the department.

In-class discussions, including GRE preparation – Several times during the semester, the class engages in a round table discussion on contemporary issues in science. In addition, two class periods are devoted to a discussion of the Chemistry subject GRE exam. Students work through a sample exam and discuss their rationale for answer choices.

Capstone assessment is based on 3 major categories:

(i) scholarly ability;
(ii) technical skills (presentation style and format); and
(iii) participation and effort.

Both the capstone instructor and the independent project advisor make an evaluation of student performance in their independent project. In spring 2004, a written independent project final report was also required as part of the Department's efforts to conform to ACS certification standards. A scoring system was developed and is based on a 5-tier ranking (*needs improvement; meets minimum standard; good; very good average, could benefit from additional work; and excellent, little-to-no improvement necessary*). In addition to this departmental assessment, instructors utilize the School of Science Template for Assessment of the Capstone Experience. Results from these two evaluations are used to determine final course grades. Students who consistently score “excellent” will receive an A in the course, while students who consistently score at “needs improvement” risk receiving <C as their final grade. Since grades less than C in the major will not count towards the degree (unless waived by the department), the capstone course can provide a final mechanism for evaluating our graduates.

Assessment of Student Learning
Department of Computer and Information Science
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Raymond Chin, Ph.D.
(Edited by Joseph L. Thompson)
June 2004

We are continuing to assess our teaching and learning employing procedures established in the June 1, 2002, Annual Report. No significant changes were observed for most of the courses surveyed. We have followed through with a course assessment typically required by the Accreditation Board for Engineering and Technology (ABET) because students in the School of Engineering and Technology, particularly those in Computer Engineering, take several of our Department's courses. A Course Outcome Survey was performed for Discrete Computational Structures (CSCI 340), Advanced Programming (CSCI 265), Data Structures (CSCI 362), Introduction to Programming Languages (CSCI 355), and Introduction to Operating Systems (CSCI 403). Copies of students' Course Outcome Survey and instructors' Analysis of Course Outcome Survey and Reflections are available from the Department or from the Associate Dean for Academic Programs and Student Development in the School of Science.

We have also assessed the Capstone Experience class entitled Explorations in Applied Computing (CSCI 495) as required by the School of Science using a standard template. The result showed that a majority of our students need improvement in their written communication skills. It is not apparent to them that thinking critically and writing concisely are synergistic processes. Good writing requires careful planning and uses of properly chosen expressions.

To promote effective writing and critical thinking, the curriculum in Data Analysis Using Spreadsheets (CSCI N207) was modified for the past three semesters by replacing a term project with two self-evaluations to be turned in before the midterm and the final exam. The underlying idea is that student self-evaluations offer feedback to the instructor that otherwise would not be available through existing means. Also, self-evaluations engender students to critically examine what they have learned rather than having instructors tell them. It is important that students learn self-criticism and independence of thought. If students need to be told how well they are doing, then they are not thinking critically. Indeed, a self-evaluation is an instrument of self-examination particularly in preparing for an exam. Thus, students should list what they have learned, what they do not understand, what they do understand, and, more importantly, how well they understand the concept. They should also discuss connections among topics covered and their expected usefulness. Self-evaluation is treated as another lab assignment and accordingly is given the equivalence of a lab assignment grade. Its value as an instrument of learning, however, is significant if students expend great effort writing it. In turn, the grade of the self-evaluation rests on the organization and the presentation of the written material as well as on the amount of effort expended. The content is immaterial although a conscientious effort in self-criticism will provide the necessary feedback learning from the student's perspective and of teaching from the instructor's point of view. The downside of this is that, for a large class, grading self-evaluations would be an immense undertaking for the instructor. Indeed, the feedback so derived makes the time expended on grading entirely worthwhile provided that students are performing the required self-examination. Unfortunately, a majority of the students treat self-evaluation very lightly not appreciating the role it can play in learning.

The responses of students to self-criticism and their subsequent self-evaluation are in accord with observations reported in a National Research Council publication by the Committee on Developments in the Science of Learning entitled, "How People Learn." There are two distinct learner groups: "students who are learning oriented like new challenges; those who are performance oriented are more worried about making errors than learning" (p. 49). Accordingly, the learner-oriented group is favorable to self examination and is willing to expend the necessary effort to produce a reflective document while the performance-oriented group is less inclined to do so and the self evaluations are haphazardly written. As examples,

> "In learning about problem solving, I now know that I must step back and take some what baby steps to solve problems. I pretty much have to plan out what I will do and modify my plans as I go if any problem occurs. This is exactly what the stair does for each lab. I find that doing half the stair before I do the lab allows me to set out a plan of action. Then I finish the lab I am able to go back and write down what went wrong and what I can do next time to stop the same problem from occurring. I can use this outside of this class by applying it to several other big assignments that I have in many of my other classes. I can make out a plan to allow time to get everything done. Then when I am finished I can go back and reflect on the problem I had getting it done so that I will know how I can do better the next time."

> "Data Analysis Using Spreadsheets (CSCI 207) has continued to be a challenge to me since midterm. I was completely unprepared for the ABNIAC [Absolute Beginner's Numerical Integrator and Calculator] portion of the test, which was a surprise since I did so well and enjoyed it so much in lab. The objective portion of the test was just as expected, and corresponded well to the books required for the class. I came away from the midterm feeling unsure of my knowledge base and incapable of performing well on the final. In effect, I felt ambushed by the open-ended questions on the midterm. I am a serious student who prepares well for tests, and it was a surprise to be blindsided. I never saw such a question coming! It is with trepidation that I look forward to the final, and try to second-guess which type of problem [our instructor] will select as subjective portion of the test."

Despite the details concerning the particulars of the class, it is seen in these two selections from students' self evaluations that one is completely at ease with learning by reflecting upon the process of learning while the other is devoid of retrospection and is unappreciative of the learning process.

Reference

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, school*. Committee on Developments in the Science of Learning, National Research Council. Available online at http://www.nap.edu/catalog/6160.html.

Assessment of Student Learning
Department of Geology
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Kathy J. Licht, Ph.D.
(Edited by Joseph L. Thompson)
June 2003

This report summarizes the Department of Geology's assessment of student learning for the capstone course G420: Summer Field Camp taught by Dr. Andrew Barth in summer 2003. The course, G420, was taken by nine Geology majors and involved four weeks of intensive of field mapping in California's San Bernadino Mountains. Following the fieldwork, students returned to IUPUI to complete a final geologic map as well as a written summary of their observations and conclusions. This course is designed to integrate material covered in all previous geology courses. Results are based on a formal rubric adopted to examine students' mastery of the Principles of Undergraduate Learning (PULs).

PUL 1 (Communication and Quantitative Skills) was assessed by measuring skills on the following tasks: (1) collects and records data in the field accurately and effectively and (2) communicates scientific results and interpretation orally and in written form. For task 1, 89% of students performed at or above the minimum standard. Students performed very well on task 2, with 44% performing at the level of excellent (little-to-no improvement necessary). This represents a doubling of students who performed excellently when compared to results from 1999, the last year the course was offered.

PULs 2 and 3 (Critical Thinking *and* Integration and Application of Knowledge) were evaluated by assessing students' skills of data synthesis and three-dimensional interpretation of geologic data. Compared to 1999, students' data synthesis skills improved most dramatically, with 78% scoring at the good to excellent level, compared to 29% in 1999.

PUL 4 (Intellectual Depth and Breadth) was measured by assessing how well students placed geologic results and interpretations in a temporal context (a 4^{th} dimension). Two-thirds of the students scored good to excellent and all students met minimum standards. Results were similar to the 1999 assessment.

PULs 5 and 6 (Understanding Society and Culture / Values and Ethics) were not specifically assessed in this field-based course although they are emphasized throughout the undergraduate program.

For all PULs together, students received marks of good to excellent 65% of the time. Although the total proportion of students in the good to excellent range did not change between 1999 and

2003, the number of excellent marks improved by 10%. Across all PUL's, students met the minimum standard 31% of the time and in rare cases (4%) a student failed to meet the minimum standard.

Improved student performance on PULs reflects the Geology Department's continuing focus on high quality undergraduate education. It is difficult to determine the specific reasons for the improvement, but since 1999, a higher proportion of undergraduate students have participated in internships research with Geology Department faculty and new faculty who teach courses for Geology majors have been hired.

Starting fall 2004, the Geology Department will have three new faculty members in the areas of hydrology, soil chemistry and geological remote sensing. If necessary, the student assessment rubric will be re-evaluated to reflect any programmatic changes associated with the department's evolving strengths and curriculum.

Assessment of Student Learning
Department of Mathematical Sciences
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Robert D. Rigdon, Ph.D.
(Edited by Joseph L. Thompson)
May 2004

As outlined in previous reports, the Department of Mathematical Sciences has in place ongoing assessment procedures for several courses.

Assessment Procedures for Service Courses: MATH 111, M118, 163

These courses include a developmental course (111), a service course (M118) that is taken by a wide cross-section of students, and an introductory major course (163) that is also taken by students in disciplines that require a considerable level of mathematical sophistication.

We continue to identify (among other things)

Topics that give students the most trouble

Topics for which there is an appreciable gap between students' performance during the semester and their performance on the final

Topics that produce the greatest variation in performance from student to student

Topics that produce the greatest variation in performance from section to section.

One result:

In comparing the performance of students across different sections of 111, we discovered that for some instructors, the correlation between student scores on departmental finals and the students' course grades was less than ideal. Since the departmental exams emphasized those skills that the Department had determined to be most important in that course, we communicated to all instructors the need for greater uniformity. The result has been the greater correlation that we consider desirable.

Assessment of the Upper Division Major Course: MATH 351

MATH 351 is a course in which the student acquires several skills that are required for success in upper division courses in the major. We have developed an assessment form for this course in which the course instructor indicates the extent to which the math majors in his section have mastered these skills. We are using these forms to determine areas of strength and weakness of individual students so that they can be advised of the areas that require improvement. So far, we have found that the assessment report is a good indicator of a student's future success in upper division courses, but have not had time to refine our observations.

Program Assessment - Assessment of the Capstone Experience: MATH 492

All capstone mentors complete a Department capstone assessment form that is based on the template developed by the School of Science Teaching and Learning Committee. The questions asked on the capstone assessment form essentially assess attainment of the Principle of Undergraduate Learning (PUL) objectives while also assessing achievement of the discipline specific goals. We are using this form to both assess how well the capstone experience is serving its intended purpose (requiring the students to show growth in all the PUL's, and in discipline specific outcome goals) and as an assessment tool to assess how well our programs are achieving their goals.

Assessment of the capstone experience has yielded the following information – <u>In their capstone experiences</u>:

- more than 90% of our graduating seniors have shown themselves to be skillful problems solvers
- more than 80% of our graduating seniors have shown mastery of diverse mathematical ideas
- nearly 90% of our graduating seniors have shown ability to communicate ideas of their discipline orally and over 70% have shown ability to communicate ideas about their discipline in writing

- approximately two-thirds of our graduating seniors have shown ability to apply knowledge from one area of own discipline to another area and from mathematics to other disciplines
- approximately 60% have shown ability to make use of technological tools.

However, in their capstone projects, our graduating seniors do not consistently

a) show ability to make use of scientific resources, such as journals

b) show knowledge of contemporary issues in science and their relation to society

c) display appreciation of the historical development of (an area of) mathematics

d) show understanding of the nature of proof.

Items b) and c) are not really addressed by much of our coursework and so it is no surprise that these issues are not really addressed in the capstone experience either. However, a) and d) need to be addressed by the Department and the Department will be doing precisely that in the immediate future. We will be looking to determine whether some of our majors are actually lacking in these areas or whether these issues are just not being addressed in their capstone experiences.

Future Assessment Plans

The Department is going to implement an exit survey for math majors with a one-year-later follow-up to get feedback of students on their perceptions of the strengths and weaknesses of their mathematics programs.

Assessment of Student Learning
Department of Physics
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Andrew D. Gavrin, Ph.D.
(Edited by Joseph L. Thompson)
Spring 2004

Introduction

The Department of Physics grants the Bachelor of Science (B.S.), Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in Physics from Purdue University. The B.S. degree emphasizes preparation for graduate studies in Physics, and for careers in private firms and governmental agencies. Students in this program also can satisfy the Indiana certification requirements to teach Physics in secondary schools. The M.S. degree provides more rigorous training in mathematics and physics, preparing students for employment in government and industry. The Ph.D. degree prepares students for a career in research, and employment in academia, government or industry. Several Physics Department faculty members also participate in the Medical Biophysics program, which offers the Ph.D. through the IU School of Medicine.

Teaching Mission of the Department

The Physics Department has a relatively small number of majors, so a large part of our mission is to provide support courses for the rest of IUPUI. PHYS 152 / PHYS 251 is a calculus-based sequence for science and engineering majors, and serves as a first course sequence in Physics for our majors. These courses have undergone extensive innovation and assessment in recent years. PHYS 218 / PHYS 219 is an algebra-based sequence for engineering and technology students. PHYS P201 / PHYS P202 is an algebra-based sequence for pre-professional students. The Department also offers two conceptual physics courses: PHYS P100 (for allied health technologists), PHYS P200 (for primary education majors), and a two-semester astronomy sequence suitable for all students.

Student Learning Objectives

Development of a unified core curriculum for the Schools of Science and Liberal Arts resulted in the delineation of a number of general education learning objectives. The general education objectives and the manner in which they are implemented in the Physics Department are delineated in Table I.

Table I: Education Objectives and Methods

General Education Objective	Implementation in the Physics Department
A. Knowledge of, and proficiency in, communication and core skills.	1. Laboratory reports, capstone report. 2. Classroom and Capstone presentations. 3. Literature research, web-based learning. 4. Essay questions on homework and exams.
B. Proficiency in critical, analytical thinking and creative problem solving.	1. All physics courses require students to retrieve, evaluate, and interpret information from textbooks, lectures, journals, seminars, and/or internet sources. 2. Students must solve physical problems and draw mathematically based conclusions through clear and logical reasoning from course assignments, laboratory exercises, and independent study.
C. Achievement in intellectual depth, breadth, and adaptability.	1. Extensive knowledge in physics and mathematics is required in all physics courses. 2. Many School and University requirements (e.g., social, biological, and other physical sciences, and the humanities) also require students to demonstrate these traits.
D. Proficiency in the integration and application of knowledge.	1. Upper division courses and the capstone experience require students to integrate knowledge from numerous fields of mathematics and science to solve complex physical problems.
E. Understanding the individual's role within society.	1. In discussion of the historical development of physics (e.g., discovery of atomic structure, Manhattan Project), our courses provide opportunities for students to consider ethical issues. These range from the roles science and technology play in society, to the necessity of unbiased assessment and reporting of scientific data.

External Evaluations

The Department initiated an internal review process in 1995. Late that year the Department was evaluated by an external visiting committee composed of members of five colleges and universities and one industrial corporation. In 1996, the Department received a report. Several suggestions of the external committee have since been acted upon, including the creation of a new combined B.S. / M.S. program in collaboration with the Department of Mechanical Engineering. The Physics Department will undergo its next external review in 2006.

Introductory Physics Courses

Physics 152 / 251 (Calculus-Based)

Beginning in 1994, the development of a new teaching pedagogy was initiated by a member of the department (Gregor Novak). His effort was joined shortly thereafter by a new faculty member (Andrew Gavrin). The result is a nationally recognized teaching pedagogy called "Just -in-Time Teaching" (JiTT). A text was published with that title by Prentice Hall in 1999, and was co-authored by Novak, Gavrin, and collaborators from two other institutions. Extensive assessment has been carried out since 1994 on our Science and Engineering sequence. This has been done based on retention data and nationally accepted standardized tests. The results of this program continue to be excellent.

Novak, G. M., Patterson, E. T., Gavrin, A. D., & Christian, W. (1999). *Just-in-Time teaching: Blending active learning with web technology*. Upper Saddle River, NJ: Prentice-Hall.

Physics 218 / 219 and P201 / P202 (Algebra-Based)

These two course sequences are about to undergo a major revision. Dr. Gavrin recently received the 2004 "Course Transformation Grant" funded by IUPUI's Commitment to Excellence funds through the Office of Dean W. Plater. This course transformation will entail three primary components:

1. The two course sequences will be combined.
2. Credit will be awarded in six small "learning modules" rather than two semester-long courses.
3. Lectures will be replaced by a combination of multimedia resources and increased recitation and "workshop" style meetings. Drs. Gavrin, Vemuri, Woodahl, and Yurko are responsible for this effort.

We expect this course transformation project to be the focus of most assessment activities in the Department over the next several years. Although the courses will not be offered in the revised form until fall of 2005, we have already begun work on selecting or developing appropriate assessment instruments. A pilot study in two courses (Physics 218 and P202) was carried out in the spring of 2004 using a 60 item post-course survey. The survey was developed by A. Gavrin (in consultation with H. Mzumara of the IUPUI Testing Center) based on a survey used to assess a similar effort at the University of Wisconsin, Madison. The survey is intended to measure students' satisfaction with the course, and the ways in which they interact with the subject. It also measures their perceptions of the difficulty of the subject, and their (self-reported) effort. A total of 80 students in the two classes responded to the survey. While detailed results are not available yet, it is apparent that students felt the questions were clear and answerable in their current form. During the upcoming academic year, we will use this survey in all four classes to gain baseline data for the transformation project. In addition to the above survey, we hope to develop or adopt other instruments that are suited to measuring students' success in learning the knowledge and skills central to the courses.

Assessment of Physics 490 (Capstone)

In 1999, the Department revised our capstone course, Physics 490, with explicit learning goals spelled out, and new student assessment tools put in place to match these goals. In previous years, the assessment of the 490 project was entirely between the student and his or her research advisor. Under the new system, students must to submit a written report to a committee composed of the student's advisor and two other faculty members, and to make an oral presentation to a group of faculty and student peers. This last requirement may be met by giving a presentation within the Department or at an appropriate scientific meeting or research symposium. In the last two years, two students have completed the capstone experience. They were each rated according to criteria on the school of science capstone assessment template. The results are summarized below.

	Needs Improvement	Meets Minimum Standards	Good	Excellent	Not Applicable
Shows ability to formulate problems, solve them, and interpret their solution				2	
Shows understanding of the scientific method				2	
Displays overall comprehension of own discipline				2	
Shows ability to communicate					
orally				2	
in writing			1	1	
Gives experience in applying					
from own discipline to			1		1
among areas of own				2	
Makes efficient use of					
technological tools			1	1	
scientific resources			1	1	
Shows knowledge of contemporary and ethical issues in science and their relation to society			1	1	
Displays appreciation of the historical development of (an area of) the discipline				2	

Assessment of Student Learning
Department of Psychology
Indiana University-Purdue University Indianapolis

Report for the Academic Year 2003-2004

Prepared by Drew C. Appleby, Ph.D.
Director of Undergraduate Studies in Psychology
(Edited by Joseph L. Thompson)
June 1, 2004

This report is essentially the same as the 2002-2003 report.

This report will be organized according to the answers to the following eight questions.

A. How does the IUPUI Psychology Department want its students to change as a result of successfully completing its undergraduate program?
B. What methods did the Department use to assess how successfully its students accomplished these changes?
C. What were the results of these methods?
D. What has the Department learned from these results?
E. What has the Department concluded from these results?
F. What modifications in the Department have been made on the basis of these results?
G. What have been the impacts of these modifications on the Department and its students?
H. What are future plans for assessment in the Department?

A. How does the IUPUI Psychology Department want its students to change as a result of successfully completing its undergraduate program?
   1. The American Psychological Association is in the process of creating a set of student learning outcomes (i.e., specific types of knowledge and skills) for undergraduate psychology programs. The Department's Undergraduate Committee has used the most recent draft of this document to construct a new set of student learning outcomes (SLOs) for the department.
   2. Although this document has been approved by the Undergraduate Committee and has been endorsed by the faculty, it contains some SLOs that may be very difficult to assess (e.g., personal development) and therefore will be revisited by the Undergraduate Committee next fall for re-evaluation.

B. What methods did the department use to assess how successfully its students accomplished these changes? (The Department is in the initial stages of assessing its SLOs, and the methods described below do not correspond directly with the Department's new set of SLOs because of the recency of their existence.)
   1. Methods used

a. The School of Science (SOS) Senior Reflections on the Principles of Undergraduate Learning (PULs)
   1) The Senior Assessment Project is a package of surveys that graduating SOS students are asked to complete and return. The most important survey for the purpose of departmental assessment is a written senior reflection on IUPUI's six PULs.
   2) Each year a random sample of these surveys are distributed to the department by the School of Science. The department's representative on the Teaching and Learning Committee uses a School of Science rubric to determine:
      a) the extent to which our graduating seniors positively or negatively experienced each PUL and
      b) how well they were able to articulate and support the way in which they experienced each PUL.
   3) The following rating categories were used to make these assessments.
      a) Strong Positive: The student provides a strong, positive response connecting one or more substantive personal examples of experiencing the principle.
      b) Positive: The student discusses the principle in a positive light and provides a personal example of experiencing the principle, but without much amplification.
      c) Negative: The student discusses the principle from a negative aspect and provides a personal example, but without much amplification.
      d) Strong Negative: The student provides a strong, negative response and amplifies with one or more substantive personal examples.
      e) Unsatisfactory: The student restates or philosophizes about the principle and provides little or no substantiation in terms of a personal example or the personal example may be superficial.
   4) This is assessment technique that combines subjective student responses of how they experienced the PULs and objective faculty ratings of these responses.
   5) <u>Report Author's Suggestion</u>: I believe this assessment method could be improved by asking students how successfully they <u>accomplished</u> each of the PULs with a Likert scale (5 = accomplished completely to 1 = did not accomplish at all) as well as asking them to reflect on how they <u>experienced</u> each PUL. This way, the School could gather data that would reflect both the students' views of how well they accomplished the PULs and the faculty's views of how articulately their students were able to communicate their experiences with the PULs in writing. With the present system, it is not possible to differentiate between these two measures.

b. The SOS Capstone Template
   1) The SOS Teaching and Learning Committee created a capstone assessment template that is completed by all SOS capstone instructors for each of their students.
   2) This template allows instructors to rate their students on a variety of dimensions related to the Principles of Undergraduate Learning in (e.g., their ability to communicate, apply knowledge, solve problems, and utilize technology) and to the field of science in particular (e.g., shows understanding of the scientific

method, makes efficient use of scientific resources, shows knowledge of contemporary issues in science in their relation to society).

3) Report Author's Suggestion: I believe that the Psychology Department should create its own senior capstone template that can be used to measure its specific student learning outcomes. This recommendation will be presented to the Department's Undergraduate Committee in the fall of 2004.

C. What were the results of these methods?

1. The SOS Senior Reflections on the PULs
   a. When seniors' responses were rated according to the extent to which they believed they had accomplished each PUL and how well they were able to articulate the way in which they experienced each PUL, the results were as follows:
      1) Principle 1: Core Communication and Quantitative Skills
         a) 12 = Strong Positive
         b) 6 = Positive
         c) 0 = Negative
         d) 0 = Strong Negative
         e) 0 = Unsatisfactory
      2) Principle 2: Critical Thinking
         a) 10 = Strong Positive
         b) 8 = Positive
         c) 0 = Negative
         d) 0 = Strong Negative
         e) 0 = Unsatisfactory
      3) Principle 3: Integration and Application of Knowledge
         a) 6 = Strong Positive
         b) 11 = Positive
         c) 0 = Negative
         d) 0 = Strong Negative
         e) 2 = Unsatisfactory
      4) Principle 4: Intellectual Depth, Breadth, and Adaptiveness
         a) 6 = Strong Positive
         b) 8 = Positive
         c) 0 = Negative
         d) 0 = Strong Negative
         e) 5 = Unsatisfactory
      5) Principle 5: Understanding Society and Culture
         a) 8 = Strong Positive
         b) 7 = Positive
         c) 3 = Negative
         d) 0 = Strong Negative
         e) 1 = Unsatisfactory
      6) Principle 6: Values and Ethics
         a) 5 = Strong Positive
         b) 5 = Positive
         c) 0 = Negative

d) 0 = Strong Negative
e) 7 = Unsatisfactory

2. The SOS Capstone Template
    1) 95 to 97% of our graduating seniors meet the minimum standards for the following abilities:
        a) proficient users of scientific resources such as journals.
        b) make use of technological tools
        c) show knowledge of contemporary issues in science and their relation to society
        d) can apply knowledge from one area of own discipline to another area
        e) give experience in applying knowledge from own discipline to other disciplines
        f) display appreciation of the historical development of (an area of) the discipline
    2) 90 to 93% of our graduating seniors meet the minimum standards for the following abilities:
        a) show understanding of the scientific method
        b) display overall comprehension of own discipline
        c) be able to communicate ideas about psychology in writing
        d) show ability to communicate ideas of discipline orally
    3) 80% of our graduating seniors meet the minimum standards for the following abilities:
        a) shows the ability to formulate and solve problems and interpret their solutions

D. What has the Department learned from these results?
1. The SOS Senior Reflections on the PULs
    a. 84% of our Department's graduating seniors' responses indicated that they experienced the PULs in a positive or strongly positive manner and their faculty judged that they were able to successfully articulate and support the way in which they experienced these PULs.
    b. 3% of our Department's graduating seniors' responses indicated that they experienced the PULs in a negative manner and their faculty judged that they were able to articulate and support the way in which they experienced these PULs.
    c. 14% of our Department's graduating seniors responses were judged to be unsatisfactory in their ability to articulate and support the way in which they experienced these PULs.
2. The SOS Capstone Template
    a. Taking "meets minimum standards" as a level of acceptability, it appears that 80% or more of our graduating seniors can be described as:
        1) skillful problem solvers
        2) proficient users of scientific resources and technological tools
        3) having a strong grasp of the scientific method
        4) good writers
        5) good speakers
        6) possessors of a satisfactory comprehension of psychology
        7) knowledgeable of current issues in science in relation to society

8) able to apply knowledge from one area of psychology to another
9) able to apply knowledge from psychology to other disciplines
10) able to display an appreciation of the history of psychology

E. What has the Department concluded from these results?
   1. The SOS Senior Reflections on the PULs
      a. It appears that students who are completing our program believe they have experienced the PULs in a positive manner and are capable of communicating this belief in an articulate and supported manner.
   2. The SOS Capstone Template
      a. It appears that capstone faculty believe that the students who are finishing our program do so in a relatively skillful and knowledgeable manner.
      b. Two items on which our students scored relatively low are not a particular concern for the Department (applying knowledge from psychology to other disciplines and appreciating the history of psychology) because applying psychological knowledge to other disciplines is not an objective of our capstone laboratory classes and the department does not offer a course in the history of psychology.
      c. One concern that emerged from these results is that our seniors are not particularly skilled in oral communication. Although 93% of our students were judged to meet minimum standards of oral communication, their skill in this area was rated as only 1.17 on a 3-point scale.

F. What modifications in the Department have been made on the basis of these results?
   1. These results will be brought to the attention of the Undergraduate Committee next fall. It will be up to them to decide if these data are sufficiently compelling to warrant any modifications in our curriculum.
   2. The results from last year's assessments were not considered to be problematic by this committee, and they offered not suggestions for change.

G. What have been the impacts of these modifications on the Department and its students?
   1. There have been no modifications.

H. What are future plans for assessment in the Department?
   1. The Assessment Subcommittee of the Undergraduate Committee proposed the creation of a senior exit exam that would assess seniors' knowledge of the contents of psychology.
   2. The first proposal for this exam (see Appendix B) was approved for a $2,000 Program Review and Assessment Committee (PRAC) grant, but was rejected by the Department faculty.

Appendix A

2003-2004 IUPUI Psychology Department
School of Science Capstone Assessment Template

B425 Capstone Laboratory in Personality (enrollment = 7)
B471 Capstone Laboratory in Social Psychology (enrollment = 13)
B461 Capstone Laboratory in Developmental Psychology (enrollment = 21)
Total = 41 enrollees

Prepared by Drew Appleby, Ph.D.
June 4, 2004

	Needs Improvement 0	**Meets Minimum Standards 1**	**Good 2**	**Excellent 3**	**Not Applicable**	**Mean Rating 0-3 Scale**	**% Meets Minimum Standards**
Shows ability to formulate problems, solve them, and interpret their solution	8 = 20%	2 = 5%	17 = 41%	14 = 34%	0 = 0%	1.66	80%
Shows understanding of the scientific method	4 = 10%	6 = 15%	19 = 46%	12 = 29%	0 = 0%	1.95	90%
Displays overall comprehension of own discipline	4 = 10%	5 = 12%	18 = 44%	14 = 34%	0 = 0%	2.15	90%
Shows ability to communicate ideas of discipline							
orally	3 = 7%	13 = 32%	10 = 24%	5 = 12%	10 = 24%	1.17	93%
in writing	3 = 7%	7 = 17%	18 = 44%	13 = 32%	0 = 0%	2.00	93%
Gives experience in applying knowledge							
from own discipline to other disciplines	5 = 12%	1 = 2%	7 = 17%	8 = 20%	20 = 49%	0.93	95%
from one area of own discipline to another area	5 = 12%	2 = 5%	18 = 44%	15 = 37%	0 = 0%	2.02	95%

	Needs Improvement 0	Meets Minimum Standards 1	Good 2	Excellent 3	Not Applicable	Mean Rating 0-3 Scale	% Meets Minimum Standards
Makes efficient use of							
technological tools	4 = 10%	4 = 10%	7 = 17%	26 = 63%	0 = 0%	2.34	96%
scientific resources (e.g., journals)	4 = 10%	5 = 12%	14 = 34%	18 = 44%	0 = 0%	2.24	96%
Shows knowledge of contemporary issues in science and their relation to society	3 = 7%	6 = 15%	13 = 32%	13 = 32%	6 = 15%	1.73	97%
Displays appreciation of the historical development of (an area of) the discipline	4 = 10%	17 = 42%	7 = 17%	8 = 20%	5 = 12%	1.34	96%

Mean rating of each of the 11 abilities on the following scale

0 = Needs Improvement
1 = Meets Minimum Standard
2 = Good
3 = Excellent

2.34 Makes efficient use of technological tools
2.24 Makes efficient use of scientific resources (e.g., journals)
2.15 Displays overall comprehension of own discipline
2.02 Gives experience in applying knowledge from one area of own discipline to another area
2.00 Shows ability to communicate ideas of discipline in writing
1.95 Shows understanding of the scientific method
1.73 Shows knowledge of contemporary issues in science and their relation to society
1.66 Shows ability to formulate problems, solve them, and interpret their solution
1.34 Displays appreciation of the historical development of (an area of) the discipline
1.17 Shows ability to communicate ideas of discipline orally
0.93 Gives experience in applying knowledge from own discipline to other disciplines

Appendix B

Departmental Grant Proposal

Submitted by

Drew Appleby, Ph.D., Bethany Neal-Beliveau Ph.D., and Dennis Devine, Ph.D.
(Members of the Assessment Subcommittee of the Undergraduate Committee)

February 2, 2003

Purpose of this Project

The purpose of this project is to create a computer-administered senior exit test designed to assess how successfully our majors have attained five of the Psychology Department's seven Student Learning Outcomes (SLOs) endorsed by the Undergraduate Committee. These SLOs are as follows:

- ***SLO #1:*** ***<u>Content of Psychology</u>*** ***(to show familiarity with the major concepts, theoretical perspectives, empirical findings, and historical trends in psychology)***
- ***SLO # 2:*** ***<u>Research in Psychology</u>*** ***(to understand and be able to use basic research methods in psychology, including design, data analysis, and interpretation)***
- ***SLO #3:*** ***<u>Application of Psychology</u>*** ***(to understand and generate applications of psychology to individual, social, and organizational issues)***
- ***SLO #4:*** ***<u>Ethics in Psychology</u>*** ***(to understand and abide by the ethics of psychology, including those that encourage the recognition, understanding, and respect for the complexity of socio-cultural and international diversity)***
- ***SLO #7:*** ***<u>Critical and Creative Thinking and Problem Solving</u>*** ***(to use critical and creative thinking in the scientific approach to problem solving)***

The Nature of the Test

This test will be created from a bank of multiple-choice questions written to cover material from the courses that compose the Methods and Core areas of our undergraduate curriculum. (See Sub-Appendix A for a list of these courses.) These questions will be written to measure the following three levels of critical thinking skills based on the following arrangement of three pairs of educational outcomes as described in Bloom's Taxonomy of Cognitive Objectives (Bloom, Englehart, Furst, & Krathwohl, 1956). (See Sub-Appendix B for an explanation and examples of these levels of critical thinking.)

- <u>Informational</u> (Bloom's objectives of Knowledge and Comprehension)
- <u>Relational</u> (Bloom's objectives of Analysis and Synthesis)
- <u>Applicational</u> (Bloom's objectives of Application and Evaluation)

The Administration of the Test

The test will be a component of the capstone course each psychology major is required to take, and it is proposed that its score will account for 10% of the total course points. The test will be administered with IQUIZ in the Psychology Testing Lab (SL 070), and students may take it at any time during their capstone course. Students can take the test twice and only their higher score will count, which will allow them to increase their scores by reviewing their areas of weakest performance from their first test.

The Composition of the Test

The test will be composed of eight subtests, each of which will have four equivalent forms. The composition of the test will vary for each student depending upon which Core courses they completed. All students will answer 24 questions that cover material from their two required Methods courses (12 questions from B305 and 12 questions from B311). The remaining 72 questions will cover material from the six Core courses (12 questions per Core course) that students selected from the 12 total Core courses in our curriculum. Each subset of 12 questions will contain four Informational questions, four Relational questions, and four Applicational questions. The composition of each test will be created from the results of a brief survey that will precede the test. This survey will ask testees to complete a table (see Sub-Appendix C) in which they will identify the six Core courses they completed, where they completed them (i.e., at IUPUI or at another school), and when they completed them (i.e., within the last five years or longer ago than five years). IQUIZ will then create a test for each student that contains questions that cover material from the courses they have completed.

How the Test Will Be Scored for Testees

Testees will receive the following immediate feedback after they complete the test:

- a raw score and a percent correct score for the entire test
- a raw score and a percent correct score for each of the eight domains
- a raw score and a percent correct score for each of the three levels of critical thinking
- a raw score and percent correct score for each of the three critical thinking levels in each of the eights tested domains.

How the Test Will Be Scored for the Department

IQUIZ will be programmed to filter out scores from courses that testees completed more than five years ago and/or at other colleges or universities. For assessment purposes (i.e., to make data-informed programmatic changes), the Department will be interested only in the results of the subtests that covered material from recent IUPUI courses. One of the major problems of senior exit tests (e.g., the ETS Undergraduate Field Test and the ACAT) is that their scores reflect testee's knowledge regardless of how long ago or where they acquired it. This test would overcome this problem by allowing the department to consider only the data from recent IUPUI courses.

How the Test Will Be Created

The Assessment Subcommittee of the Undergraduate Committee will recruit members of the IUPUI psychology faculty who teach the courses covered by the test to create its multiple-choice questions. They will be fully informed of nature, purpose, administration, and scoring of the test. Each question author (QA) will be instructed to create 48 questions that cover material from her/his course. QAs will be encouraged to consult with faculty who teach other sections of their course to insure that all students who take the course at IUPUI—regardless of which section they take—will have been exposed to the material contained in the questions they create. One third (16) of the 48 questions will be written to measure testees' Informational competence, 16 will be written to measure Relational competence, and 16 will be written to measure Applicational competence. Each of these 16-question sets will also include two questions that address ethical principles, issues, or dilemmas. QAs will be paid $500 to write these questions, and payment will be made when the members of the Assessment Subcommittee have approved all 48 questions.

Outcomes of this Test

The results of this test can be used by the Department to assess the five SLOs described in the first paragraph of this proposal in the following ways:

- ***SLO #1: Content of Psychology will be assessed with the scores of the subtests created to measure knowledge from department's 12 Core courses.***
- ***SLO # 2: Research in Psychology will be assessed with the scores of the subtests created to measure knowledge from the department's two Methods courses.***
- ***SLO #3: Application of Psychology will be assessed with the scores from the Applicational questions from all of the subtests.***
- ***SLO #4: Ethics in Psychology will be assessed with the scores from the questions created to measure knowledge of ethical principles, issues, and dilemmas.***
- ***SLO #7: Critical and Creative Thinking and Problem Solving will be assessed with the scores from the Informational, Relational, and Applicational sets of questions.***

It should be noted that this testing format can also allow the Department to collect other assessment-related data from its graduating seniors, such as the following:

- satisfaction with the Department's advising system
- perceived sense of mentoring in the Department
- perceived sense of community in the Department
- participation in Departmental activities and events
- suggestions to improve the Department's undergraduate program
- willingness to serve as a resource for the Department (e.g., to serve on a graduate student panel in B103)

Budget

The budget for this project will consist of two items: (a) the payment for creating the questions and the cost involved in programming IQUIZ to create, administer, and score the test. The cost of writing the questions will be $4,000, $2,000 of which is requested from the Psychology Department with this proposal and $2,000 of which will be requested with grant proposal to the university's Program Review and Assessment Committee (PRAC). If the PRAC proposal is not funded, the $4,000 cost will be requested from the Department. The cost for programming IQUIZ is unknown at this time.

Timeline

The timeline for this project is dictated by the deadline for spending the available grant money. The QAs must be recruited and their questions created and approved by June. Likewise, the IQUIZ programming must also be completed by this deadline.

References

Bloom, B. S., Englehart, M. D., Furst, E. J., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: Cognitive domain*. New York: McKay.

Sub-Appendix A

The Methods and Core Courses from the Psychology Curriculum

Methods Courses

B305 Statistics

B311 Introductory Laboratory in Psychology

Core Courses (six from the following twelve courses are required)

B307 Tests and Measurement

B310 Life Span Development

B320 Behavioral Neuroscience

B334 Perception

B340 Cognition

B344 Learning

B356 Motivation

B358 Industrial/Organizational Psychology

B370 Social Psychology

B380 Abnormal Psychology

B398 Brain Mechanisms of Behavior

B424 Theories of Personality

Sub-Appendix B

A Sample Knowledge Domain and Examples of Multiple-Choice Questions that Can Be Written to Assess the Informational, Relational, and Applicational Aspects of that Domain

Three Levels of Cognitive Competence

That Can Be Assessed With Multiple-Choice Questions

A. Informational Competence (to remember and to understand)
   1. the ability to remember specific information in the way it was originally presented
      a. being asked to recognize the exact definition of a bold-faced term in a textbook
      b. questions it can be used to answer: Who, what, where, and when?
      c. Bloom calls this "knowledge"
   2. the ability to understand information when it is presented in a different manner than it has been originally presented
      a. being asked to recognize a principle, concept, or method when presented with an example that has not been previously encountered
      b. questions it can be used to answer: How and why?
      c. Bloom calls this "comprehension"

B. Relational Competence (to analyze and to synthesize)
   1. the ability to analyze (i.e., reduce) a complex whole into its constituent parts and their functional relationships
      a. being able to recognize the parts of a complex whole and how they interact or are related to one another
      b. questions it can be used to answer: Of what is this complex whole composed, and how are its parts related to one another?
      c. Bloom calls this "analysis"
   2. the ability to synthesize (i.e., create) new wholes from previously unrelated parts
      a. being able to recognize how elements that have been previously unassociated can be combined into meaningful whole
      b. questions it can be used to answer: What new conclusions can you reach on the basis of what you have learned?
      c. Bloom calls this "synthesis"

C. Applicational Competence (to apply and to evaluate)
   1. the ability to produce and apply original and useful solutions to solvable problems
      a. being able to recognize how the products of analysis and synthesis can be used to solve real world problems
      b. questions it can be used to answer: How can this problem be solved?
      c. Bloom calls this "application"
   2. the ability to evaluate the effectiveness and/or merit of these solutions
      a. being able to recognize how established criteria can be used to judge the success of problem-solving methods (e.g., the scientific method and psychotherapy)
      b. questions it can be used to answer: What is the validity or value of a particular principle, theory, or method?
      c. Bloom calls this "evaluation"

Reference

Bloom, B. S., Englehart, M. D., Furst, E. J., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: Cognitive domain*. New York: McKay.

The Human Memory System

Memory refers to our ability to maintain information over time and involves the processes of acquisition, storage, and retrieval. According to many theorists, human memory is composed of three interconnected memory stores. Information from our senses is initially stored in ***sensory memory*** in the same manner that it was perceived (e.g., as images or sounds). Although information is stored in sensory memory for less than two seconds, that is long enough for us to interpret it and to decide which of it is important enough to transfer to ***working memory***, where we can continue to process it. Information in working memory is stored primarily in terms of how it sounds (i.e., acoustically), and approximately seven separate bits of information (e.g., numbers, letters, or words) will remain in working memory for only about 30 seconds, unless we continue to maintain them by repeating them to ourselves. Forgetting occurs in working memory when we transfer more information from sensory memory into working memory—and therefore exceed our seven-item capacity—or if we stop repeating the information currently stored in working memory. This repetition process, known as rehearsal, serves two purposes. First, it allows us to maintain information in working memory as long as we continue to repeat it to ourselves. Second, rehearsal enables us to transfer information we wish to remember more permanently to the third and final memory store known as ***long-term memory***. Information in long-term memory is stored primarily in terms of its meaning (i.e., semantically), and this memory store is often compared to a library whose contents are organized in a number of different meaningful ways (e.g., by subject matter, by authors' names, in alphabetical order, etc.). We may not always be able to retrieve information from long-term memory when we want to—in the same way that a book in a library may be sometimes hard to find—but once it is there, it is stored relatively permanently, and we do not forget it in the same manner that we forget information that has been stored only in sensory memory or working memory.

A. Examples of <u>Informational</u> Multiple-Choice Questions (#1 = knowledge and #2 = comprehension)

1. Which of the following is <u>true</u> about working memory?
   a. It can hold only about seven bits of information.
   b. The information it holds is usually in the form of sounds.
   c. The information it holds lasts only about 30 second unless it is rehearsed.
   d. all of the above

2. Joan just looked up a new telephone number, closed the phone book, and is repeating the number to herself as she is dialing the phone. This number is being stored in __________.
   a. sensory memory
   b. working memory
   c. long-term memory
   d. none of the above

B. Examples of Relational Multiple-Choice Questions (#1 = analysis and #2 = synthesis)

1. Which of the following is the correct sequence through which information passes as it is processed by the human memory system?
   a. sensory memory → working memory → long-term memory
   b. working memory → sensory memory → long-term memory
   c. sensory memory → long-term memory → working memory
   d. working memory → long-term memory → sensory memory

2. Working memory is to _____, as long-term memory is to __________.
   a. semantic, acoustic
   b. approximately seven, unlimited
   c. relatively permanent, thirty seconds
   d. all of the above

C. Examples of Applicational Multiple-Choice Questions (#1 = application and #2 = evaluation)

1. Tom was introduced to Marguerite only three minutes ago, but he has already forgotten her name. How could he have avoided this embarrassing situation?
   a. He could have told her as many things about himself as he could immediately after hearing her name.
   b. He could have repeated her name several times during their conversation (e.g., “Is Marguerite a French name?”).
   c. He could have relaxed and assumed that he will be able to remember her name if he doesn’t worry about trying to memorize it.
   d. He could have tried to remember seven different things about her (e.g., her height, her hometown, her major, the color of her hair, the perfume she was wearing, the sound of her voice, and the cute little mole on her left earlobe).

2. Which of the following students has given the best explanation of why Tom has already forgotten Marguerite’s name?
   a. John: "Her name was never in Tom's sensory memory."
   b. Paul: "Her name was lost from Tom's long-term memory."
   c. George: "Tom did not successfully transfer her name from his working memory to his sensory memory."
   d. Richard: "Tom did not successfully transfer her name from his working memory to his long-term memory."

Sub-Appendix C

The Table Testees Must Complete Before They Take the Test

Please place an “X” in each box in which your answer to the question at the top of the column is Yes. For example, if you have successfully B305 at IUPUI during the past 5 years, then put an X in each of the boxes to the right of B305 Statistics.

Course Number and Title	Successfully Completed?	Taken within the last five years?	Taken at IUPUI?
B305 Statistics			
B307 Testing			
B311 Introductory Laboratory in Psychology			
B320 Behavioral Neuroscience			
B334 Perception			
B340 Cognition			
B344 Learning			
B356 Motivation			
B358 Industrial/Organizational Psychology			
B370 Social Psychology			
B380 Abnormal Psychology			
B398 Brain Mechanisms of Behavior			
B424 Theories of Personality			