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

Annual Report: June 1, 2002

General Context

The 2002 report is the fifth 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 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 and Implementation of the Principles of Undergraduate Learning

General Education Curriculum

The new general education curriculum common to the School of Science and the School of Liberal Arts is reaching full implementation in terms of students served. It is anticipated that three junior/senior integrator courses offered for fall 2002 will be fully subscribed. The need for developing additional topics for the course was part of a continuing discussion of the Common Core Curriculum Committee. The Committee also spearheaded the development of a website that features the curriculum and presents procedures for approval of junior/senior integrator offerings. The curriculum, based on the IUPUI Principles of Undergraduate Learning, is being assessed in the School though the Senior Reflection project.

Senior Reflection Project

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. The Teaching and Learning Committee of the School applied a newly designed rubric to evaluate 83 reflection papers from the 2000/2001academic year. As a result, it was discovered that the principle of ethics should be addressed more intentionally. This issue was discussed by the Committee and will be the focus of additional work in fall 2002. We have just compiled a new set of reflection papers for this past academic year and the Committee will evaluate these papers for comparison to last year’s data.

Windows on Science Freshman Experience Seminar

Assessment has been integrated into the Windows on Science course since its inception in 1996. An earlier outcome was a major restructuring of the course. Pre-/ Post-skills perception surveys and feedback from focus groups are assessment tools currently being applied to the course. As a byproduct of assessment and discussion by course facilitators, plans are being initiated to develop updated activities and materials for several sessions of the course. Additionally, a search is underway for a shared advisor/career specialist position with University College and the School of Science. This individual will work with the Windows on Science sections and be a resource for career/major connections for students in the course.

Academic Advising

A new Undergraduate Academic Advisor Survey mentioned in last year's report was fully implemented this academic year. The survey is a means for graduating seniors to identify advisors who have been a positive influence on them and to select the types of quality interactions that they have had with those advisors. The survey will help to identify the exchanges that students' value most in the advising process. The data from the current set of surveys will be evaluated this summer and the information garnered will be shared with academic advisors and department chairs.

Graduating Student Survey

The new graduating student survey reflects items on surveys conducted under the auspices of IUPUI institutional research. This year, the 2000/01 data from the Graduating Student Survey was compared to School data in the most recent surveys of continuing students and of alumni. The data from the graduating student survey compared favorably with the institutional data. In terms of teaching in the major and academic advising, the School of Science graduating student survey indicated somewhat better satisfaction outcomes compared to the data in the institutional surveys in which there are a smaller number of respondents. This year's data will be compiled and analyzed in the fall.

Capstone Assessment Template

The Teaching and Learning Committee approved the proposed School template for rubrics that are being applied to departmental capstone courses. With the completion of the academic year, the data from the departmental rubrics will now be fed into the template to achieve a School-level assessment of the capstone experience. This will provide the School with both a soft (senior reflection) and a hard (capstone assessment template) assessment of learning outcomes associated with the IUPUI Principles of Undergraduate Learning.

Special Retention Project

The Office of Information Management and Institutional Research provided data for 5 years of DW(Withdrawal)F rates for majors enrolled in courses specific to their programs. The information was shared with department chairs and members of the Teaching and Learning Committee with a request that the data be analyzed to identify courses, especially at the sophomore level or higher, that are particular barriers for students in progressing in degree programs. The next phase will be to address those courses in terms of pedagogical strategies to enhance learning and to increase successful completion of the courses. This project was based on the experience of one department in the School that analyzed similar data for its majors and is now addressing the "bottleneck" course that was identified.

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

Annual Report: June 1, 2002

INTRODUCTION

The teaching mission remains as stated in the July 2000 and June 2001 reports. The department currently has 21 full-time faculty, including two who hold the title of Lecturer. Departmental teaching responsibilities include a large service component and a substantial undergraduate program with two degree options (B.A. and B.S.), as well as graduate instruction for the 80 – 85 students enrolled in M.S. and 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 Master of Science (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 (see report, 7-18-2000)

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 7-18-2000)

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

Courses described for the first time in this 2002 report are indicated by the phrase [NEW] before the course number.

For course descriptions, please see the IUPUI Online Catalog at http://www.indiana.edu/~enrolctr/iniupui/biol/.

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 7-18-00.

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 7-18-00.

BIOL K322 / K323 Genetics Lecture and 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 (one to two) problems and solved problems (one to two), which 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 problems 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 and 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 again with the bulk of each exam emphasizing problems and problem-solving skills. Students are asked to write two lab reports, one on an experiment that the entire participates. This experiment spans two-thirds of the semester; the second lab report requires that students access a genomic database to identify a gene from a partial nucleotide sequence.

All exams in both lecture and lab are graded by the instructors. 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 7-18-00.

[NEW] BIOL K356/ K357 Microbiology Lecture / Lab

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.

[NEW] 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 expansively described in the assessment reports dated 7-16-00 and 6-15-02, 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, scantron

Assessment of N100 using Just-in-Time-Teaching has been extensively described in the Assessment Report dated 6-15-01.

BIOL N217 Human Physiology (Dr. Pflanzer)

Student Learning is currently assessed by the following measures:
4 Lecture exams (objective / scantron)
2 Laboratory exams
5 Laboratory quizzes (unannounced; lowest quiz dropped, formative assessment)
30 Lab reports

For detailed description, see report dated 7-18-00

GRADUATE LEVEL COURSES:

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

Student Learning is currently assessed by the following measures:

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

[NEW] 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)

[NEW] "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.

[NEW] 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 6-15-01.

[NEW] 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, emphasizing problem solving, data interpretation, and experimental design.

Students' lab notebooks are evaluated for content and quality.

[NEW] 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

[NEW] 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.

[NEW] 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.

[NEW] 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 minute review of the chosen subject and then leads a ~30 minute 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%

[NEW] 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 instructor choosing related to stem cell research

[NEW] 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.

[NEW] 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 presenting 1 paper and leading discussion, participating in the other journal clubs

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

Annual Report: June 1, 2002

Course Assessments, Modifications and Improvements

C100
This course serves approximately 120 students per semester drawn largely from the School of Education (Elementary Ed program). Drop+Withdraw+Fail (DWF) rates have averaged 20-25% in this course, so we are fairly happy with student success. Another way we have assessed learning in this course is through the use of a standard pre- and post-survey, administered over several years. A summary of some of the results is shown in Attachment A. Because students are doing well and are satisfied with their learning in this course we have been reluctant to change it. However, changes in state certification requirements for science education may begin to negatively impact enrollments in this course, since one less science course will be required. We have worked with the School of Education on this and are preparing a joint offering with Geology to replace a section of both C100 and G107, courses that have developed a common focus. This course is being developed during the summer, 2002, and will be piloted in the fall. Plans are to convert most sections of C100 to this format by the fall of 2003.

C110
This course was developed to replace our previous course C102 that had experienced severe decreases in enrollments, dropping from over 200 students to less than 20. This course was re-vamped to remove the need for C101 as a pre-requisite. The instructors of the course visited with several units who had previously provided students for C102, most notably the School of Nursing, and discussed the topics and level that would best serve the needs of that student population. Enrollments have increased dramatically, doubling three times since the new title, "The Chemistry of Life," was introduced. Another change which was instituted along with the change in course title and level was to split the 5 credit C102 lecture/lab course into a 3 hour C110 lecture and 2 hour C115 lab. Less than half the students who take the lecture opt for lab, indicating a great need among the student body for a non-lab science course at this level. Our plans are to continue meeting with units that supply students for this course to ensure the course content is aligned with student needs.

C105
Workshop Chemistry, a peer-led method of team learning, was introduced into the C105 course several years ago. We have studied the effect of this change on student performance by looking at both the DWF rate and student performance on the American Chemical Society (ACS) standardized final exam for C106, the second semester of this course. The ACS final covers topics from both semesters and is a measure of retention of learned material over time. This analysis showed that the DWF rate has, in fact, decreased as a result of the introduction of Workshop Chemistry. Further analysis shows that this is largely due to a drop in Ws; in other words, students are being retained at a higher rate without any drop in grade performance. At the end of fall semester, 2001, the withdrawal rate had fallen to less than 12%, the lowest it has ever been and much lower than the normal 30% rate. Because Workshop Chemistry has been so successful we are extending it to the second semester of the course (C106) and will phase it in during the next academic year. Performance on the ACS standardized exam has been consistently above the 50^{th} percentile nationally since the introduction of this teaching method, whereas it often fell below the mid-point before we introduced Workshops. The effect in this measure is less dramatic, however. The previous instructor, Dr. Blake, had begun to introduce a second intervention technique, Just-in-time Teaching (JiTT), but left the university before this could be fully implemented, so we dropped this additional intervention. The results observed in the Physics program are quite impressive, however, so we are considering using this technique in another course (C101).

C125/S125
The laboratory portion of the C105 course (C125) was split off from the lecture several years ago to align our course numbering scheme with the other IU campuses. We subsequently developed a separate honors section, S125, which has grown in popularity and proven to be an excellent recruiting tool for both the Department and the School. The larger course, C125, is currently undergoing a curriculum overhaul under the direction of Prof. Frank Schultz who is developing new experiments and rewriting the textbook for the course. This work will continue throughout the spring and summer; the new laboratory curriculum and textbook is expected to be ready by fall, 2002. Beginning this fall (2002) we will be linking the honors section, S125, in a block with our new separate section of Windows on Science (focused on Chemistry majors), providing a learning community experience for potential Chemistry majors that is tied directly to laboratory work. We believe this will increase the engagement level of students in the Windows section as well as further enhancing the possibilities for retention of these high-quality freshmen.

Upper-level Laboratories
All upper-level laboratory courses have continuously updated curricula. C342, for example, has recently seen the introduction of group synthesis projects. One interesting project involved the synthesis of Prozac starting from benzene. These and other curriculum development efforts strive to increase the relevance of the educational experience to real world situations.

C495 Capstone

The Senior Capstone course continues to develop through the involvement of additional instructors in the department. One problem encountered early on in this course was the need for students to begin thinking about their independent project at least a semester before enrolling in the C495. Advisors consistently and forcefully push this information on the students, the Chair includes information about it in an annual letter to majors, colorful bulletin boards and website postings alert students to the need to plan ahead and develop a project well before their senior graduation semester – but students still register for the course claiming they have never heard or seen any of this information. The quality of the independent project, therefore, is quite low for this subset of students. We are considering ways in which we might require students to register for the course *before* their last semester and file reports regarding their progress in choosing a project and advisor, beginning work on the project (usually, although not always, undergraduate research), etc. Students in C495 are evaluated by both their research mentor and the Capstone instructor and given extensive feedback on both their project and their course portfolio, prepared during the semester they are in C495. Other activities that occur during the semester include: oversight of the SOS Graduating Student Survey (which includes reflection on the Principles of Undergraduate Learning), a few case studies involving ethical issues which may be encountered in a scientific career, preparation of a résumé and guidance on interviewing opportunities, job fairs, and so on. The following shows an example of the template used to give students feedback in this course with comments that might be given to a student (fictitious, here) who we would consider to have done “A” work in this course.

Critique for Jennifer Q. Student
Capstone C495, Spring 2000

	Needs Improve-ment	**Meets minimum Standards**	**Avg**	**Above avg, could benefit from additional work**	**Excellent, little-to-no improvement necessary**
Academic Portfolio[1]					X
Résumé[1]					X
Writing skills[2]					X
Computer skills[3]					X
Presentation style					X
Ability to understand and communicate scientific information				X	
Knowledge of contemporary issues in science and their relation to society			X		
Overall comprehension of chemistry				X	

[1] includes hard copy and electronic versions
[2] based on senior reflection and research summaries
[3] includes word-processing and graphics programs, web page construction, and database searching.

FINAL GRADE: A

Portfolio
Excellent portfolio. Less effort placed on web page construction.
Résumé
Good résumé. Both hard copy and electronic versions provided.
Writing skills
Senior Reflection was not submitted. Only assessment is based on independent project abstract–good writing skills noted.
Computer skills
Knowledge of word processing, spreadsheet and presentation programs. Ability to create web pages, including digital pictures. Some knowledge of CAS searching.
Presentation style
Good preparation seen for all presentations. Excellent overall skills, but could benefit from more attention to scientific detail.

Ability to understand and communicate scientific information
Excellent communication skills seen.
Knowledge of contemporary issues in science and their relation to society
Participated in roundtable discussions, appears to have good knowledge of contemporary issues in science.
Overall comprehension of chemistry
Appears to have good knowledge of chemistry and related fields, particularly biology.
Other comments
Jennifer did an excellent job in all requirements of the Capstone course. Her research and literature presentations were well organized and researched. She has an engaging presentation style and is able to think on her feet when presented with questions in front of an audience. At times, however, her answers seemed a little too glib and showed a hesitancy to think critically when questions went beyond her level of expertise. The instructors encourage her to address this tendency.

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

Annual Report: June 1, 2002

---

1. Introduction

IUPUI strives to serve Indiana as the exemplary “urban university.” The department’s mission, in support of this goal, is to build excellent academic programs coupled with strong research programs, industrial collaborations and community relationships. The department plays a key role in advancing the information technology capabilities of the surrounding community and, indeed, society in general. The three pillars of this mission are its Graduate, Undergraduate and Service Course Programs. These programs of study emphasize research and practice in the basic principles of computing and information processing, which include the creation, representation, storage, transformation and transmission of information, and the mechanisms, both hardware and software, for accomplishing them. To achieve its vision and responsibilities to the community, the department has adopted four strategic objectives:

i. Develop excellent academic programs that will have local and national recognition;
ii. Develop excellent research programs that are well focused and will bring local and national recognition;
iii. Develop strong business and industrial connections through research and academic programs;
iv. Provide leadership in delivering Information Science and Technology to the IUPUI community and Central Indiana.

The department seeks to achieve these objectives by building strong undergraduate programs, developing rigorous graduate programs with emphasis on research, and maintaining a strong, market-driven, service course program in applied computing areas.

Students who complete an undergraduate degree have acquired a fundamental understanding of computing, information processing and information communication. They serve in a variety of programming, software engineering, database administration, systems analysis, computer-systems administration, management and research positions.

The department’s students who complete a B.S. are generally mature persons, with around 70% having transferred previous studies, amounting on average to 50 credit hours. On graduation, the average student has completed 145 credit hours with a GPA of around 3.3. There is no significant difference in GPA between transfer students and departmental students admitted directly to IUPUI.

2. Student Learning Objectives of the Department

A. The Service Course Program

The objective of this program is to provide computing skills and knowledge of computer science concepts to a wide variety of students not in the department's B.S. or M.S. programs. Many students in other departments of the university, including those within the School of Science, take one or more of these at a level appropriate for their background and major program requirements. In doing this, the objective of the student is to broaden his or her general knowledge by achieving a general familiarity with computing as well as problem solving (analytical and critical) tools and skills.

The Certificate Program in Applied Computer Science is the heart of the Service Course Program. This greatly enhances the visibility and flexibility of the service course offerings for students because it responds to aspects of technology that traditional computer science programs do not address. Its mission is to introduce computer science principles, develop practical skills in market-driven software applications, and prepare students to be successful with emerging technologies. It is designed to supplement and enhance a primary degree, so it adds breadth to the students' knowledge as well as some depth in the area of computer science applications.

Students who earn the Certificate demonstrate that they have the core competencies necessary for entry-level positions in information technology. These skills include the ability to solve complex problems, design and implement algorithms, apply computer science theory to practical problems, adapt to technological change and program in at least two languages.

B. The M.S. in Computer Science

The Graduate Committee of the department formalized general learning objectives as well as learning objectives that are specific to the goals the department sets for the graduate students.

<u>Outcomes related to the Principles of General Knowledge</u>

Communication and Core Skills:

- Facility in writing and oral communication as practiced in science and business, with emphasis on the needs in Computer Science.
- Ability to collaborate productively in a group as well as provide group leadership in the area of expertise.
- Capability to comprehend written and auditory technical material.
- Ability to learn and integrate new knowledge, both general and in the area of expertise, and to discuss them intelligently.

Analytical and Critical Thinking:

- Ability to apply mathematical (such as algorithmic procedures and complexity analysis) and computing tools (such as languages and packages) to the formulation and solution of problems.
- Capability to apply inductive and deductive reasoning, abstraction and decomposition to the solution of problems.
- Ability to formulate and evaluate competing models at various levels in the discipline and at general levels in other areas.
- Capability to apply scientific approaches to the solution of problems.

Breadth of Knowledge:

- Capability of intelligently discussing the inter-relationships between the area of expertise and other disciplines, as well as society in general.

Integration of Knowledge:

- Capability to integrate and apply knowledge and experience from various disciplines to form a broad view of the world and to deal successfully with unusual circumstances.
- Ability to successfully apply expertise in computer science to other disciplines and the issues important to the society.
- Capability to facilitate technology transfer, and comprehension of the relationship between basic research and applications.
- A sound set of ethical guidelines for professional and social behavior.
- An understanding of aesthetics and the ability to apply it in the discipline of expertise.

<u>Learning outcomes related to Computer Science</u>

A thorough knowledge of the theoretical foundations and models of computer science:

- A firm understanding of the theoretical foundations of computer science. These foundations and models of computing include principles of data structures (organization of data so as to achieve the maximum performance), algorithms (precise techniques for solving problems), computer organization (functions of and relationships among the various components, such as processor, memory, secondary storage, operating system and their interrelations), mathematics of computers (mathematical tools used in the formal analysis of computing systems and their applications, such as switching theory, graph theory and associated algorithms), theory of language translation (finite automata), abstract computational models (Turing machines and theory of programming languages (different execution models of higher-level languages).
- Ability to analyze different data structures and algorithms and to choose the most appropriate combinations for a given problem.
- Ability to formulate appropriately and devise optimal solutions to problems arising in practice or in research.

- Ability to analyze any problem domain, identify its requirements and characteristics (such as the complexity), model it accurately, select/create appropriate algorithms and object structures, and map the resulting problem solution onto a specific computing system architecture.
- Ability to define, plan, and execute a large-scale, software project following an efficient software engineering process implemented with an appropriate programming language.

Recent computing trends:

Knowledge of advanced computing trends (in all different aspects) and an ability to extrapolate this knowledge in order to adapt quickly to future advances.

C. The B.S. in Computer & Information Science

In 1998, the Undergraduate Committee of the department formalized eight learning objectives that are specific to the goals the department sets for its students. These complement the more general objectives enunciated in the Principles of Undergraduate Learning (PUL). They were published in the *Report on Assessment of Student Learning*, David Stocum, Dean, School of Science, June 19, 1998. The 1999 Undergraduate Committee chose CSCI 230 *Computing I* as the course on which to start the assessment process because it is the first required course for computer science majors. It tailored the eight objectives into six objectives pertinent to this course. These were published in the *Annual Report on Assessment of Student Learning*, School of Science, July 30, 1999, and are summarized below for reference in the subsequent analysis.

In these courses, every student's performance is measured not only by a letter grade, but also by an evaluation against the major objectives that are set for each assignment and exam. These are based on the six Principles of Undergraduate Learning in which the 4^{th} one, "Intellectual Depth, Breadth, and Adaptiveness," is refined to include the six tailored objectives mentioned above:

1. Basic understanding of computing:
   Our students will have a basic understanding of the theoretical foundations of computer science. These foundations and models of computing include principles of data structures (organizations of data so as to achieve the maximum performance), algorithms (precise techniques for solving problems), computer organization (functionalities and relationships of various components such as processor, memory, secondary storage, operating system and their interrelations), and theory of programming languages (different execution models of higher-level languages).

2. Ability to analyze different data structures:
   Selecting an appropriate data structure is extremely critical for performance. Performance can be measured in terms of execution speed and/or computational resource requirements. Different problem characteristics benefit from the use of different data structures. Hence, it is of the utmost necessity to analyze the problem domain and select a suitable data structure from the set of well-known data structures such as linked lists, arrays, stacks, trees, hash tables etc. All these data structures and operations on them are mathematically analyzable. Students will be familiar with various data structures and be able to select the most appropriate one for a given problem.

3. Knowledge of a diverse array of computational algorithms:
   The precise technique, an algorithm, to solve any problem not only guarantees the correct solution, but also achieves it in an optimal fashion. Just like the data structures, students will have an in-depth knowledge of a diverse array of computational algorithms and their mathematical analysis. Algorithms, which our students will know, include searching, sorting, graph, and floating point computations.

4. Basic understanding of computer architecture:
   The structure and functionality of hardware (CPU, I/O, Memory, etc.) and software components (operating system, compilers, interpreters, etc.), and the interrelations among these will be known to our students. This understanding is of the utmost necessity for exploiting the capabilities offered by modern computer systems.

5. Ability to develop and design small-scale software projects:
   Currently used, high-level programming language. Mapping a problem into a specific architecture includes implementing the solution in a particular higher-level language. Advances in programming have facilitated the creation of large software systems, often needed for solving fairly complex real-world problems. Students will be able to apply the principles of Software Engineering to the entire software life cycle (i.e., problem specification, analysis, design, implementation, testing, verification and maintenance) and develop large software systems in at least one currently used high-level programming language.

6. Knowledge of advanced and recent computing trends:
   Computer Science, being a relatively young branch of science, is constantly changing. Students will possess knowledge of the advanced computing trends (in all different aspects) and will have an ability to extrapolate this knowledge to quickly adapt to future advances.

These six objectives plus the five remaining Principles of Undergraduate Learning form the basis for the department's eleven objectives with which it measures student progress in its courses. However, in view of the fact that some engineering students are present in these courses, the department decided this year to incorporate the ABET guidelines for computer engineering and ACM guidelines for computer science curricula into these objectives. This change resulted in a slight broadening of the objectives used previously. Section 4.C. describes these in detail under the new title, General Principles of Undergraduate Learning (GPUL).

3. Assessment Activities

A. New Activities

Because students in the School of Engineering and Technology, particularly those in Computer Engineering, take several of the department's courses, the department decided in 2002 to extend assessment activities to include such courses. Thus, for the spring of 2002, it collected data for CSCI 242 *Computing II for Engineers*, 265 *Advanced Programming* and 403 *Introduction to Operating Systems* as well as for 230.

The Teaching & Learning Committee of the School of Science decided in 2000 that the Capstone Course, which Science majors take during their final undergraduate year, should be assessed according to uniform guidelines. Prior to this time, the departmental Capstone Course, CSCI 495, was taught in a one-on-one (faculty/student) basis, like a research course. The department decided that this structure did not lend itself well to uniform assessment because of the great variation in the faculty/student relationships. This course is now taught as a group project under the direction of one faculty member. This structure enables assessment following closely the uniform guidelines that the Teaching & Learning Committee established. Thus, Section 4.C. discusses assessment data for this course. However, the format of the guidelines differs significantly from those the department has been following for assessing its other courses.

The university administration is rightly interested in the assessment of first year students in order to assure their well-being and retention. Many of the department's students in the B.S. Program, however, are either returning, part-time students, are transfers from other institutions, or do not enter the program their first year because they find it necessary to shore up their mathematics background before they are prepared to undertake the first computer science course. For this reason, the department is keenly interested in the retention rate of its students in the second year in the program, too. It is at this point that many have achieved economic viability as computer programmers and may encounter economic pressures to leave school. To be able to study the situation at this level, the department is building a small customer relations management system and is collecting data for use in tracking its students.

The department is in the process of developing a formal assessment program for the diverse collection of courses in its Service Course Program. This year, it established a placement procedure that guides students in preparing for entry into the Certificate Program.

B. Ongoing Activities

Student Assessment in the M.S. Program

General Academic Standards

- Grades of A and B are expected; up to 6 credit hours of C may be included provided an overall grade average of 3.0 (B) is maintained. Other grades are unacceptable and the course work will not be counted toward fulfilling program requirements as listed on the student's plan of study.

Overall Student Performance

The objective of this type of assessment is to determine whether or not a given student is satisfactorily progressing towards, and finally achieves, the performance objectives that the Graduate Faculty have set for the Program.

- The instructor in each class will evaluate the progress of each student through the course and the final achievement by using the mechanisms and objectives stated in the course syllabus. These vary by course. The mechanisms are typically evaluations of exercises, written and oral examinations, and projects, collaboratively or individually executed. The general outcomes are that the student will understand the theoretical concepts and be proficient in applying them within the context of the course's subject.
- The student must accumulate individual and cumulative performance ratings for all courses taken that satisfy the minimum acceptable standards the department establishes. The outcome here is that the graduate will have a uniformly high technical capability across a broad spectrum of subjects in computer science.
- Each student must demonstrate satisfactory accomplishment in a fundamental domain of knowledge, which the group of Core Courses provides. The outcome of this requirement is that the student will possess solid knowledge of the theoretical basis of computer science.
- Every student must achieve a sufficiently deep command of a specialization area to successfully complete a thesis or project. The evaluations from the specialization courses combined with the evaluation by the student's thesis or project supervisors measure this. The outcome of the student's preparation for this will be that she or he will possess expertise in a specific research or application area for future use in the profession.
- Finally, each student must make a written and public presentation of the thesis or project work, which the student's Examination Committee evaluates. This measures and sets a minimum standard on the student's capability to:

    - integrate appropriately new knowledge with the knowledge and skills presented in the taken courses in ways sufficient to engage in research or the solution of problems arising in practice;
    - communicate effectively, orally and in writing, with colleagues or teammates while solving problems and in presenting the solutions;
    - think analytically and critically and apply a variety of logical and computational tools as aids in this process;
    - articulate clearly the relationships between the area of expertise and other discipline areas and society in general.

Evaluation in the Semester Prior to Graduation

The student’s Graduate Examination Committee examines the student’s Project or Thesis and general proficiency in computer science at the satisfactory completion of her or his program of studies.

Program Assessment in the B.S. Program

The department uses a grading system as the fine-grained component of its approach to assessing learning outcomes. For certain courses, on selected exams, homework and programming assignments, a student's performance relative to each of the objectives enunciated in the eleven General Principles of Undergraduate Learning are evaluated. In CSCI 230, the department expects students to demonstrate only a "breadth" level of knowledge for the six outcomes listed in Section 2 because it is the first course in the major. The evaluations in each course are combined to form a measure of the student's performance relative to the General Principles of Undergraduate Learning. A high rank of this value means that the student has made significant achievement in progressing towards the objectives of the General Principles. For a low one, the individual components of the ranking indicate the areas that need addressing. As mentioned before, the Capstone course, CSCI 495, is evaluated according to the guidelines that the Teaching & Learning Committee of the School of Science established. These are explained more at the end of Section 4.C.

The primary purpose in performing this assessment is not to assign grades to individual students. Rather, it is to determine in what ways the department can improve its instruction to better support its students' achievement of the goals embodied in the General Principles of Undergraduate Learning.

To compare this approach to evaluating student performance with the traditional methods the department uses for grading student performance, the correlations between the measure of learning outcomes mentioned above and the course grade determined according to traditional criteria are computed for the exams, homework and programming assignments. This allows the department to determine whether or not there is a significant discrepancy between the objectives that the traditional methods measure and the General Principles of Undergraduate Learning.

Three of the other vehicles that the department employs to assess the quality of the delivery of its services are described below. These are coarse-grained measures.

Enrollment Data: The department monitors, documents, and analyzes the Drop+Withdraw+Fail (DWF) rate and enrollment data throughout the registration cycle. It uses these latter data particularly for determining course offerings for service courses. Monitoring the data tells it student demands for learning in areas such as Web design and popular programming languages, such as Java and C#. The department continuously adjusts Certificate Program course offerings based on student demand. For our major's courses, enrollment and DWF data are analyzed particularly for determining retention percentages. Low retention can be an indicator of a possible problem that needs further investigation. This information has influenced faculty hiring and assignment decisions as well as course delivery systems.

Recent Alumni and Continuing Student Surveys: The university annually provides the department the results of the Recent Alumni and Continuing Student Survey. This information provides a tool for evaluating the quality of our advising in addition to the quality of our curriculum.

Student Evaluations of Teaching: The department extensively uses the information from these student questionnaires, not only to assess the quality of instruction, but also the quality of specific course content.

Faculty Reviews: As the need arises for specific courses, the responsible faculty committee (Graduate, Undergraduate, Service Course) examines their content, delivery, objectives and student performance in order to maximize the achievement of the program's objectives.

C. Previous Activities

The first fine-grained assessment of the undergraduate major program was done during the fall semester of 1999. No data were collected for spring 2000. The fall data were analyzed in the *Annual Report on Assessment of Student Learning*, July 2000, of the School of Science. Also in that report was a brief history of the department's previous assessment activities and the periodic revisions of the curriculum to which they have lead. Again, assessment data were collected and analyzed in the department's June 15, 2001, *Assessment Report*, which was incorporated into the School of Science's *Annual Report on Assessment of Student Learning* for that year. These reports also discuss the other assessment activities and their results during these periods.

4. Feedback and Response

A. The Service Course Program

The department maintains an ongoing informal assessment of enrollments and student satisfaction and needs. This, in fact, led to the development of the placement procedure for the Certificate Program and the modification of courses in order to serve the students in the School of Informatics.

B. The M.S. Program

As a result of information collected about advising, registration and course scheduling patterns, the department decided to eliminate the requirement that students follow a specific disciplinary track in their Program of Study. Instead, in consultation with their advisors, the students can select courses to develop depth in the area of their Project or Thesis.

C. The B.S. Program

This year, the department did an analysis of the historical DWF rates for the majors over its curriculum. These data reveal that the most troublesome rates occur in the first two levels of courses (200 and 300), with 230, 265, 300 and 362 standing out. The worst offender had been 230 until recently, when its rate began dropping towards acceptable levels. This may be due in part to the recent adjustment the department made in its content. CSCI 300 *Systems Programming* has exhibited a downtrend, so that its present DWF rate is not serious. Some modification in its content was made about the time the trend began, so this might be part of the explanation. The rate for CSCI 362 *Data Structures* has remained relatively constant, but not at a level of great concern. The second most troublesome course has been 265. Historically, it has not been a problem, but recently its rate has been ascending into the region of concern.

Because of the concern about the course, the Undergraduate Committee last year evaluated the content and delivery of CSCI 265 and made some recommendations. Because this is a foundation course for the majors' curriculum, the committee examined the impact of these recommendations this year. The one semester's DWF data since these were implemented do show some improvement. About half of these problematic CSCI 265 students received an F and half withdrew, so these are non-performing students, not under-performing ones. There is a certain sagging of grade as some of the students progress from 230 to 265, which suggests that they are entering 265 without the maturity to do well in a more rigorous course. Based on its study, the committee concluded that the content and delivery of 265 now needs no significant changes, but that the difficulties some students have in it arise primarily from the preparation they derive from CSCI 230. This latter course has large sections, which may leave some students without the motivation to develop the self discipline they will need in significantly more demanding courses later in the program. The analysis of the data from 230 in the 2001 Annual Report suggested that this course be reviewed for ways to reduce the percentage of non-performing students. These are students who do not turn in assignments or attend examinations; eventually they contribute to the course's DWF rate, as in the semester cited above. Because of these observations, the committee recommended a number of changes to 230 that might help to increase the students' engagement in their own progress. It is also advisable for the department to continue monitoring the DWF rate in 265 in search of ways to reduce it.

The eleven General Principles of Undergraduate Learning against which the students are now evaluated are summarized below for convenient reference in the following.

Definitions of The General Principles:		
1	The ability to write, read, speak and listen, perform quantitative analysis, and use information resources and technology, both individually and in teams.	
2	The ability to analyze carefully and logically information and ideas from multiple perspectives.	
3	The ability to use information and concepts from studies in multiple disciplines in their intellectual, professional, and community lives, and a commitment to update these continually.	
4	The ability to examine and organize disciplinary ways of knowing and to apply them to specific issues and problems, both in teams and individually:	
	4.1	Basic understanding of computing;
	4.2	Ability to analyze different data structures;
	4.3	Knowledge of a diverse array of computational algorithms;
	4.4	Basic understanding of computer architecture;
	4.5	Ability to develop and design small-scale software projects;
	4.6	Knowledge of advanced and recent computing trends.
5	The ability to recognize their own cultural traditions and to understand and appreciate the diversity of the human experience, both in the U.S. and internationally.	
6	The ability to make judgments with respect to individual conduct, citizenship, and aesthetics. Ability to recognize ethical and professional responsibilities and evaluate current issues.	

Specific Comments Concerning the Manner of Rating Student Achievement:

Each student is evaluated for each Principle on a maximum Score of 10 points; this includes those Principles not important for the assignment.
The student is scored on a Principle irrespective of how important that Principle is in the assignment.
The importance of a Principle is weighted for the particular exercise. - The sum of the weights over all Principles is one.
The Class_Mean for a Principle (out of 10 points) indicates the students' performance on the Principle relative to expectations of a maximum of 10.
This is a measure of how well the assignment communicates the Principle to the students relative to the maximum Score.
The Class_Mean of the Weighted Student PUL Means is a measure of how well the assignment communicates the PUL's to the students relative to the maximum Score. It is also the weighted sum of the Class_Means.
The Class_Mean*Weight is a measure of how well the assignment communicates the given Principle to the students.
A typical ideal value would be the Principle's Weight times the maximum Score.

What follows is a report and analysis of the data that was collected on the B.S. curriculum during the 2001 – 2002 academic year. To prevent large class sizes from making the collection effort unmanageable, data is typically collected only for a few instruments; in 230, these are two assignments and an exam.

Summary data for each of the evaluation instruments for the spring of 2002 are tabulated in the remainder of this section. This analysis parallels that reported for the 2000 – 2001 academic year. In the tables, each column 1 to 11, from left to right, corresponds sequentially to the General Principle of Undergraduate Learning listed above. The 12th column, first row, is the Weighted Student Mean across the preceding 11 columns averaged over the class and the second row in that column is the corresponding standard deviation for that average. The instructors set the weights according to how they believe the work of the instrument supports the development of ability in the area of the Principle. Most set the weights equal except for the last two Principles, which they weighted zero because they deemed them not to be represented significantly in the instruments. When a Principle has Weight 0, the student is scored the maximum value (10) because no effort is required to meet that expectation. The right-most column is the traditional grade (based on the maximum value listed at the top of the column) averaged over the class.

The correlation between a student's traditional grade and the Weighted Student Mean across the eleven General Principles of Undergraduate Learning was calculated over the class for each instrument. For each instrument, the correlation was so high that the hypothesis "*the correlation coefficient, rho, is zero*," was rejected using a 5% critical value. Confidence bounds of 95% on the correlation coefficient are presented.

The high correlations exhibited here indicate that the traditional grade on a task, such as an assignment, will likely reflect well a student's accomplishment of the overall collection of objectives in the General Principles of Undergraduate Learning. The breakdown of the achievement measure into scores on the individual General Principles as described above permits drawing conclusions about which General Principles are being addressed adequately and which are not. A caveat to bear in mind when performing such analysis is that not all topics of any given course need to address equally strongly all of the General Principles. This is why students are required to take courses across a spectrum of subjects within the department and throughout various other departments and schools.

<u>CSCI 230, Spring 2002:</u>

Lab Assignment

Class_Mean	7.6	7.6	7.4	7.4	6.5	6.5	7.1	7.2	7.2	10.0	10.0	7.2	77.7
Class Standard Deviation	3.0	3.0	3.0	3.0	3.4	3.3	3.2	3.2	3.1	0.0	0.0	3.1	28.4
Class_Mean*Weight	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.8	0.0	0.0		

rho = .9569 [.9566, .9573]

The first thing to note is that the Standard Deviation indicates the wide dispersion of the data. This is in part due to the significant presence of non-performing students, i.e. ones who scored 0 on an item because they did not do the assigned task. This indicates a need to emphasize to the students the importance of doing assignments.

In the row of the Class_Mean, two General Principles (data structures and algorithms) rated low (6.5 relative to a maximum of 10) on this assignment. This is not surprising because these central concepts typically are hard for students to grasp well early in their academic career. The traditional average grade assigned (in column 13) is around the typical average for this course and on the order of the desirable average. The Weighted Mean of the GPUL ratings over the class, 7.2, from column 12, also seems acceptable compared to the ideal value of 10. The third row confirms these observations.

Lecture Assignment

Class_Mean	6.8	6.7	6.5	6.7	6.0	5.8	6.3	6.5	6.3	10.0	10.0	6.4	67.8
Class Standard Deviation	4.0	4.0	3.8	3.9	3.6	3.5	3.7	3.7	3.7	0.0	0.0	3.8	40.7
Class_Mean*Weight	0.8	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.0	0.0		

rho = .9965 [.9964, .9965]

As for the Lab Assignment, the dispersion of the scores is large, leading to the same recommendation for this subject matter.

In this case, the General Principle 4.3 (algorithms) rates low (5.8 relative to 10). Again, the Weighted Class_Mean data in the third row confirm this, which suggests that the instructors examine how the subject matter of this assignment could be modified to increase the students' ability to think algorithmically. The traditional grade average of the class shown in column 13 is perhaps somewhat lower than desirable, but not unexpected for a student population such as this. The high correlation here between the students' individual traditional scores and their Weighted Class_Means suggests that the Weighted Class_Mean here, 6.4, is also within an expected range for such students.

Last Exam

Class_Mean	5.3	5.3	5.3	5.2	4.0	3.9	5.2	5.2	5.2	10.0	10.0	5.0	52.5
Class Standard Deviation	3.0	3.0	3.0	3.0	2.6	2.6	2.9	2.8	2.7	0.0	0.0	2.8	28.5
Class_Mean*Weight	0.6	0.6	0.6	0.6	0.4	0.4	0.6	0.58	0.6	0.0	0.0		

rho = .9683 [.9680, .9686]

The dispersion of the rankings is still quite large, despite that fact that this is an examination, which students are more likely to attend, whereas they feel freer to downgrade assignments in the press of priorities. Again, this seems due in part to the number of non-performing students (10%) in the sample. Values in the Weighted Class_Mean row seem low, particularly for GPUL items 4.2 and 4.3 (data structures and algorithms). Also, the traditional grade average seems lower than desirable on this instrument, (why is it significantly lower than that of the programming assignment, i.e. Lab?) Given the high correlation between these scores and the individual students' weighted GPUL means, the Weighted Class_Mean, 5.0, likely represents a not very satisfactory value. This leads to the recommendation that the instructors examine ways to increase the support that the course gives to comprehending algorithms and data structures.

Course-wide Data

To obtain statistics that can be used to evaluate the impact of the overall course on the students' achievement of the individual General Principles of Undergraduate Learning, the data for the separate instruments were combined using their respective weights, 50%, 4.9%, and 12.5% relative to the overall course grade. The result is the analogous table below, which can be used to draw conclusions about the general nature of the course, as opposed to a specific task.

Class_Mean	7.1	7.1	7.0	6.9	6.0	5.9	6.7	6.8	6.7	10.0	10.0	6.7	72.3
Class Standard Deviation	2.8	2.9	2.9	2.9	3.0	3.0	3.0	2.9	2.9	0.0	0.0	2.9	27.5
Class_Mean*Weight	0.79	0.79	0.77	0.77	0.67	0.66	0.75	0.76	0.75	0.00	0.00		

Again, the Standard Deviations show that the dispersion of the data is moderately large for the first nine General Principles. The Class_Mean for each General Principle ranges moderately from about 67% to 71% of the maximum possible 10, except for the two corresponding to data structures and algorithms. The value 6.7 in column 12 of the first row is the Weighted sum across the Class_Means in that row. It is a measure of the overall impact of the course across the class. The value 72.3 next to it is the class traditional grade average for these three instruments. This is about the level of achievement that might be expected for a beginning class of this size. The high correlations of the individual, traditional grades with the achievement rankings for the General Principles suggest that the value, 6.7, is also a typical rating.

The third row, which contains the product of the Class_Mean by the corresponding Weight, varies moderately (relative to a high of about 1.1), again except for data structures and algorithms. This shows that the weakness observed in data structures and algorithms is also coming through in the global statistics. Thus, it merits reiterating that the instructors examine the course material for ways of supporting the learning and use of these concepts.

It might be fruitful to examine what intervention in the course could be performed that would tend to raise all of these scores closer to the maximum. The two zero weights for the last two General Principles indicate that these are not significantly reflected in the course, according to the instructors' opinion. However, it is arguable that this should be true of the last Principle, which has to do with ethics and aesthetics. Although these may not be direct topics in the course, an argument can be made that an ethical standard of conduct reigns in the work expected of the students and that there are aesthetical standards applying to the design of computer programs, such as simplicity, elegance and efficiency. Dedicating class time to these topics would undoubtedly raise the value of the Weighted sum across the Class_Means above its current value of 6.7. That is, explicitly recognizing more in class the roles of ethics and aesthetics in the professional life of computer scientists would increase the students' accomplishment of the university's educational goals.

In summary, the theme that runs through the foregoing analysis of the data collected during the academic year 2001 – 2002 suggests that the department evaluate the course CSCI 230 for ways to reduce the number of non-performing students and to augment the achievement of the course objectives, particularly those that contribute to the General Principles 4.2, 4.3, and 6.

<u>CSCI 265, Spring 2002:</u>

This year, the department did an assessment of 265 *Advanced Programming* that is analogous to that done for 230. The weights are the same as for 230. However, the department collected data for only two instruments, a programming assignment and the last test. The tabular data appear below. Again, the dispersion is large as to be expected with the number (around 17%) of non-performing students. The correlations between the traditional grades assigned the students and their GPUL scores are high. This suggests that the Weighted Class_Means (column 12) and the means of the traditional Grades (column 13) in the first rows of these two tables reflect comparable performances across the class, although on somewhat different criteria. Given the letter grade scale established for the course, the grade averages here seem somewhat low. This suggests that the department look for ways to improve the response in the course on all GPUL areas. Here, in contrast to 230, the GPUL scores are remarkably uniform. Thus, these data do not highlight any particular General Principle that needs to be addressed.

Assignment

Class_Mean	5.8	6.0	5.8	6.0	6.0	5.9	5.9	6.0	6.1	10.0	10.0	5.9	59.4
Class Standard Deviation	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.6	36.5
Class_Mean*Weight	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0		

rho = .956, [.956, .957]

Last Test

Class_Mean	6.1	5.9	6.0	6.0	6.0	6.0	6.0	6.0	6.0	10.0	10.0	6.0	63.5
Class Standard Deviation	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0	3.2	33.2
Class_Mean*Weight	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0		

rho = .968, [.968, .969]

Course-wide Data

To obtain statistics, as with 230, that can be used to evaluate the impact of the overall course on the students' achievement of the individual General Principles of Undergraduate Learning, the data for the separate instruments were combined using their respective weights, 6% and 25%, relative to the overall course grade. The result is the analogous table below. The data essentially confirm the observations from the individual instruments.

Class_Mean	6.0	5.9	5.9	6.0	6.0	6.0	6.0	6.0	6.0	10.0	10.0	6.0	63
Class Standard Deviation	3.1	3.2	3.1	3.2	3.2	3.2	3.2	3.2	3.2	0.0	0.0	3.2	32.7
Class_Mean*Weight	0.67	0.66	0.66	0.67	0.67	0.66	0.66	0.66	0.66	0.0	0.0		

<u>CSCI 490 (new course 242 *Computing II for Engineers*), Spring 2002:</u>

This is a course specially designed for students in the School of Engineering and Technology. For this reason, the instructor felt that not all of the General Principles rated in 230 were appropriate for this course. Accordingly, the weights are not equal. Those for GPULs 3, 4.5, 4.6, 5 and 6 are zero. Those for GPULs 2 and 4.3 are one tenth, while those for GPULs 1, 4.1, 4.2, 4.4 are two tenths. This places the emphasis on communication and quantitative analysis, basic computing, data structures and computer architecture.

This was a small class, and no non-performing students were reported in the data. Notably, the dispersions in the two instruments reported are somewhat smaller than for 230 and 265. The correlations between the traditional grades of the students and their ratings on the GPULs are lower than for 230 and 265, but still quite high.

Assignment

Class_Mean	8.0	8.3	10.0	8.7	8.9	8.4	8.8	10.0	10.0	10.0	10.0	8.5	85.8
Class Standard Deviation	3.4	3.3	0.0	3.3	3.3	3.3	3.3	0.0	0.0	0.0	0.0	3.3	32.9
Class_Mean*Weight	1.6	0.8	0.0	1.7	1.8	0.8	1.8	0.0	0.0	0.0	0.0		

rho = .889 [.863, .909]

In the Assignment, the Class Mean does not vary over a wide range. However, because of the variation in the weights, the third rows with the Class Means times the respective Weights give a better idea of the contribution of a General Principle to the overall performance rating, 8.5. These must be valued relative to their approximate maximums, though, 2 in the case of weight .2 and 1 in the case of weight .1. Also notable is that the scores are considerably higher than for 230 and 265. The effect of the class size in this is unknown. A significant factor is likely to be the nature of the assignment.

Last Test

Class_Mean	6.3	7.4	10.0	7.9	7.2	7.3	7.7	10.0	10.0	10.0	10.0	7.3	69.3
Class Standard Deviation	2.3	2.7	0.0	2.0	2.7	2.7	2.6	0.0	0.0	0.0	0.0	2.2	21.6
Class_Mean*Weight	1.27	0.74	0.00	1.58	1.44	0.73	1.53	0.0	0.0	0.0	0.0		

rho = .880, [.853, .903]

The GPUL that appears weakest here is the first, related to communication and quantitative analysis. The row with the weighted means confirms this. This suggests that the instructors seek ways to reinforce this capability in the course. It is also arguable whether or not GPUL 3, related to integrating knowledge from multiple disciplines, should not be a factor in a course whose purpose is to provide students from one discipline with knowledge from another for integration into their professional repertoire. Including it as a factor in the assessment may tend to raise the overall performance scores.

CSCI 403, Spring 2002:

Only one instrument was reported for this course this year. It included no non-performing students. The GPULs 3, 5, and 6 are assigned weights of zero, indicating that the instructor believes that they are not significantly supported by this instrument; the remaining weights are equal (1/8).

Assignment

Class_Mean	8.3	6.7	10.0	9.0	8.7	8.7	5.6	8.1	7.3	10.0	10.0	7.8	73.3
Class Standard Deviation	1.4	1.5	0.0	2.0	1.3	1.3	1.9	1.3	1.2	0.0	0.0	1.0	11.7
Class_Mean*Weight	1.0	0.8	0.0	1.1	1.1	1.1	0.7	1.0	0.9	0.0	0.0		

rho = .909, [.908, .911]

The dispersion in this case is considerably lower than for the lower-level courses. The correlation between the GPUL scores and the traditional grades is high, as in the previous courses. The GPULs that rated somewhat low here are 2 (logical analysis) and 4.4 (computer architecture). Because this is a high-level course, this suggests that it and the lower-level courses in the curriculum be examined to find ways to support the ability of students to reason logically and analytically from multiple perspectives in order to meet the demands of their higher-level courses and eventual employers.

CSCI 495, Spring 2002:

As indicated earlier, the format for evaluating the Capstone course is standard across all departments in the School of Science, but differs from the format the department uses to assess the other courses it has analyzed in the Annual Reports. The table on the following page shows the assessment the instructor responsible for the class in CSCI 495 *Explorations in Applied Computing* made for this year. This shows a general satisfaction with the performance of the students on the PUL (not GPUL) categories decided upon by the Teaching & Learning Committee, except for written communication. This is despite the fact that a great majority of the students will have completed a semester of English composition and a subsequent semester of advanced technical writing, TCM 320 *Written Communication in Science and Industry*. A few of the majors' courses, such as CSCI 450 *Principles of Software Engineering*, do require a significant amount of writing, which develops this ability. Others do, depending upon the demands of the instructor. Required courses of this nature would be 265, 300, 362, and 403 in which writing significant programs is normally required. Requiring careful documentation of these would support the principles of good software engineering while developing skill in written technical communication.

School of Science Template
for Assessment of the Capstone Experience

Data from CSCI 495, Section B374, Spring 2002 Session

	Needs Improvement	Meets Minimum Standards	Good	Excellent	Not Applicable
Shows ability to formulate problems, solve them, and interpret their solution.		22%	44%	33%	
Shows understanding of the scientific method.		11%	56%	33%	
Displays overall comprehension of own discipline.		22%	56%	22%	
Shows ability to communicate ideas of discipline:					
Orally.		11%	89%		
In writing.	22%	11%	67%		
Gives experience in applying knowledge:					
From own discipline to other disciplines.					X
From one area of own discipline to another area.					X
Makes efficient use of:					
Technological tools.					X
Scientific resources (e.g., journals).		33%	44%	22%	
Shows knowledge of contemporary and ethical issues in science and their relation to society.			100%		
Displays appreciation of the historical development of (an area of) the discipline.					X

Note: There were 9 students enrolled in this class. The assessment is based on the score associated with the number of students.

5. Future Assessment Plans

A. The Service Course Program

The Service Course Committee will formulate recommendations on what and how to assess the quality of the courses that make up the Service Course Program, and in particular the Certificate Program. It is intended that the Principles of Undergraduate Learning play a significant role in the criteria. However, the nature and implementation of the assessments may differ significantly from those being used in the B.S. Program in Computer & Information Science because the objectives and student clientele are different.

B. The M.S. Program

The department intends to continue monitoring the curriculum and the accomplishments of the students, as is described in Section 3.B.

C. The B.S. Program

Although the fine-grained, numerical assessment method reported in the tables here is labor intensive and somewhat orthogonal to the evaluation of the objectives that the department's instructors normally make, the department will continue it for CSCI 230 and 495 during the academic year 2002 – 2003. Once the customer relations management system for students is completed, as mentioned in Section 3.A, the department will track the progress and retention of the mid-level students based on grades, registration and drop rates. The department does not contemplate a detailed assessment against the General Principles of the students at this level for the present time.

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

Annual Report: June 1, 2002

In accordance with the strategy agreed upon in the School of Science's Teaching and Learning Committee, the Geology Department used an introductory course and the capstone course to begin the assessment of student learning to obtain feedback that will assist in evaluating the curriculum.

1. **Introductory Course:** Introduction to Petrology (G222) is a sophomore-level course for majors that is required for all higher-level courses in Geology.

   The course has three components: a thorough exposure to chemical principles involved in the formation of rocks; principles used to classify rocks based on their composition and mode of origin; and experience in identification of rocks.

   Discussions between the instructor and students indicated that problem-based exercises and examinations typically used did not adequately measure students' understanding of the material. So, a variety of changes were made to the course during the 1998-1999 school year to introduce active learning experiences into the curriculum.

   These activities include a recitation section, small group discussions of material in the textbook have been added to the usual material on problem-solving, additional numerical exercises to illustrate principles, essay questions on examinations (in addition to the normal problem-based questions), and a term project involving original data collection and synthesis.

   Results of the changes were encouraging, although the class size was small – eleven students. The instructor saw clear evidence of improvement from the previous year's class, and felt that it was due to the increased interactions. Test grades were higher than in the past, and students' ability to explain concepts orally in class were satisfactory.

   The results of these changes suggest that the new activities are worthwhile and that variations of them might provide additional benefits.

2. **Capstone Course:** The Geology Department's Capstone Course is G420: Summer Field Camp. This course involves three weeks of fieldwork in the San Bernardino Mountains in California. In this experience, students make use of knowledge gained in every course required for the major: G110: Physical Geology, G209: Historical Geology, G221-222: Mineralogy and Petrology, G303: Field Methods, G323: Structural Geology, and G334: Sedimentation and Stratigraphy.

Students spend several days collecting data related to each subject area and incorporate the data into a report and a geologic map of the area studied. The geologic map represents a synthesis of their undergraduate experience because a satisfactory map contains information about the entire history of an area and shows how various geologic processes interact (e.g. rock type and kind of deformation; fossil assemblage and sedimentary history).

Feedback from instructors has led to changes in some of the sophomore- and junior-level courses Geology majors take before taking G420.

a. Evaluation of students in the summer 1999 Capstone course indicated that students would benefit if more time were spent in G209: Historical Geology, on the historical development of the western part of the North American continent. Emphasis on this topic would provide contexts for students when they attempted to make sense out of the information they collected during fieldwork.

   The instructors of G209 agreed to make the suggested changes to the curriculum. Results of the change should become known in the summer 2002 session of G420.

b. One of the major problems noticed by instructors of the Capstone Course is that students find it difficult to take information from isolated outcrops of rock and visualize in three dimensions the structures that are suggested by the outcrop data.

   The junior-level course, G323: Structural Geology addresses three-dimensional visualization, so the instructor of that course modified it to give students more practice in problems that require students to visualize situations from a variety of perspectives. A set of gradational exercises involving most of the components of the course, that use basic trigonometry and concepts from mechanical drawing, has been designed to examine geologic structures in two and three dimensions. The exercises utilize a limited number of techniques to address a variety of kinds of problems. The intent is to get students used to the idea of using the techniques whenever they are faced with questions that involve three-dimensional situations. A paper describing the approach appeared in the March 2002 issue of the Journal of Geoscience Education.

The criteria used in evaluating success in the capstone course are shown on the following pages. Data entered in the table are based on the students taking the course during summer 1999.

School of Science Template
for Assessment of the Capstone Experience

Data from G420: Field Geology, Summer 1999 Session

	Needs Improvement	Meets Minimum Standards	Good	Excellent	Not Applicable
Shows ability to formulate problems, solve them, and interpret their solution.		2	5		
Shows understanding of the scientific method.	1	4	2		
Displays overall comprehension of own discipline.		2	5		
Shows ability to communicate ideas of discipline:					
Orally.					
In writing.		2	3	2	
Gives experience in applying knowledge:					
From own discipline to other disciplines.					
From one area of own discipline to another area.	1	1	3	2	
Makes efficient use of:					
Technological tools.					
Scientific resources (e.g., journals).		2	3	2	
Shows knowledge of contemporary issues in science and their relation to society.					7
Displays appreciation of the historical development of (an area of) the discipline.					7

Data from G420: Field Geology, Summer 1999 Session

Principles of Undergraduate Learning	Tasks Performed	Does not Meet Minimum standards	Meets minimum standards	Good, but could benefit from additional work	Excellent. Little-to-no improvement necessary
1	Collects and records data in the field accurately and effectively		2	3	2
2 and 3	Synthesizes data	1	4	2	
3	Three dimensional interpretation of geologic data	1	1	3	2
4	Places geologic results & interpretation in temporal context		2	5	
1	Oral & written communication of scientific results and interpretation		2	3	2

Numbers in this table represent how many of the seven students enrolled in the Capstone Course in Summer II, 1999, satisfied the criteria for the five kinds of tasks evaluated.

	Principles of Undergraduate Learning	
1. Communication and quantitative skills.		4. Intellectual depth and breadth.
2. Critical thinking.		5. Understanding society and culture.
3. Integration and application of knowledge.		6. Values and ethics.

Criteria used in filling out the rubric

Collects and records data in the field accurately and effectively.

Does not meet minimum standards.	Field notes are not organized effectively. Student does not define symbols used and descriptions of features at the outcrops are too sparse to be useful.
Meets minimum standards.	Data for each outcrop are clearly separated, and standard symbols are used.
Good, but could benefit from additional work.	Organization of field notes is clear. Data collected seems adequate to analyze the problem presented. Sketches of large-scale structures made at each outcrop as a check on interpretation.
Excellent. Little-to-no improvement necessary.	Organization of notes is clear. Data are recorded with cross-references to outcrops seen earlier. Sketches of large-scale structures made at each outcrop as a check on interpretation.

Ability to synthesize data.

Does not meet minimum standards.	Student does not recognize relationships between disparate sets of data.
Meets minimum standards.	Student recognizes when new data pertain to previously collected data.
Good, but could benefit from additional work.	Student has developed rudimentary mental contexts to use in evaluation of new data.
Excellent. Little-to-no improvement necessary.	Student has well-developed mental contexts by which new data can be evaluated.

Three-dimensional interpretation of geologic data.

Does not meet minimum standards.	Student does not seem to visualize spatial relations between outcrops.
Meets minimum standards.	Student can correlate contacts across the area studied.
Good, but could benefit from additional work.	Student recognizes where units are in the stratigraphic sequence.
Excellent. Little-to-no improvement necessary.	Student clearly has developed a mental model of the large-scale structures, which includes the plunge and the effects of faulting.

Placement of geologic results and interpretation in temporal context.

Does not meet minimum standards.	Student does not recognize sequence of origin of different features.
Meets minimum standards.	Student can put features in correct sequence of origin.
Good, but could benefit from additional work.	Student can construct a rudimentary history of the area based on the sequence of origin of features observed.
Excellent. Little-to-no improvement necessary.	Student has developed an accurate stratigraphic section, and has a clear understanding of the sequence of intrusions, faulting and folding.

Final report and geologic map.

Does not meet minimum standards.	Report not complete; interpretation incomplete or wrong. Grammar is poor. Map is poorly drawn.
Meets minimum standards.	Report is complete, but some interpretations are wrong and the report's organization needs improvement. Grammar needs work. Map and stratigraphic section are largely adequate.
Good, but could benefit from additional work.	Organization of report is good. Interpretations are accurate. Description of relationships between structural and sedimentary events could be stronger. Grammar is adequate to good. Map and stratigraphic section are accurate.
Excellent. Little-to-no improvement necessary.	Report is complete, well organize, and interpretations are correct. Grammar is adequate to good. Map and stratigraphic section are accurate and visually acceptable.

As part of the assessment process, the Geology Department developed a table illustrating how each of the Undergraduate Principles of Education are addressed in our curriculum. The results are shown in the table on the following page.

Matrix for the Principles of Undergraduate Learning

Department of Geology

Principle	**Ways of Accomplishing the Principle**	**Learning Objectives Associated with the Principle**	**Strategies for Applying and Improving Accomplishment of the Principle**	**Assessment Methods for the Principle**	**Feedback to the Program**
Comprehending, Interpreting, and Analyzing Texts	Assigned readings from the professional literature	Understanding of technical material in context of a particular course	Level of readings assigned tailored to the level of the course and topic covered.	Write summaries of articles. Oral presentation of material in the articles.	Adjust lecture material to better prepare students for the readings.
Quantitative Analysis	Interpretation of graphical data in professional literature. Order of magnitude calculations. Application of statistics to data sets collected in the field.	Understanding of the relevance of quantitative methods to particular subject areas.	Give practice in doing various kinds of calculations.	Successful completion of assignments. Ability to discuss results orally in class.	Vary the cognitive level of the assignments, based on student success.
Writing Skills	Require technical writing course in the geosciences. Assign short and long papers in every course majors take. Include writing assignments in courses for non-majors.	Be able to construct a logical argument and express it clearly and correctly in written form.	Discuss structure of expository argumentation. Discuss criteria for clear writing. Grade all assignments partly on grammar and expression.	Evaluate written assignments for logic, content, and grammar	Class discussions of all written assignments, based on logic, content, and grammar.
Oral Communications	Required technical writing course in the geosciences has an oral communication component.	Be able to express ideas clearly to a group.	Provide criteria for acceptable presentations and short talks at first, to give feedback.	Videotape presentations so students can see themselves giving presentations.	Remind students to review previous videotapes before giving next presentation.
Use of Technology	Give assignments involving spreadsheets, graphics programs, and statistical packages. Field course involves use of GPS in mapmaking.	Become comfortable with modern ways to calculate, and to synthesize data.	Geologic techniques are discussed in the context of the technologies to be used.	Assess approaches students take to analyze data, as well as the accuracy of their results.	Vary the cognitive level of the exercises to ensure that students continue to improve.
Critical Thinking	Approach problems with multiple working hypotheses. Critique professional articles based on classroom work.	Recognize that more than one explanation is possible. Learn how to evaluate hypotheses.	Provide exercises that are open-ended. Require students to develop multiple explanations to problems.	Compare student progress in thinking over the semester.	Relate concepts from logic to student explanations in exercises.
Intellectual Depth, Breadth, and Adaptiveness	Classroom and laboratory exercises. Field experiences.	Recognize relations between cognitive activities approached in different manners.	Ensure that all exercises assigned are related at some levels.	Require application of classroom topics to field exercises and vice versa.	Modify classroom exercises as deficiencies in field applications develop.
Integration and Application of Knowledge	Classroom and laboratory exercises. Field experiences.	Recognize relations between cognitive activities approached in different manners.	Ensure that all exercises assigned are related at some levels.	Require application of classroom topics to field exercises and vice versa.	Modify classroom exercises as deficiencies in field applications develop.
Understanding Society & Culture	Classroom Discussions	Evaluate goals and consequences of scientific activities	Introduce societal concerns in classes and exercises	Require discussions of societal concerns.	Tailor discussions to suit the particular mix of students.

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

Annual Report: June 1, 2002

As outlined in last year's report, the Department of Mathematical Sciences has in place assessment procedures for five courses.

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.

The assessment process for these three courses entails identifying Student Learning Course-Specific Outcomes for these courses. Data on each exam in these courses is collected and analyzed as follows: problems are assigned to one or more of the course-specific outcomes for the given course. In this way, a score is determined on each exam for each student on each of the above outcomes. Aggregate class scores on the different outcomes can then be compared across sections and at different times of the semester providing feedback on the effectiveness of the instruction given. This information is being passed on to instructors and mentors so that they can increase emphasis on those topics that prove to be most problematical. Also, instructors and course coordinators can develop more consistent ways of presenting this material. For example, we have been able to identify:

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.

Upper-division major courses: MATH 351 and 492

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 a course instructor indicates the extent to which the math majors in his section have mastered these skills. However, we intend to use these forms to determine areas of strength and weakness of individual students so that they can be advised of the areas that require improvement.

Math 492 is the capstone experience. The questions asked on the 492 assessment form essentially assess attainment of the Principles of Undergraduate Learning (PUL) objectives while also assessing achievement of the discipline specific goals. The form is based on the template developed by the School of Science Teaching and Learning Committee. We have used this form for only one year; however, we will be using this form both to assess how well the capstone experience is serving its intended purpose (requiring that students show growth in all the PUL's, and in discipline specific outcome goals) and an assessment tool to assess how well our programs are achieving their goals. Results so far indicate that the projects are, as intended, requiring the students to display a variety of both quantitative and communication skills. One unexpected finding is that not many of the capstone projects are requiring students to exhibit an understanding of the nature of proof, although they are requiring students to exhibit ability to formulate and solve problems.

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

Annual Report: June 1, 2002

Introduction

The Department of Physics grants the Bachelor of Science, Master of Science and Doctor of Philosophy 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 school. 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 in Physics for our majors. This course has undergone extensive innovation and assessment in recent years. PHYS 218/ PHYS 219 is an algebra-based sequence for engineering 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 that science and technology play in society to the necessity of unbiased assessment and reporting of scientific data.

Departmental Activities since the last NCAC review.

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. A report was received by the Department in 1996. Several suggestions of the external committee have since been acted upon, such as formation of an industrial advisory committee, a new course offering in computational physics, and discussions with Engineering about a combined Physics/Engineering B.S./M.S. degree.

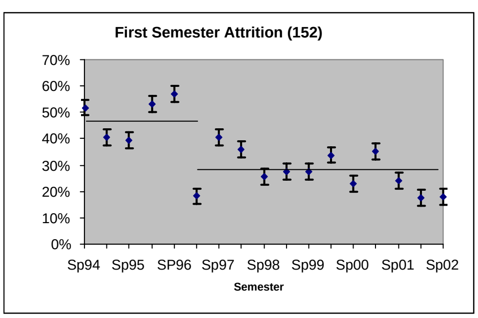
Introductory Calculus-based Physics

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.

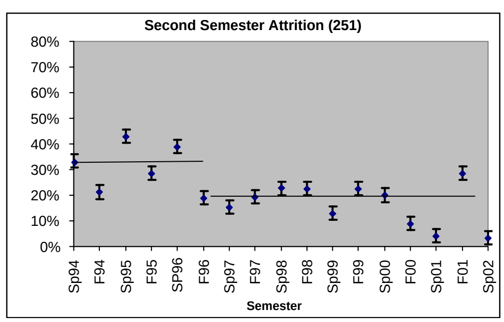
Retention

Table II: Summary of DFW rates in Physics 152/251

Semester/course	**152**	**251**
Sp94	52%	33%
F94	40%	21%
Sp95	40%	43%
F95	53%	29%
SP96	57%	39%
F96	18%	19%
Sp97	40%	15%
F97	36%	19%
Sp98	26%	23%
F98	27%	23%
Sp99	28%	13%
F99	34%	23%
Sp00	23%	20%
F00	35%	9%
Sp01	24%	4%
F01	18%	29%
Sp02	18%	3%



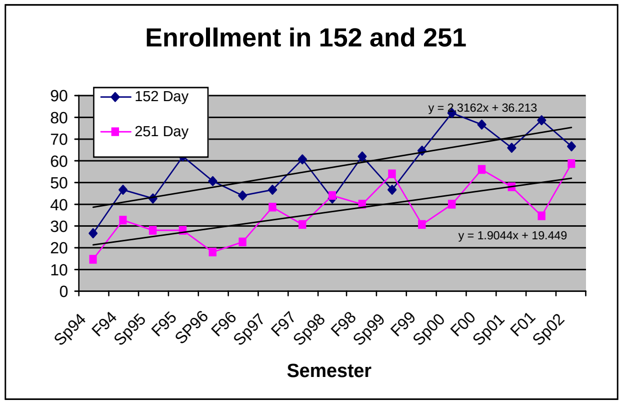
(a)



(b)

Fig 1 Graphs of the DFW rates in (a) Physics 152 (Mechanics) and (b) Physics 251 (Heat, Electricity and Optics)

The retention data shown in Table II and Fig 1 show a significant improvement in retention between the traditionally taught sequence: (Sp94-F95)<DFW(152)> = 42%, <DFW(251)> = 33%
and the sequence using JiTT methods: (Sp96-Sp01)<DFW(152)> = 27%, <DFW(251)> = 17%. It is noteworthy that the JiTT data include several semesters taught by instructors that did not participate in the development of the JiTT method. Therefore, these results cannot be explained exclusively by instructor-dependent effects. It is also worth noting that these changes have occurred in an environment of steadily increasing enrollments, see Fig. 2



Standardized Tests

Another means to assess our courses is through the use of standard pre-test/post-test instruments, such as the Force Concept Inventory (FCI). The FCI is a nationally recognized test of student conceptual gains in introductory mechanics. The test consists of 30 questions that test a student’s ability to describe to responses of objects to forces. The questions are written without physics jargon and describe simple everyday situations, such as the motion of a person in a swivel chair, or of a car on the road. The test is administered before and after the introductory mechanics course to determine if students’ ideas about forces have been changed by the course. The figure of merit for the FCI is the normalized gain $\langle g \rangle = (S_f - S_i)/(100 - S_i)$, where S_i and S_f are the percent correct answers on the pre-test and the post-test, respectively. We have also begun administering the Conceptual Survey in Electricity and Magnetism (CSEM). A new test modeled on the FCI, but intended to probe students’ knowledge of electrical concepts. The figure of merit for the CSEM is defined in the same way as it is for the FCI.

Results for the FCI

Our average gain for Fa98-Sp02 is 0.272.
Nationwide, the average for “traditional” physics courses is 0.23±0.04.

Results for the CSEM

Our average gain for Fa01-Sp02 is 0.135.
No national data are yet available for comparison.

Physics P201-P202: Overview of the Assessment of Student Learning

Beginning with the spring semester 2001, we are giving an attitude survey to the students at the beginning and end of each semester. Data analysis will begin after fall semester 2001, and thereafter. Lessons learned will be used to implement changes in the course, and refinement of the survey. Initial results indicate students have a positive attitude toward the course at the beginning of the course, and this attitude is the same at the end. We are questioning whether this survey is yielding any useful information.

Assessment activities in Physics
A. Gavrin

What I have done

As a part of my NSF CCLI grant, I have worked with others in the School to develop a variety of assessment tools. These tools are intended to be used together in order to produce a complete picture of the results of our efforts to reform several courses. For instance, items 1, 3, 4, and in the list below all touch on some of the same issues. However, students respond differently in different contexts (online, in class, in small groups) so the different methods produce complementary results. This process is know as a "mixed methods approach" and was recommended to us by Dr. H. Mzumara of the IUPUI Testing Center. Collaborators include K. Marrs (Biology), R. Blake (formerly Chemistry), J. Watt (Math) and H. Mzumara (IUPUI Testing Center). The results of this effort are, to large extent, available online at

http://webphysics.iupui.edu/webscience/assessment.html

The highlights include:

1. A pre-/post-semester attitude survey.

This is a Likert scale instrument asking 30 questions that measure students' attitudes on a variety of subjects such as working in groups, using computers and seeking help from faculty. This instrument has been used for three semesters, but substantial revisions were made to it after the first year of use. The fall 2001semester was the first use of the survey in its final form.

2. Pre-/Post-course surveys of cognitive gains.

In Physics 152 we have used the Force Concept Inventory (FCI) test for several years to gauge students gains in replacing naïve "Aristotelian" notions of kinematics and dynamics with more modern "Newtonian" ideas. This test, developed by D. Hestenes and I. Halloun is use nationally, providing a baseline for analysis of our efforts. In 251, we have used both the Conceptual Survey of Electricity (CSE) and the Conceptual Survey of Electricity and Magnetism (CSEM) developed by D. Maloney, et al. These instruments are relatively new, and no substantial base of data has yet emerged. We will review the use of these exams over the next few years to determine whether they are providing the data we need.

3. A classroom observation protocol.

This is a sheet used by outside observers (generally graduate students in the social sciences) employed by the testing center during visits to classrooms. The sheets focus observers on several measures of effectiveness, including the extent to which students are paying attention, and the level of interaction between students and faculty.

4. A focus group protocol.

The focus group protocol provides backup information on the same subjects as the classroom observation and attitude survey. Students meet with a focus group leader and discuss issues including interaction with faculty, ability to stay "caught up" with assignments, and learning issues.

5. A mid-term survey.

This is a single use, online survey that provides a quick snapshot of students' attitudes and satisfaction part way through the semester.

6. A group of external reviewers.

Each of the disciplines (physics, chemistry, math, biology) has requested an external review of the course materials, dissemination efforts, and other assessment tools by an outside reviewer familiar with science education issues. The Physics review was written by Dr. Richard Hake of the Physics department at IUB (retired).

What I learned

A great deal has been learned during the course of this project, and I will not attempt to describe all of the results. Here are a few high points:

1. The results of the first year data on the attitude survey were discouraging. The survey indicated little positive change, and some negative change in the attitudes we hoped students would develop (e.g., that it is better to study frequently and stay caught up rather than save large chunks of work for occasional cram sessions). However, results from the mid-term survey, focus group, and classroom observations tend to show that our reforms are doing better than the survey indicated. The difference appeared to be that the midterm surveys and personal contacts highlighted student attitudes well, while the survey was worded in such a way as to cause students to mix reports of their behavior with reports of their attitudes. This motivated a review/revision of the survey after its first year of use. The end of the current semester will help show if this has been successful.

2. One result that showed up consistently was the change in students' attitudes concerning working in teams. Students in every course that used group work felt more positive about its effect on their learning after the course than before. The degree of improvement was clearly correlated with the amount of group work the students engaged in during the course.

3. Mid-term surveys showed that students were somewhat less likely to "cram" for tests if Just-in-Time Teaching methods were used. The survey also confirmed previous indications that these methods are well received by students.

Implemented changes

No significant pedagogical changes were introduced during this year. The attitude survey was rewritten (as described above) in the hope that it would produce results that are more finely focused on the issues it was intended to address.

Planned changes

The labs used in P202 are in great need of revision. While I do not expect to teach this course again in the near future, I will work with the new instructional team on this. In Physics 251, which I will teach next semester, I hope to introduce computer-based homework assignments similar to those used in Physics 152.

Assessment of Physics 490

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 three years, ten students have completed the capstone experience working with five faculty mentors.

The numbers of students taking Physics 490 are quite small (typically 2-4/year), so it is fruitless to attempt the sort of quantitative analysis of 490 that we have used in assessing Physics 152/251. Our assessment of Physics 490 is limited to faculty comments.

<u>Ricardo Decca, Assistant Professor of Physics:</u>

Does the evaluation accomplish its goals? I think that it does it most of the time in the research part. In other areas (writing, communication, independence), I doubt it (or they didn't learn much!). The evaluation of the research part is largely done by the advisor. Since the communication report part is poor, what the committee evaluates is mostly this second part… I suggest that the grade on 490 is given in the following way: 40% from the advisor, about the work done, 20% from the committee in the quality of the talk, 20% from the committee on the quality of the report, 20% by the Committee members other than the advisor on the work done on the lab.

<u>Andy Gavrin, Associate Professor of Physics:</u>

Do you think 490 is doing its job (ability to integrate and apply their knowledge, ability to communicate orally and in writing)? I think that 490 is strongest in stretching a student's ability to integrate a broad range of knowledge, and to use research methods to expand that range of knowledge. It provides a good opportunity to teach students a few basics about giving oral presentations, but it has little impact on students' written communication skills. This is largely a result of the way 490 fits in to a student's IUPUI education. By the time they reach 490, they are well primed for the research experience, but have little or no background. Thus, they are open to the new experience. In contrast, they have been writing since elementary school, so a single additional paper has little impact.

Based on what you have seen of recent 490 students, do our students have these abilities? Our students also exhibit better research ability, and are weakest in their communication skills, mirroring my comments above. This is somewhat surprising, as they have had many writing experiences and at least one semester of Speech (COMM R110). It may simply reflect my biases concerning to what standards students should be held. That is, I expect college seniors to write quite well and they do not. I do not expect them to be competent researchers, so I give them great credit when they do accomplish a significant task.

Steve Wassall, Associate Professor of Physics:

Do you think 490 is doing its job (ability to integrate and apply their knowledge, ability to communicate orally and in writing)? Yes. I try to ensure that students that work in my lab learn to extrapolate what they know from their classes to a small project. I don't sign off on them until they write a short report and, typically, make an oral presentation at a local conference.

Based on what you have seen of recent 490 students, do our students have these abilities? Yes, although "advice and coaching" is usually necessary. In a research lab situation, the student has to adjust to obtaining results when the answer is not known. More than one iteration of a report is required and rehearsal is essential before a student speaks at a conference for the 1st time.

Marvin Kemple: Professor of Physics:

Do you think 490 is doing its job (ability to integrate and apply their knowledge, ability to communicate orally and in writing)? In general I would say yes, perhaps changing the definition of job a little. Certainly 490 is a research experience, which is the nature of 490 by definition. The question of integration of knowledge depends on the project and the student. The extent of the integration of "science" (physics, etc.) knowledge may be small although often the students integrate various math and computer skills to perform a project. The communication aspect seems to go well.

Based on what you have seen of recent 490 students, do our students have these abilities? I have been pleased with the communication aspect including both oral and written communication. It often takes some work and a few iterations, but that is fine. The integration of knowledge concerns me some… I think the advisor should probably put more emphasis on the integration aspect.

Summary

From these comments and informal discussions among physics faculty, it seems that 490 is capable of doing its job, so long as the research advisor keeps the goals of the program in mind, and holds students to high standards. We do not feel that significant programmatic changes to 490 are needed at this time.

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

Annual Report: June 1, 2002

Overview of Student Learning

Prepared by Drew C. Appleby, Ph.D.
Director of Undergraduate Studies in Psychology
May 15, 2002

<u>Assessment sub-projects that have been implemented</u>

Individual Course Data

Many psychology faculty have collected assessment data in their individual courses to make data-informed decisions that can improve teaching and learning. An example is given below.

- B104 Introductory Psychology as a Social Science has been challenged with high DFW rates for many years. John Kremer undertook the formidable task of lowering these rates in 1993 by implementing the following series of literature- and experienced-based interventions and assessing their ability to bring about a decrease in these rates.
  - Introducing active learning in the classroom
  - Providing immediate feedback on test performance
  - Increasing contact with other students and faculty
  - Integrating all course materials
  - Increasing the applied focus of the course
  - Providing multiple opportunities to demonstrate mastery learning
  - Increasing the clarity of learning objectives
  - Increasing student time on task
  - Providing supplemental computer activities
  - Providing distance learning opportunities
  - Providing high availability of tests
  - Providing an opportunity to make-up missed classes
  - Encouraging group responsibility for learning and persistence
  - Providing tutoring and supplemental instruction

  Although the literature supports the efficacy of these interventions, they have not produced the desired decrease in the DFW rate of this class. As a result, Dr. Kremer has turned his attention from these types of pedagogical interventions to the study of student variables (e.g., student effort/motivation and life circumstances) that can affect course performance. The remarkable results of one of these assessments were that (a) 97% of B104 students pass the course if they complete 67% or more of their assignments and that (b) it is possible to predict 70% of the students who will receive a DWF in the course after only 4 weeks of the semester using homework and class attendance data. These findings challenge the standard assumption of outcomes assessment that faculty must discover ways to improve their students' learning by modifying their pedagogies. It appears that Dr. Kremer has modified B104 in about as many ways as it can be modified. Perhaps it is now time to turn the focus of assessment in this class from the class itself to its student clientele and their willingness and/or ability to assume their fair share of the teaching-learning responsibility.

Student Survey Data

Faculty often request student feedback about pedagogical techniques to determine their perceived effectiveness. Two examples are given below.

- The Drop+Withdraw+Fail (DWF) rates in the sections of B103 offered for students with 18 hours of college credit were unacceptably high (40%) when Drew Appleby began teaching the course in fall, 1999. A final assignment in this class is to provide the instructor with suggestions that would allow him to modify the course to improve its ability to retain and serve students. Examples of these student suggestions—and suggestions from teaching assistants (TAs) in the course—that have been built into the course are as follows.

    - add teaching assistants to assist students with APA-style writing
    - assign each TA a "family" of students to help
    - make TAs responsible for student success
    - provide each family group with a table of their names and email addresses to facilitate intra-family communication
    - provide a standardized evaluation checklist for TAs
    - have the same TA grade each student's chapters to provide continuity
    - require communication between students and TAs
    - decrease the number of chapters in the "book" that is required in the class
    - provide incentive for students incorporating feedback into their papers
    - provide an opportunity for peer review

These interventions appear to be working because the DFW rate has decreased from 40% in the fall of 1999 to 32% in the spring of 2001. An even more dramatic decrease has been the number of Fs earned in the course, which has dropped from 10 in fall 1999 to 1 in spring 2001.

- Charlie Goodlett surveyed his B311 Introductory Laboratory class to determine their perceptions of their ability to use of computer tools for quantitative applications (i.e., Excel and SPSS), which he assumed they had developed in courses that precede B311 (B305 and CSCI N207). He discovered the following:

  - 60% of the class does not know how to generate a mean or sd with the f_X option in Excel
  - 25% of the class does not know how to generate graphs
  - 15% does not know which axis to use for independent and dependent variables
  - 20% of the class has never heard of SPSS
  - 50% does not know the difference between independent and paired-sample t-tests
  - 50% of the class believes that they should learn Excel and SPSS before entering B311

- These data caused him to understand that his assumption was incorrect and to state that "I think those skills should be taught sooner." These results also prompted the chair of the department's Assessment Subcommittee of the Undergraduate Committee to send the following memo to all faculty who teach methods classes.

  - The Assessment subcommittee of the Undergraduate Committee suggested that we begin to investigate the skills our students develop as they progress through our sets of sequenced methods courses (e.g., B305, B307, B311, and capstone lab). In other words, what can we expect our students to be able to do when they exit the entire sequence and what can individual instructors expect students to be able to do when they progress from one course to the next (e.g., What level of SPSS sophistication can a B311 instructor expect from students who have completed B305?).

    I would like to invite you—the instructors in these courses—to an 11:30 to 12:45 lunch in LD 129 on Friday, November 9. This would give you an opportunity to discuss the issues I have described above and perhaps plan future meetings. The goal of this "teaching circle" will be to bring about curricular changes that will produce a standardization of the teaching of SPSS in our sequence of methods courses. This change will have three important results.
    - Faculty who teach these courses will have had an opportunity to sit down together and discuss their concerns and expectations.
    - Faculty can be assured that students will enter their courses with a specific level of SPSS competence.
    - Students who complete our methods sequence will exit with the same level of SPSS skill.

<u>Assessment sub-projects that will be implemented</u>

Adoption of New Student Learning Outcomes (SLOs)

- The Undergraduate Committee has adopted a modified version of the American Psychological Association's newly created—but not yet fully endorsed—set of goals (and subsidiary student learning outcomes) for an undergraduate education in psychology (see the Appendix). The first three of these goals will be assessed with the proposed senior exit content test described below.

Senior Exit Content Test

- The department is in the process of creating a senior exit content test to be administered to majors as a requirement in their capstone course to measure their mastery of the contents, methods, and applications of psychology as they exit the program. This test will be constructed from multiple-choice questions solicited from faculty who teach the psychology classes required for graduation.
- This test will be administered with our IQUIZ testing program, which allows students to take the tests on-line at any time during their capstone course.

Tracking through the Major

- Some of our faculty have spent portions of their careers recording our majors' progress as they enter, pass through, and exit our program.
- Their data will be used to give us an idea of how effective our orientation program has been, our majors' characteristics and subjective goals, our students' course mastery patterns, and how well informed our majors are of their post-baccalaureate opportunities.

Capstone Skills Templates

- The School of Science has adopted a rubric that will allow instructors in capstone courses to assess their students' ability to exhibit the University's Principles of Undergraduate Learning.
- The Psychology Department is considering creating a similar rubric to assess its seniors' abilities to masters its unique SLOs.

Paper and Electronic Portfolios

- One capstone seminar (B454) requires the creation of a "Professional Planning Portfolio" in which students collate evidence of progress toward their post-baccalaureate goals. Unfortunately, this capstone was cancelled this year because of low enrollment.
- The University is currently creating an Electronic Portfolio that students my use to provide proof of competence to potential employers and graduate school admissions committees.

Senior Exit Essays

- The School of Science requires graduating seniors to write essays that describe how successfully they have accomplished the University's Principles of Undergraduate Learning.
- The Department could also require its seniors to write a series of similar essays about specific departmental SLOs during their final IQUIZ test.

Alumni Surveys

- IUPUI's Office of Information Management and Institutional Research administers surveys to alumni designed to collect their perceptions of a wide variety of curricular and extracurricular topics. One of the most important aspects of these surveys is student perceptions of the quality of academic advising they receive in the department. The results of the last 5 years of these surveys indicate that these perceptions are changing in a positive manner.

Assessment Website

- Drew Appleby is in the process of creating an assessment website that will allow the department to identify, organize, evaluate, centralize, maintain, revise, utilize, and communicate its assessment activities.

Meta Ideas about Implications of our Departmental Assessment for Work at the Campus Level

At the present time, the only "meta" level ideas that have come from our assessment work is the suggestion that came out of our methods sequence teaching circle to include representatives from the Math and Computer Science Departments in our discussions so that they can become aware of the mathematical and computer skills with which we would like our students to enter our B305 Statistics class. We hope they will be receptive to our expectations so that our students will be better prepared to succeed in their sequence of methods courses.

Appendix

The IUPUI Psychology Department's
Seven Goals of Undergraduate Learning
and Their Component Student Learning Outcomes

A. Goal One → Content of Psychology: Students should understand the major concepts, theoretical perspectives, empirical findings, and historical trends in psychology.
   1. Describe the nature of psychology as a discipline.
      a. Explain why psychology is a science.
      b. List the primary objectives of psychology: describing, understanding, predicting, and controlling behavior and mental processes.
      c. Compare and contrast the assumptions and methods of psychology with those of other disciplines.
      d. Describe the contributions of psychology perspectives to interdisciplinary collaboration.
   2. Use the concepts, language, and major theories of the discipline to account for psychological phenomena.
      a. Describe behavior and mental processes empirically, including operational definitions.
      b. Identify antecedents and consequences of behavior and mental processes.
      c. Interpret behavior and mental processes at an appropriate level of complexity.
      d. Use theories to explain and predict behavior and mental processes.
      e. Integrate theoretical perspectives to produce comprehensive and multi-faceted explanations.
   3. Explain major perspectives of psychology (e.g., behavioral, biological, cognitive, humanistic, psychodynamic, and socio-cultural).
      a. Compare and contrast major perspectives.
      b. Describe advantages and limitations of major theoretical perspectives.
   4. Demonstrate knowledge and understanding representing appropriate breadth and depth in selected content areas of psychology.
      a. Theory and research representing each of the following four general domains:
         - Learning and cognition;
         - Individual differences, psychometrics, personality, and social processes, including those related to socio-cultural and international dimensions;
         - Biological bases of behavior and mental processes, including physiology, sensation, perception, comparative, motivation, and emotion;
         - Developmental changes in behavior and mental processes across the life span.
      b. The history of psychology, including the evolution of methods of psychology, its theoretical conflicts, and its socio-cultural contexts.
      c. Relevant levels of analysis: cellular, individual, group/systems, and culture.
      d. Overarching themes, persistent questions, or enduring conflicts in psychology, such as:
         - The interaction of heredity and environment;

- Variability and continuity of behavior and mental processes within and across species;
- Free will versus determinism;
- Subjective versus objective perspective;
- The interaction of mind and body.

e. Relevant ethical issues, including a general understanding of the APA Code of Ethics.

B. Goal Two → Research Methods: Students should understand and be able to use basic research methods in psychology, including design, data analysis, and interpretation.

1. Describe the science of psychology in terms of the different research methods used by psychologists.
   a. Describe how various research designs address different types of questions and hypotheses.
   b. Articulate strengths and limitations of various research designs.
   c. Distinguish the nature of designs that permit causal inferences from those that do not.
2. Evaluate the appropriateness of conclusions derived from psychological research.
   a. Interpret basic statistical conclusions.
   b. Distinguish between statistical significance and practical significance.
   c. Describe effect size and confidence intervals.
   d. Evaluate the validity of conclusions presented in research reports.
3. Design and conduct basic studies to address psychological questions using appropriate research methods.
   a. Locate and use relevant databases, research, and theory to plan, conduct, and interpret results of research studies.
   b. Formulate testable research hypotheses, based on operational definitions of variables.
   c. Select and apply appropriate methods to maximize internal and external validity and reduce the plausibility of alternative explanations.
   d. Collect, analyze, interpret, and report data using appropriate statistical strategies to address different types of research questions and hypotheses.
   e. Recognize that theoretical and socio-cultural contexts as well as personal biases may shape research questions, design, data collection, analysis, and interpretation.
   f. Follow the APA Code of Ethics in the treatment of human and nonhuman participants in the design, data collection, interpretation, and reporting of psychological research.
4. Generalize research conclusions appropriately based on the parameters of particular research methods.
   a. Exercise caution in predicting behavior based on limitations of single studies.
   b. Recognize the limitations of applying normative conclusions to individuals.
   c. Acknowledge that research results may have unanticipated societal consequences.
   d. Recognize that individual differences and socio-cultural contexts may influence the applicability of research findings.

C. Goal Three → Application of Psychology: Students should understand and generate applications of psychology to personal, social, and organizational issues.

1. Describe major applied areas of psychology (e.g., clinical, counseling, health, and industrial/organizational) in terms of their application in solving problems such as the:
   a. Pursuit and effect of healthy lifestyles;

   b. Determination of the origin and treatment of abnormal behavior;
   c. Improvement of hiring, training, and evaluation processes in business and industry;
   d. Empirical evaluation of psychology-based interventions community settings.
2. Articulate how psychological principles can be used to explain social issues and inform public policy.
   a. Recognize that socio-cultural contexts may influence the application of psychological principles in solving social problems.
   b. Describe how applying psychological principles can facilitate change.
3. Apply psychological concepts, theories, and research findings as these relate to everyday life.
4. Recognize that ethically complex situations can develop in the application of psychological principles.

D. Goal Four → Professional and Cross-Cultural Ethics in Psychology: Students should understand the ethics of those who have been trained in the science of psychology, including those that enable them to recognize, understand, and respect cross-cultural diversity.
   1. Recognize the necessity for ethical behavior in all aspects of the science and practice of psychology.
   2. Demonstrate reasonable skepticism and intellectual curiosity by asking questions about causes of behavior.
   3. Seek and evaluate scientific evidence for psychological claims.
   4. Tolerate ambiguity and realize that psychological explanations will often be complex and tentative.
   5. Recognize and respect human diversity and understand that psychological explanations may vary across populations and contexts.
   6. Assess and justify their engagement with respect to civic, social, and global responsibilities.
   7. Understand the limitations of their psychological knowledge and skills.
   8. Interact effectively and sensitively with people from diverse backgrounds and cultural perspectives.
   9. Examine the socio-cultural and international contexts that influence individual differences.
   10. Explain how individual differences influence beliefs, values, and interactions with others and vice versa.
   11. Understand how privilege, power, and oppression may affect prejudice, discrimination, and inequity.
   12. Recognize prejudicial attitudes and discriminatory behaviors that might exist in them and others.

E. Goal Five → Personal Development, Relationship Building, and Career Planning: Students should understand themselves and others, acquire skills for interacting successfully in groups, and should emerge from the major with realistic ideas about how to implement their psychological knowledge, skills, and values in occupational pursuits in a variety of settings.
   1. Reflect on their experiences and find meaning in them.
      a. Identify their personal and professional values.

   b. Demonstrate insightful awareness of their feelings, emotions, motives, and attitudes based on psychological principles.
2. Apply psychological principles to promote personal development.
   a. Demonstrate self-regulation in setting and achieving goals.
   b. Self-assess performance quality accurately.
   c. Incorporate feedback for improved performance.
   d. Purposefully evaluate the quality of one's thinking (metacognition).
3. Enact self-management strategies that maximize healthy outcomes.
4. Display high standards of personal integrity with others.
5. Apply knowledge of psychology (e.g., decision strategies, life-span processes, psychological assessment, types of psychological careers) to formulating career choices.
6. Identify the types of academic experience and performance that will facilitate entry into the work force, post-baccalaureate education, or both.
7. Describe preferred career paths based on accurate self-assessment of abilities, achievement, motivation, and work habits.
8. Identify and develop skills and experiences relevant to achieving selected career goals.
9. Demonstrate an understanding of the importance of lifelong learning and personal flexibility to sustain personal and professional development as the nature of work evolves.

F. Goal Six → Communication Skills, Information Competence, and Technological Proficiency: Students should be able to write and speak effectively, demonstrate information competence, and use computers and other technologies for many purposes.
1. Demonstrate effective writing skills in various formats (e.g., essays, correspondence, technical papers, note-taking) and for various purposes (e.g., informing, defending, explaining, persuading, arguing, and teaching).
   a. Demonstrate professional writing conventions (e.g., grammar, audience awareness, and formality) appropriate to purpose and context.
   b. Use APA-style effectively in empirically-based reports, literature reviews, and theoretical papers.
2. Demonstrate effective oral communication skills in various formats (e.g., group discussion, debate, lecture) and for various purposes (e.g., informing, defending, explaining, persuading, arguing, teaching).
3. Exhibit quantitative literacy.
   a. Apply basic mathematical concepts and operations to support measurement strategies.
   b. Use relevant probability and statistical analyses to facilitate interpretation of measurements.
   c. Articulate clear and appropriate rationale for choice of information conveyed in charts, tables, figures, and graphs.
   d. Interpret quantitative visual aids accurately, including showing vigilance about misuse or misrepresentation of quantitative information.
4. Demonstrate effective interpersonal communication skills.
   a. Listen accurately and actively.
   b. Use psychological concepts and theory to understand interactions with others.
   c. Identify the impact or potential impact of their behaviors on others.
   d. Articulate ideas thoughtfully and purposefully.

   e. Use appropriately worded questions to improve interpersonal understanding.
   f. Attend to nonverbal behavior and evaluate its meaning in the communications context.
   g. Adapt communication style to accommodate diverse audiences.
   h. Provide constructive feedback to colleagues in oral and written formats.
5. Exhibit the ability to collaborate effectively.
   a. Work with group to complete projects within reasonable timeframes.
   b. Solicit and integrate diverse viewpoints.
   c. Manage conflicts appropriately and ethically.
   d. Develop relevant workplace skills: mentoring, interviewing, crisis management.
6. Demonstrate information competence at each stage in the following process:
   a. Formulate a researchable topic that can be supported by database search strategies;
   b. Locate and choose relevant sources from appropriate media, which may include data and perspectives outside traditional psychology and Western boundaries;
   c. Use selected sources after evaluating their suitability based on:
      - Appropriateness, accuracy, quality, and value of the source;
      - Potential bias of the source;
      - The relative value of primary versus secondary sources, empirical versus non-empirical sources, and peer-reviewed versus non-peer-reviewed sources.
   d. Read and accurately summarize the general scientific literature of psychology;
   e. Use appropriate software to produce understandable reports of the psychological literature, methods, and statistical and qualitative analyses in APA or other appropriate style, including graphic representations of data.
7. Use information and technology ethically and responsibly.
   a. Quote, paraphrase, and cite correctly from a variety of media sources.
   b. Define and avoid plagiarism.
   c. Avoid distorting statistical results.
   d. Honor commercial and intellectual copyrights.
8. Demonstrate these computer skills:
   a. Use basic word processing, database, email, spreadsheet, and data analysis programs;
   b. Search the World Wide Web for high quality information;
   c. Use proper etiquette and security safeguards when communicating through email.

G. Goal Seven → Critical and Creative Thinking, Reasoning, and Problem Solving: Students should respect and use critical and creative thinking, skeptical inquiry, and the scientific approach to solving problems.
1. Use critical thinking effectively.
   a. Evaluate the quality of information, including differentiating empirical evidence from speculation and the probable from the improbable.
   b. Identify and evaluate the source, context, and credibility of information.
   c. Recognize and defend against common fallacies in thinking.
   d. Avoid being swayed by appeals to emotion or authority.
   e. Evaluate popular media reports of psychological research.
   f. Demonstrate an attitude of critical thinking that includes persistence, open-mindedness, tolerance for ambiguity, and intellectual engagement.
   g. Make linkages or connections between diverse facts, theories, and observations.

2. Engage in creative thinking.
   a. Intentionally pursue unusual approaches to problems.
   b. Recognize and encourage creative thinking and behaviors in others.
   c. Evaluate new ideas with an open, but critical mind.
3. Use reasoning to recognize, develop, defend, and criticize arguments and other persuasive appeals.
   a. Identify components of arguments (e.g., conclusions, premises/assumptions, gaps, counterarguments).
   b. Distinguish among assumptions, emotional appeals, speculations, and defensible evidence.
   c. Weigh support for conclusions to determine how well reasons support conclusions.
   d. Identify weak, contradictory, and inappropriate assertions.
   e. Develop sound arguments based on reasoning and evidence.
4. Approach problems effectively.
   a. Recognize ill-defined and well-defined problems.
   b. Articulate problems clearly.
   c. Generate multiple possible goals and solutions.
   d. Evaluate the quality of solutions and revise as needed.
   e. Select and carry out the best solution.