

**Assessment of Student Learning
School of Science
IUPUI
2012-2013 Report**

Overview: The School of Science provides outstanding science education for all IUPUI students, education in depth for Science students, and engages in research in the physical, biological, mathematical, and psychological sciences in order to increase scientific knowledge and advance the development of the life sciences at IUPUI and in Indiana. Within the seven academic departments (Biology, Chemistry & Chemical Biology, Computer & Information Science, Earth Sciences, Mathematical Sciences, Physics, and Psychology) and the Forensic and Investigative Sciences Program, there are over 160 full-time faculty members. The School is the academic home of ~2,000 undergraduate majors and ~450 graduate students.

Part 1: Student Learning Outcomes for Each Academic Program

The School of Science has been utilizing Student Learning Outcomes developed during the 2010-2011 academic year. A comprehensive list of SLOs for both undergraduate and graduate education and degree programs can be found in the [IUPUI Bulletin, 2012-2014](#) (or by clicking the links below).

Undergraduate SLOs (B.A. and B.S.)	Graduate SLOs (M.S. and Ph.D.)
<ul style="list-style-type: none">• Biology• Chemistry• Computer and Information Science• Environmental Science• Forensic and Investigative Sciences• Geology• Interdisciplinary Studies• Mathematics• Physics• Psychology	<ul style="list-style-type: none">• Biology• Chemistry• Clinical Psychology• Computer and Information Science• Geology• Industrial Organizational Psychology• Mathematics• Physics• Psychobiology of Addictions

How is the School of Science assessing Student Learning Outcomes and Student Learning?

The main focus of this 2012-2013 School of Science’s annual report is on the efforts undertaken in the last year to refine, measure, and improve the attainment of the student learning outcomes for our programs. The following data and information provides evidence that we are assessing our programs, that we are addressing the IUPUI [Principles of Undergraduate Learning](#) and [Principles of Graduate Learning](#), that we have deliberate and ongoing processes in place for performing these assessments of student learning, and that we are using the results to guide improvements in our programs.

We will also report on assessment and improvement of processes that support student learning and student retention and success, as well as research on formative and summative assessment of student learning. Several continuing grants from the National Science Foundation (NSF) that focus on undergraduate education or undergraduate student success have allowed us to commit significant resources to expanding best practices related to the academic experience in the School of Science.

Part II: Outline of Assessment Activities and Accomplishments, 2012-2013

This year's report will next highlight a number of ongoing and new initiatives in the School of Science that assess student learning outcomes and student success. While this is not a comprehensive list, it details many of our major initiatives in the School of Science. Many of the initiatives mentioned in this report are continued efforts of the following programs described in detail in our **2011-2012 PRAC report** (<http://www.planning.iupui.edu/929.html>). Please see this report for more detail on each of these efforts:

1. Continued external funding to support course transformation and STEM curricular development
2. Course Redesign Based On Assessment Of Student Learning Outcomes
3. Formative and Summative Assessment of SLOs via Improved Pedagogy
4. Summative Assessment of Student Learning:
5. Student Success Initiatives
6. Assessment of student learning in Graduate Programs

The current report (2012-2013) will discuss new initiatives as well as provide updates based on evidence to support continuous improvement in instruction, curriculum, assessing student learning outcomes, and increased efforts in student support and Science Career Development Services:

- 1. External Funding received to adopt, expand, or develop new courses or curricula**
 - A. Central Indiana STEM Talent Expansion (CI-STEP) Program at IUPUI
 - B. Cyber PLTL (cPLTL): Development, Implementation, and Evaluation,
- 2. Course and Program Development or Redesign Based On Assessment Of Student Learning Outcomes, 2012-2013**
 - A. Biology: Continued efforts to expand Peer Mentoring to enhance Student Learning
 - B. Chemistry C341: First Semester Organic Chemistry continues PLTL Workshop Series
 - C. New Degree Programs and Courses in support of meeting Student Learning Outcomes
- 3. Formative and Summative Assessment of SLOs in Graduate and Undergraduate Courses**
 - A. Summary Report for *Survey on Teaching Practices in the School of Science*: A project led by the School of Science Assessment Committee, 2012-2013
 - B. Summary Report on *New Evaluation of SCI-I 120: Windows on Science (First Year Seminar)*
 - C. Mastering Biology /Mastering Chemistry / Smart Physics: Continuing a Research Study and adding Adaptive Feedback
- 4. Summative Assessment of Student Learning:**
 - A. PUL Data: Principles Of Undergraduate Learning
 - B. Student Ratings
- 5. Student Success Initiatives**
 - A. Summer residential STEM Bridge program
 - B. Continuation of the Physics Learning Space (PhyLS)
 - C. Implementation of a new Post Enrollment Requirement Checking (PERC)
 - D. Actively promoting the MATH Minor to students and advisors
 - E. New Math Assistance Center (MAC) Director
 - F. School of Science Career Development Services (CDS) Center.
- 6. Graduate Program Assessment**
 - A. Program Overview
 - B. Program Outcomes

Part III: Evidence of assessment and changes made towards continuous improvement in instruction, curriculum, and student support services

1. External Funding received to adopt, expand, or develop new courses or curricula

A. Central Indiana STEM Talent Expansion (CI-STEP) Program at IUPUI (2010-2014) Principal Investigator: Jeff Watt, Co-PI; Kathleen Marrs, Charlie Feldhaus, Andy Gavrin, Stephen Hundley (NSF DUE) \$1,995,765.00.

The focus of CI-STEP is to employ and assess the impact of several intervention strategies on student success, leading to higher numbers of students graduating with STEM degrees. These intervention strategies have been described in detail ([PRAC 2011-2012](#)). This program takes a coordinated and systemic approach to increasing undergraduate success in STEM at all levels, from pre-college to the important first year experience, to the sophomore year and onto graduation, through leadership and career development. In the current year (2012-2013), CI-STEP continues to strengthen our central Indiana pipeline to increase the number of students from IUPUI and Ivy Tech obtaining STEM degrees. This year, we have continued efforts for students in all demographic groups who pursue STEM academic and career pathways, participate in STEM research, industry internships, and honors activities, graduate with an undergraduate degree in STEM fields; and transition into industry, graduate and professional programs.

To meet these goals, the School of Science has spent the last 2.5 years initiating a series of new programs and funded a series of STEP mini-grants to expand, extend, or develop new programs at IUPUI based on successful existing high-impact practices. These initiatives and activities fall under one of four broad categories: (1) Articulation with 2-year Colleges, (2) Student Success, (3) Student Centered Pedagogies, and (4) Career Services. As a result, *we have met or exceeded our target goals for each year of the funding*, including a:

- 10% increase in the number of new and transfer students admitted to STEM majors,
- 10% increase in the number of minority students admitted to STEM majors
- 10% decrease in the DFW rates for MATH, CS, PHYS, TECH and other courses
- 15 additional students participating in internship and research experiences
- 50 graduating seniors participating in honors seminars

The primary goal of these activities is to reach the set a target of increasing the number of STEM graduates at IUPUI by 10% per year (an increase of an additional 782 STEM graduates by 2015).

Notes: (a) IUPUI was mentioned by name "As one example of success" by NSF EHR Director Joan Ferrini Mundy to the US Congress House Committee on Science, Space and Technology (June 2013). (b) [Indianapolis Mayor Says IUPUI STEM Efforts Are Critical to Indiana Economy](#) (May 2013) Mayor Greg Ballard, Deputy Mayor for Education Jason Kloth and Employ Indy President and CEO Brooke Huntington visited the School of Science to celebrate the success of [CI-STEP](#), (c) A STEM Education track will be held at the 2013 Assessment Institute this October, which will bring national leaders on STEM education to campus to share their knowledge of research and best practices, and for CI-STEP to showcase the work being done at IUPUI and other institutions on increasing student learning, success, and the number of STEM degrees awarded.

B. Cyber PLTL (cPLTL): Development, Implementation, and Evaluation, National Science Foundation Transforming Undergraduate Education in Science (NSF–TUES), Pratibha Varma-Nelson (PI), Lin Zhu, J. Randy Newbrough, Tom Janke, Lorie Shuck

Peer-Led Team Learning (PLTL) is a model of teaching where six to eight students work as a team to solve carefully constructed problems under the guidance of a peer leader. The impact of the PLTL workshop on students, leaders, faculty and institutions has been assessed and evaluated in a variety of settings for more than ten years ([Review and references](#)). As we have already reported, PLTL students earned 14% more ABC grades (76%) than their non-PLTL counterparts (62%), with students making positive gains in critical thinking when compared to their non-PLTL counterparts. At IUPUI, PLTL was first implemented in general chemistry C105 in 1998. The DFW rates for fall semesters decreasing from above 45% before PLTL was implemented to below 20% in 2010.

The 2011 launch Cyber PLTL (cPLTL)—synchronous, interactive online workshop environments where students work through problem solving while using a synchronous online environment – allows for an examination of the effectiveness of cPLTL to PLTL. Preliminary data gathered at IUPUI indicates that achievement levels of students enrolled in cPLTL in CHEM C105 are commensurate with those enrolled in PLTL. As previously reported, cPLTL students at IUPUI ($M = 72.3$) significantly outperformed control group students enrolled in PLTL ($M = 66.5$), and the national average ($M = 61.3$) on the American Chemical Society (ACS) Exam taken as a final. New data is the current year (2012-2013) indicate high **student satisfaction** with cPLTL: 83.3% of cPLTL participants and 81.5% of PLTL participants agreed or strongly agreed. Among cPLTL participants 65.7% ($M = 3.77$ in Likert scale) agreed or strongly agreed that their knowledge and understanding of the material taught in the course was a result of the cPLTL workshops, while 83.2% of PLTL students ($M = 4.19$) agreed or strongly agreed with the same statement. The other statistically significant item asked if students enjoyed their participation in cPLTL/PLTL workshops. In this case 63.9% of the cPLTL participants ($M=3.72$) and 76.3% of the PLTL ($M= 4.00$) agreed or strongly agreed. In terms of **assessment of student learning**, an analysis of student performance across 5 semesters showed no statistically significant differences in students' academic performance on the ACS exam, mean grade earned, or end-of-course grades (A, B, C, versus D, F, W grades). While there were slight differences on each measure, none were statistically significant, indicating that cPLTL students are performing as well as students in the face-to-face workshop.



To determine the impact of the online workshop on **student outcomes**, achievement and course completion rates of PLTL and cPLTL students were compared on final exam scores, course grades, and DFW rates. The analysis of ACS exam scores and course grades shows students in cPLTL workshops performing at the same level as students in face-to-face workshops.

Table 1: Comparisons of PLTL and CPLTL over 5 semesters (2010-2013)

Outcome	cPLTL (n = 111)	Face-to-Face (n =121)
ACS Exam	62.78 (15.90)	61.49 (17.11)
Final Grade in CHM105	2.30 (1.11)	2.34 (1.22)
DFW Rate	30.6%	28.1%

2. Course and Program Development or Redesign Based On Assessment Of Student Learning Outcomes, 2012-2013

A. Biology: Continued efforts to expand Peer Mentoring to enhance Student Learning

The Department of Biology has long realized the benefit of undergraduate peer mentoring on success of students in Gateway Courses (typically large enrollment introductory courses for majors or non-majors). Gateway courses often have unacceptably low student success rates (A, B, and C grades), indicating that students are not attaining the learning goals and outcomes of the course.

In 2005, the gateway courses in Biology, K101 and K103, plus non-majors courses in Anatomy (N261), Physiology (N217) and Human Biology I and II (N212 and 214) implemented mandatory or supplemental recitations sections with their traditional lecture courses to increase student achievement and retention. Peer mentoring that originally supported in these 5 courses each semester, reaching over 2,500 students each fall, spring, and summer semester, have recently been expanded to Genetics. DFW (drop, fail, withdraw) data analyzed from 2000-2013 supports the trend of positive improvement student learning and success during recitation implementation. The average DFW rates for K101 without a recitation (pre 2005) was 38%. During implementation of the recitation, the average DFW rates for K101 has dropped considerably and today is stable at about 24-26%. Similar statistics have been seen throughout other peer mentored Biology courses throughout the department.



Results:

1. Continued efforts to decrease the DFW rates for K101 and K103, Anatomy (N261), Physiology (N217) and Human Biology I and II (N212 and 214) (2005-present)
2. Continued efforts to increase Critical Thinking and Core Communication and Quantitative Skills through continued peer mentoring in Genetics (2011-present)
3. New efforts to increase course success in Cell Biology (K324) through the introduction of peer mentoring to increase problem solving and critical thinking in the course. (New in 2012-2013)

B. Chemistry C341: First Semester Organic Chemistry continues PLTL Workshop Series

The Department of Chemistry and Chemical Biology continued their development and implementation of the nationally recognized Peer Led Team Learning (PLTL) workshop series at IUPUI from Freshman Chemistry C105 into the first semester organic chemistry course, Chem C341. Organic Chemistry is a challenging course that bring together many of the student learning outcomes for Chemistry as well as places a Major Emphasis on PUL 2: Critical Thinking. Given the traditionally high the DFW rate, the primary goal of implementing the Organic Chemistry Workshop Series is to facilitate students' collaborative development of Organic Chemistry problem-solving skills, as measured by performance on an ACS Organic Chemistry Exam and survey data, as well as develop student's critical thinking skills. In order to achieve these goals, a modified Peer-Led Team Learning (PLTL) workshop series was instituted as a component of the first semester Organic Chemistry course, funded by the NSF-STEP grant. The peer leaders elicit the participation of all group members, challenge students to expand their conceptual understanding through Socratic dialogue, share insights from being reflective on their problem-solving processes, and encourage students to explain their new understanding of concepts to one another in their small group during

these 75-minute workshops. Answer keys are not provided to students since it would short-circuit the process of discussing the fundamental principles and nuances of each workshop problem.

Objectives:

1. Decrease the DFW rate for C341
2. Increase performance on the national ACS Organic Chemistry final exam
3. Increase problem solving and critical thinking in the course

Results and Major findings of 2012-2013 include: Since implementing the Workshop series, the DFW rates have dropped from a high of up to 33% to the current levels of 15-18%. Furthermore, there has been a statistically significant increase in student performance on the ACS exam. Students have commented through focus groups and that the participation in the workshops has increased their understanding of Organic Chemistry more than any other course component. In addition: (1) the DFW rates have decreased about 10% after workshops were implemented, (2) 6 to 10% increase in positive student perception of problem-solving ability, (3) 25% of the peer mentors expressed an interest in teaching after this experience, and (4) study findings to date suggest that faculty have been successful in using the PLTL approach to lower the failure rates. Reduction of DFW rates for the course and training of discussion leaders to decrease the number of students in each workshop are positive interventions for increasing the success and number of STEM graduates.

C. New Degree Programs and Courses in support of meeting Student Learning Outcomes

1. [New Neuroscience B.S. Program Launches at IUPUI](#) (July 2012) The new neuroscience program offers students an opportunity to earn an undergraduate degree in a rapidly advancing field in a climate of strong interdisciplinary collaboration. Neuroscience majors will have opportunities for research and internship experiences in the School of Science and the Indiana University School of Medicine as well as through life science, pharmaceutical and biotechnology industries in central Indiana.
2. [New B.A. in Applied Computer Science Offers Career Flexibility](#) (Oct 2012) The new applied computer science B.A. is geared toward students who want a strong computing degree and the flexibility to take that core knowledge to any industry, and requires courses in software development, data analysis and web development. The wide array of electives available with the degree will allow graduates to effectively leverage technology in any fields they are passionate about pursuing as a career.
3. [IUPUI one of 11 universities nationwide selected to Offer New Computer Science Principles Course](#) (Jun 2013) The Department of Computer and Information Science will pilot an innovative new course designed to introduce students nationwide to the career advantages of computer science. The initiative also requires efforts to attract diverse students to computer science, especially women. The College Board Advanced Placement (AP) Computer Science Principles program selected only 40 high schools and 11 universities to launch the new course. Michele Roberts will teach the course beginning Fall 2013.

3. Formative and Summative Assessment of SLOs in Graduate and Undergraduate Courses

A. Summary Report for *Survey on Teaching Practices in the School of Science*: A project led by the School of Science Assessment Committee, 2012-2013

Overview

Considerable attention has been directed towards the assessment of student learning outcomes within the University over the last decade, but less has been devoted to the assessment of teaching-related inputs that contribute to student learning. A web-based survey on teaching practices was conducted to shed light on how School of Science instructors design and conduct their courses. Ninety-eight persons provided usable data during March 2013. The results of this project provide a descriptive profile of how teaching is being practiced in the School of Science, and can be used by SOS faculty to develop and update their courses.

Procedure

Over the course of several meetings, a web-based assessment of teaching practices was developed by the School of Science Assessment Committee, Chaired by Dr. Dennis Devine in Psychology. The survey was housed on the Survey Monkey website. The final version of the instrument was distributed across 7 screens and contained sections with questions regarding:

- (1) Assigned reading and media usage,
- (2) Graded course elements,
- (3) Grading policies,
- (4) Classroom activities,
- (5) Typical grade distributions,
- (6) Student course-related behavior, and
- (7) Respondent information (e.g., affiliation, role, course load).

Most questions inquired about the frequency with which the respondent required something, graded something, performed some activity in class, or perceived students to do something. The response scale varied somewhat across sections but generally gave respondents the following options: (a) No, never, (b) No, not anymore, (c) Yes, for some courses, (4) Yes, for most courses, and (5) Yes, for all courses. All sections except those pertaining to student course-related behavior and respondent information had separate sub-sections for undergraduate and graduate courses. The instrument was designed to be able to be completed in 15-20 minutes.

In early March 2013, an email from the Dean's Office containing a link to the survey was sent to all individuals currently teaching courses for the School of Science. A follow-up reminder email was sent 1-2 weeks after the initial invitation. Data were collected over a three-week time span, with data collection ending in late March 2013. Ultimately, 98 SOS instructors responded to at least some portion of the survey. A nice cross-section of responses was obtained from the School, with every department represented by at least five respondents (ranging from 19 in Biology to 5 in Earth Sciences). Lecturers were the most frequent type of responder (30%), followed by associate professors (25%), full professors (15%), adjunct faculty (14%), and assistant professors (8%).

Results

The survey provided considerable data regarding how SOS instructors design and conduct their courses. Some of the more notable findings include:

- 82% of respondents reported regularly requiring a textbook, but very few (4-5%) said they require multiple textbooks for courses at either the undergraduate or graduate level.
- Supplemental (non-textbook) readings were assigned regularly by about a third of the respondents for undergraduate courses, whereas 84% said they use supplemental readings regularly in graduate courses.
- 40% of respondents indicated requiring an electronic textbook for at least some of their undergraduate courses.
- Over 80% of instructors reported assigning journal articles in most/all of their graduate courses, but only 18% said they use them regularly in undergraduate courses.
- Aside from exams, the most frequently graded products in undergraduate courses were quizzes, problem-solving assignments (i.e., homework), and short writing assignments of less than 6 pages. Attendance and participation were graded regularly in undergraduate courses by 30-40% of respondents, and only about 10% of respondents reported regularly requiring oral presentations or assigning papers longer than 6+ pages in undergraduate courses.
- Graduate courses showed greater variability in terms of graded products, with notably more frequent grading of class participation, oral presentations, course projects involving research or data analysis, and papers > 6 pages. Conversely, short writing assignments and attendance were used less frequently in graduate courses, and quizzes of any type much less.
- At both undergraduate and graduate levels, the most frequently employed exam format was a mix of objective and short-answer/essay questions, as opposed to purely objective or subjective. No respondent reported giving oral exams outside of the thesis/dissertation context.
- Very few SOS instructors (7%) said they do not give final exams in their undergraduate courses, whereas 82% said they use them in most or all undergraduate courses.
- A majority of respondents indicated usually allowing students to hand in work late. Of those that do, most reported applying explicit penalties, requiring a documented reason for making up an exam, and being somewhat flexible or making exceptions for handling late work.
- One in four instructors indicated they do not allow extra-credit of any type in undergraduate courses, and 55% said they do not allow extra-credit in their graduate courses.
- Most respondents reported regularly lecturing while writing on a white/blackboard (60%) and an even larger number (80%) reported regularly lecturing in conjunction with an electronic display of material in at least some of their undergraduate courses.
- 40-45% of those responding indicated that discussion of real-world events, case studies, or hypothetical scenarios was featured in all of their undergraduate courses.
- About two-thirds of those responding said they show clips of videos, movies or TV shows at least occasionally in their courses at both levels, but most indicated they do not show full-length videos, movies, or TV shows or videotaped lectures.
- Only 10% of instructors said they regularly use clickers or other interactive feedback devices.
- On average, across respondents, the distribution of grades for the typical undergraduate course was reported to be: 7% W, 7% F, 9% D range, 26% C range, 33% B range, 19% A range. For graduate courses, the mean distribution of grades was: 3% W, 2% F, 3% D range, 12% C range, 38% B range, and 46% A range.
- Over half of the respondents indicated a significant percentage of students in their typical class (i.e., more than 10%) used electronic devices excessively or inappropriately during

class. Two-thirds said that 10% or more of their typical class had problems meeting course deadlines, and one-third reported that more than 10% of a typical class has problems displaying sensitivity towards others in class.

Conclusion

Instructors at all levels of the educational pyramid have choices about how they design and implement their courses. Faculty autonomy is a value that is strongly embedded in the School of Science culture and contributes to an environment where SOS instructors have considerable discretion and choice when it comes to how they teach. Continual exigencies requiring that “more be done with less” necessitate that SOS instructors will regularly have to prep and teach a variety of courses, and the professional obligation to improve courses taught on a regular basis leads most faculty to regularly update courses. The data from this project provide comparative information about teaching practices that can contribute to faculty making informed decisions about the design and execution of SOS courses. The Assessment Committee plans to present the teaching survey findings to the School's faculty in a way that will encourage discussion and continued improvement of teaching practices in the 2013-2014 academic year.

B. Summary Report on New Evaluation of SCI-I 120: Windows on Science (First Year Seminar)

First Year Seminars are designed to ease the transition from high school to college, help students solidify their choice of major and its connection to careers, and provide access to academic advising. The School of Science First Year Seminar has the additional goals of introducing students to what scientific research entails and how it is to be conducted ethically. In Fall 2012, coordinators of the Windows on Science SCI-I 120 First Year Seminar instituted an end-of-course evaluation. The evaluation measured SLOs of the course, satisfaction with the course's instructional strategies and impact, and student intentions to remain in the School of Science and at IUPUI. The evaluation was also designed to assess the Windows course's fidelity to the campus template for First Year Seminars, a document designed in line with national best practices for these seminars.

Evaluation Results (N=253)

The five **learning outcome items** (of 47) that were most strongly correlated with overall satisfaction in the course were:

1. Overall, how satisfied were you with completing your **Personal Development Plan (PDP) as a process for helping you gain a sense of purpose at IUPUI?** ($r = .683, p < .001$)
2. This class improved my ability to **manage my time to meet my responsibilities** ($r = .660, p < .001$)
3. This class improved my ability to **adjust to college** ($r = .658, p < .001$)
4. This class improved my ability to **succeed academically** ($r = .639, p < .001$)
5. This class improved my ability to **set priorities so I can accomplish what is most important to me** ($r = .638, p < .001$)

The five **instructional/pedagogical items** (of 12) that were most strongly correlated with overall satisfaction in the course were:

1. This class included a **well organized format that helped me learn** ($r = .698, p < .001$)
2. This class included **assignments that contributed to my learning** ($r = .696, p < .001$)
3. This class included **clear and useful feedback to improve my learning** ($r = .695, p < .001$)
4. This class included **meaningful class discussions** ($r = .662, p < .001$)
5. This class included a **high level of intellectual challenge** ($r = .659, p < .001$)

Overall satisfaction in the course was weakly, but significantly, correlated with **likelihood of pursuing a major in the School of Science** ($r = .216, p < .01$) and **extent student planned to return to IUPUI next year** ($r = .199, p < .01$)

Implications for Practice

The survey results were compiled into individual instructor feedback forms comparing their students' ratings to the ratings totals of all SCI-I 120 students. Instructors then met on April 24, 2013 to discuss correlations between individual student learning outcomes and overall satisfaction as well as between instructional/pedagogical styles and overall satisfaction. Instructors shared ideas that they thought contributed particularly high ratings on certain items in their courses. Instructors also reinstated an online idea sharing site (using box.iu.edu) where instructors have been posting and commenting on syllabi, in-class exercises and presentations, assignments, and readings. Goals for next year include seeing an increase over this year's ratings in overall satisfaction with the course as well as intent to remain in a School of Science major and at IUPUI.

C. Mastering Biology /Mastering Chemistry / Smart Physics: Continuing a Research Study and adding Adaptive Feedback

As mentioned in the 2011-2012 PRAC report, a number of Gateway and other large enrolling courses have been using active learning and classroom technology such as Just in Time Teaching (JiTT), clickers and other classroom technologies, and electronic homework to assess student understanding and learning in real time or in a greatly reduced time frame that permits rapid formative feedback. These systems include **Mastering Biology**, **Mastering Chemistry**, and **smartPhysics** - integrated systems in which the textbook, homework problems, testing, classroom response and assessment metrics are all linked through a single course site for students and faculty. By setting up continuous feedback loops between the instructor and the students, inside and outside of class, students are better prepared and instructors can access powerful data to understand their students' strengths and weaknesses.

With these systems, assessment occurs at every phase of learning, including:

- Embedded questions within each Warm Up / PreLecture assignment
- Interactive clicker questions for use during lecture
- Quizzes that follow each Lecture
- Student homework that includes concept-driven feedback
- High level exam questions that connect formative and summative assessments
- Easily displayed data to demonstrate assessment outcomes.

All three of these systems are backed by research showing that the work in and out of class, and the feedback loop created by the faculty, the students, and the web improve student learning. A wide variety of published papers based on NSF-sponsored research illustrate the benefits of the Mastering programs and the Smart Physics. Faculty in these three departments continue to use these systems for assessment of student learning. This fall 2013, Adaptive Learning Paths (personalized feedback) will be introduced into the Pearson products, where students will receive real-time recommendations for additional adaptive learning homework problems based on their activity on an original assignment.

4. Summative Assessment of Student Learning:

A. PUL Data: Principles Of Undergraduate Learning During the Spring 2012 semester faculty members teaching a variety of undergraduate courses evaluated the performance of their students on the Principles of Undergraduate Learning (PULs) identified as receiving a Major and a Moderate emphasis in their courses, from 100-level to 400-level senior / capstone courses. These data were pooled together with data from each semester back to Spring 2010. Only one example is shown below, with the remainder found in Appendix A.

IUPUI Faculty Ratings of Student Performance on PULs with Major Emphasis (400-Level Courses) ¹

PUL – Major Emphasis	Mean ³	Not Effective	Somewhat Effective	Effective	Very Effective	Total
1A. Written Oral & Visual Communication Skills	2,367 3.28	113 4.8%	228 9.6%	914 38.6%	1,112 47.0%	2,367 100%
1B. Quantitative Skills	1,364 3.09	76 5.6%	234 17.2%	550 40.3%	504 37.0%	1,364 100%
1C. Information Resource Skills	278 3.11	32 11.5%	33 11.9%	85 30.6%	128 46.0%	278 100%
2. Critical Thinking	2,373 3.20	103 4.3%	286 12.1%	1,012 42.7%	972 41.0%	2,373 100%
3. Integration and Application of Knowledge	6,220 3.43	165 2.7%	365 5.9%	2,346 37.7%	3,344 53.8%	6,220 100%
4. Intellectual Depth Breadth and Adaptiveness	2,987 3.36	90 3.0%	268 9.0%	1,093 36.6%	1,536 51.4%	2,987 100%
5. Understanding Society and Culture	1,737 3.30	99 5.7%	195 11.2%	533 30.7%	910 52.4%	1,737 100%
6. Values and Ethics	1,030 3.48	26 2.5%	49 4.8%	362 35.2%	593 57.6%	1,030 100%
Total ²	18,356 3.33	704 3.8%	1,658 9.0%	6,895 37.6%	9,099 49.6%	18,356 100%

Overall, these data indicate that while the majority of our students are rated as “Effective” or “Very Effective”, there are still significant numbers of students who are ranked by faculty as being only ‘Somewhat Effective’ or “Not Effective’ in 1B: Quantitative reasoning. Some of this effect may be due to the small sample size, or differences between faculty or departments as to scoring consistency.

B. Student Ratings: A second report asked students to rate their effectiveness on each of the PULs. Here we compare the results of IUPUI Science students with IUPUI students as a whole:

IUPUI Undergraduate Student Self Ratings of Effectiveness on the Principles of Undergraduate Learning Scales

School	N	Written, Oral & Visual Skills	Quantitative Skills	Information Resources and Technology Skills	Critical Thinking	Integration and Application of Knowledge	Intellectual Depth, Breadth and Adaptiveness	Understanding Society and Culture	Values and Ethics
IUPUI	690	3.45	3.03	3.42	3.39	3.29	3.30	3.45	3.50
School of Science	119	3.46	3.12	3.45	3.38	3.25	3.27	3.47	3.45

In general, these data indicate that Science undergraduate students are confident in their attainment of the campus PULs, and that they are consistent with other students’ self-reported scores. It will be necessary to compare these self-reported data with more objective data to draw further conclusions.

5. Student Success Initiatives

A. Summer residential STEM Bridge program designed for students who will be residents on campus. There were several positives to the residential STEM bridge program. Students living in the same buildings had an opportunity to get to know one another before the semester began and there was more interaction as the semester continued. There were some issues that needed addressing: rapport with upper classmen as RAs; promoting the program during orientation (since new students see a variety of different advisors at orientation); and a decrease in outreach to participants after the semester started (plans to increase outreach with the next cohort are being considered). A spinoff of the residential STEM bridge program was an overnight orientation for the next cohort of students. A problem that faces bridge programs is finding faculty willing to teach the experience during the summer. Thus, the non-residential STEM bridge programs will experiment with increasing the number of students served by increasing the students to faculty ratio, but lowering the students to student-mentor ratio in the third year of the grant. The number of students participating in the STEM Bridge program has increased 32% and 22% over the past two years (65 students in 2010, 86 in 2011, and 105 in 2012). Recent data indicates that STEM bridge participants have higher GPAs compared to non-participants; students participating in Summer Residential STEM Bridge have lower DFW rates compared to non-participants; and minority students (especially African Americans) participating in Summer STEM Bridge obtained higher GPAs, lower DFW rates and higher Fall-to-Fall retention rates compared to non-participating AA students.



B. Continuation of the Physics Learning Space (PhyLS) in Fall 2012, and designed to advance student success in introductory physics by providing mentoring to all students taking these courses. These courses, typically having the highest DFW rates on campus (averaging 25.1% in 2010), serve almost 1500 students each year. In order to reduce the DFW rates, PhyLS has adopted the “assistance center” model that has proven successful in Math, Chemistry and Biology. Students are able to: interact with mentors and faculty in small groups or one-on-one; focus on the areas that cause them the most trouble; receive individual support; guided access to computer simulations, video analysis software; and other online tools that support learning in physics. This new center has an assessment plan, but limited data has been collected during the first semester of operation.

C. Implementation of a new Post Enrollment Requirement Checking (PERC) in MATH Courses during the Fall 2012 semester. A situation that causes many STEM students to drop out of their intended major is the result of not being successful in the first math course, and then moving onto the next math course, and failing it. These students believe they can pass the next math course without being successful in the prerequisite, but they end up digging a hole they cannot climb out. Advisors find it difficult to catch this situation before it is too late - and it contributes to lowering the first year retention rate. The math department worked with the Registrars Office to develop an automatic withdrawal program that will remove enrolled students in math courses one week before the semester starts, if they do not have the proper prerequisites grade. When the Post Enrollment Check (PERC) is run one week before classes start, the identified students are withdrawn from the math course, and the student and their advisor will be automatically notified by email of the action. In the Fall 2012 semester, 47 students were identified as enrolling in math courses in which the prerequisite course was not passed. For the Spring 2013 semester, 84 students were identified and advised before the first day of class.

D. Actively promoting the MATH Minor to students and advisors across campus as a way of setting a short-term goal in the pipeline to completing a BS degree. The department completes the paperwork and the Registrar post the minor on the transcript at the time of completion (usually in the sophomore year). This transcript documentation provides motivation to students that they have completed a component of their degree (much like an AS to BS degree). Many STEM majors will automatically have a minor in their plan of study, or will earn the minor by selecting one more math course as an elective. The number of minors awarded each year provides an indicator of the number of STEM majors in the pipeline. The number of minors have increased each year: 32%, 14%, and 94% (44 awarded in 2008, 58 in 2009, 66 in 2010, and 128 in 2011). This rapid growth is partly due to students becoming more aware of their eligibility to obtain the minor, but it is also due to 53 students (of the 128 awarded last year), who took an additional course above their requirement (a free elective) to obtain the minor.

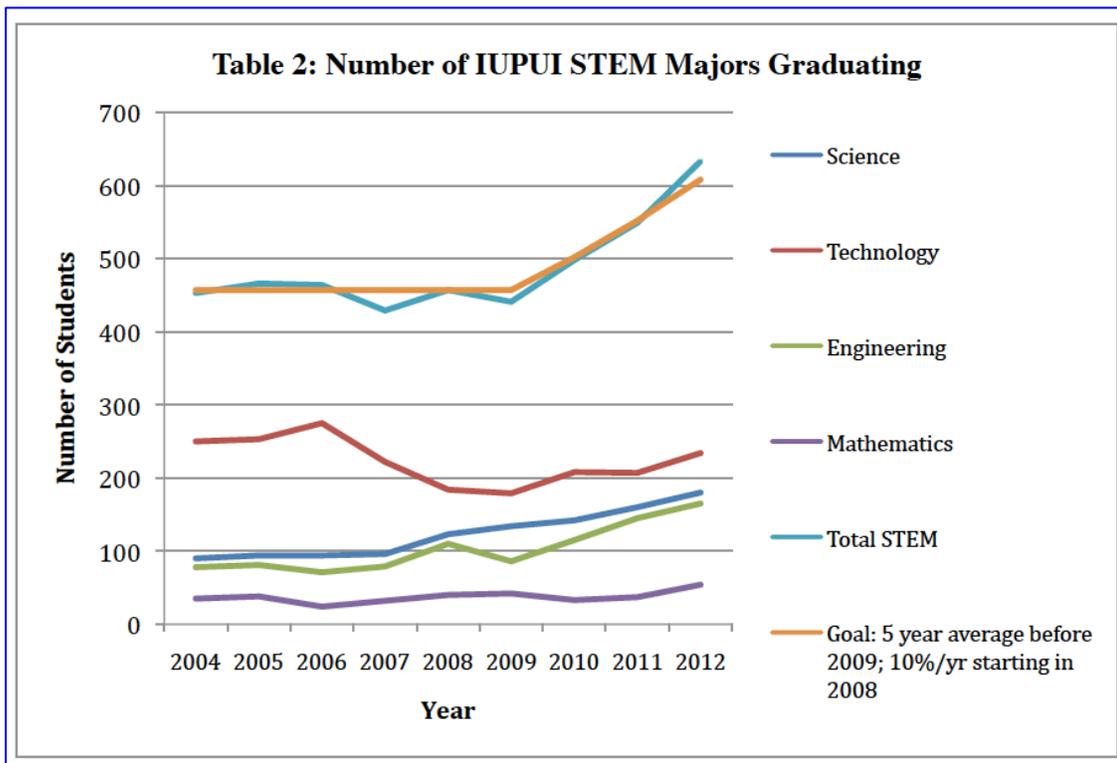
E. New Math Assistance Center (MAC) Director Serves Key Role in Success of Students Across Campus Kevin Berkopes was selected as the new director of the Math Assistance Center, (www.mac.iupui.edu). The MAC employs 70 Math Scholarship Student Mentors who understand the complexities connected to teaching and learning mathematics, and who aim to make math more accessible and achievable for the 1,000 students across the IUPUI campus who visit each week.

F. School of Science Career Development Services (CDS) Center: Career Services include the planning and implementation of the School of Science Career Development Services (CDS) Center. One of the initial goals of the new Director was to increase the awareness of the center, its location, and services provided. The center was promoted through various programs and methods. Although only two employees staff the center, outreach to hundreds of undergraduate and pre-professional students, has been successful. The number of students utilizing career services increased from 95 students in the first year to 327 students in 2011–12; and one-on-one advising went from 95 to 327. Educational programs include: resume development, class presentations, workshop series, social media networking, and etiquette lunch. Strategic and intentional efforts were undertaken to acquaint faculty with CDS staff and services. According to the **Graduating Student Survey** administered by the School of Science Dean’s office in Spring 2012:

- Students’ plans following graduation were: 17% accepted a position; 27% currently searching for a job; 24% attending graduate school; 19% attending professional school; and 13% other.
- The survey also reported 43% of graduates completed an internship.
- Science Careers (powered by CSO): a comprehensive site that provides web access for employers to post positions including part/full-time, volunteer, and internship for science majors. Students can view these postings, upload resumes, and apply within the system. During the first year, 722 new jobs were posted. During the second year, 850 new job postings with 605 employers in the system. The following are companies that have built relationships with the CDS: Roche, Theoris Scientific, Develop Indy, Appriss, ChaCha Inc, WorkOne Indy, and Biostorage.
- Usage of Departmental vs. School Career Services. There is significant ($p < .001$) overlap between users of these two provider options for Career Services. Note however that while 62% of CDS users also use their departmental services, only 39% of departmental service users also use CDS. [Holds true for use of internship/job search resources as well, 74.4% vs.42.2%]. This could relate to continued need to get the word out about this new(er) office.
- Career Services is moving to the new University Tower space (HO 200) in July 2013, and relaunching their name as “PREPs” Pre-Professional & Career Preparation for Science Students” (SciencePREPs.iupui.edu), which will position the center as a key resource for Science careers.

6. Progress to Date

A. Number of STEM BS/BA Graduates at IUPUI The program has set a target of increasing the number of STEM graduates at IUPUI by 10% per_year (an increase of an additional 782 STEM graduates by 2015). Each year represents students graduating in May, August or December of that year. We have collected the number of STEM graduates since 2004 to determine the graduation trend. The data show that the graduation numbers were flat for a number of years. The fact that the numbers began to rise in 2010, was due in part to implementing some upper-level interventions (primarily the Career Development Office). Our preliminary data indicate that we are exceeding our goals (even as associate's degrees in Technology decline as the students seeking these degrees now attain the A.S. at Ivy Tech):



B. Evidence of Undergraduate Success and Accomplishment: This year, [39 of the Top 100 Students at IUPUI were from the School of Science](#), which is at least one measure that indicated the success of our students as they progress through our degree programs. This short section highlights some of the many outstanding accomplishments of our students learning success and faculty efforts:

1. [Science Student Becomes IUPUI's First Goldwater scholar](#) (April 2013) Jason Walsman, a double major in environmental science and biology, is the first IUPUI Goldwater Scholar, considered to be the premier undergraduate award for the nation's most promising undergraduate college students in math, science and engineering. Walsman intends to earn a Ph.D. in ecology.
2. [Biology Student Credits Experiences at IUPUI with Early Entry to Dental School](#) (April 2013) Neelam Shah, a Women in Science House (WISH) student, credits her real-world experiences at IUPUI with best preparing her to begin dental school after only three years at IUPUI..

3. [IUPUI Undergraduate Presents on Neural Regeneration in China](#) (Sept 2012) Senior biology major Jennifer Romine represented the IUPUI School of Science at the International Neural Regeneration Symposium in China, for studying the maturation process of neurons in the brain.
4. [Four Science Students Honored With Plater Medallion for Civic Engagement](#) (April 2013) The students included Eric Keller, Lindsay Lazo, Jennifer Romine, and Kristyn Seibert. These students are also among the record 39 Science Students in IUPUI Top 100 for 2013.
5. [Science Represented Well at Chancellor's 2013 Honors Celebration: Gabe Filippelli](#) (Earth Sciences/Center for Urban Health) received the Chancellor's Faculty Award for Civic Engagement. [Michael Yard](#) (Biology) received the Chancellor's Award for Excellence in Teaching. [Leslie Ashburn-Nardo](#) (Psychology) received the Chancellor's Award for Excellence in Multicultural Teaching. Science majors selected as Chancellor's Scholars included Alexander Stufflebeam, John Kraihanzel, and [Eric Keller](#). [Tomas Meijome](#) earned the Chancellor's Award for Outstanding Research. [Yogesh Joglekar](#) (Physics) was recognized with the 2013 CRL [Kathryn J. Wilson Award for Outstanding Leadership in Mentoring Undergraduates](#).

C. Assessment Committee Plans For 2013-2014: The creation of cohorts and tracking their performance through the pipeline to graduation has proved to be a challenge. Since we are an urban institution, we graduate many more transfer students than first-time traditional students. However, we are currently planning track cohorts starting in 2004 to chart their progress towards graduation. Currently, we plan to collect the following data on each cohort for both first-time freshman and transfer students (by gender, race, FT/PT, etc.):

- 1) Average GPA each year for cohort
- 2) Track those who attended a STEM Bridge
- 3) Track number who changed major, but dropped STEM major each year
- 4) Track number who dropped out of higher education each year
- 5) Track students in cohort involved with each intervention, and compare their DFW and retention rates to others in cohort
- 6) Track number who use Career Development Services

An additional concern for the School of Science is the percentage of students who report completion of one or more RISE experiences. The data at right is from the School of Science Graduating Student Survey, and indicates that almost a third of our graduating seniors report no RISE experiences. We will be investigating ways to track this more closely in the year ahead and to increase efforts to promote and emphasize the academic and co-curricular benefits of Research, International Study Abroad, Service Learning, and Experiential Learning on the academic development of our Science students.

	SP11	SU11	FA11	SP12	SU12	FA12	SP13	TOTAL
R	14.5%	32.4%	18.6%	15.2%	16.7%	15.0%	10.6%	16.5%
RI			0.7%	1.6%		1.7%	2.4%	1.1%
RIS	1.3%		1.0%			0.9%		0.7%
RISE	2.6%	2.7%	2.4%	1.6%	6.7%	2.1%	2.4%	2.4%
RIE				0.8%	3.3%	1.3%		0.6%
RS	5.3%	2.7%	5.5%	4.0%	6.7%	6.4%	2.4%	5.1%
RSE	3.9%	2.7%	8.2%	4.0%	10.0%	3.8%	4.7%	5.6%
RE	1.3%	2.7%	4.1%	1.6%		3.8%	3.5%	3.2%
I	2.6%		0.7%	3.2%		1.3%	1.2%	1.4%
IS	1.3%		0.3%			0.4%		0.3%
ISE			1.0%			1.7%		0.8%
IE			0.3%	1.6%	3.3%	1.3%		0.8%
S	25.0%	10.8%	13.4%	16.8%	10.0%	18.8%	15.3%	16.3%
SE	1.3%		5.2%	4.8%		5.1%	10.6%	4.9%
E	7.9%	2.7%	6.9%	10.4%		4.3%	8.2%	6.5%
ES							1.2%	0.1%
NONE	32.9%	43.2%	31.6%	34.4%	43.3%	32.1%	37.6%	33.7%

6. Graduate Program Assessment

A. Program Overview: Graduate programs at the Ph.D. and M.S. level are advanced fields of study that provide new knowledge in areas unique to the specialization of particular faculty members within research disciplines. At the graduate level overall, however, there are generally similar educational outcomes that are usually independent of the specific field of scientific study. IUPUI has a series of Principles of Graduate Learning (PGLs) that form a conceptual framework that describes expectations of all graduate/professional students at IUPUI. Virtually all graduate students in almost all disciplines are assessed on:

- (a) Ability to undertake appropriate research, scholarly or creative endeavors, and contribute to their discipline;
- (b) Demonstrating mastery of the knowledge and skills in an advanced area expected for the degree and for professionalism and success in the field
- (c) Thinking critically, applying good judgment in professional and personal situations
- (d) Behaving in an ethical way both professionally and personally”
- (e) Ability to teach, often at the undergraduate level; and
- (f) Communicating effectively to others in the field and to the general public
- (g) Success in finding employment in a field related to their graduate work.

Together, these PGLs are expectations that identify knowledge, skills, and abilities graduates will have demonstrated upon completing their specific degrees.

B. Program Outcomes: In general, graduate programs in the School of Science assess M.S. and Ph.D. students through comprehensive written and/or oral examinations by a committee related to their field of study, and regular committee meetings to discuss research progress and mastery of skills and knowledge. Graduate students often teach in the department, and they are evaluated for their ability to teach by the campus Student Satisfaction of Teaching survey that all faculty receive. Depending on the department, the Teaching Assistants may receive peer evaluation, if teaching. Their record of presentations at meetings, invited talks, publication and submission for grants or fellowships is also a means of assessment, and contributions to the scholarly literature both during and several years immediately after graduation similarly have are used as a form of program assessment.

Evaluation of these undertakings by committees of graduate faculty remains the ultimate assessment standard of student success at the graduate level. These metrics are generally found to be an academically acceptable method of capturing most of the information necessary for graduate student assessment. In terms of final numbers, almost 200 students earned the M.S or Ph.D. in the School of Science in 2012-2013.