PRAC Report: Assessment of Student Learning
IUPUI School of Science
2022-2023 Report

Overview: The School of Science at IUPUI provides outstanding science education for all IUPUI students, education in depth for students in our School, and engages in fundamental and applied research in the physical, biological, mathematical, computational, and psychological sciences to increase knowledge and advance the development of the sciences at IUPUI and in the State of Indiana. Within the seven academic departments (Biology, Chemistry & Chemical Biology, Computer & Information Science, Earth Sciences, Mathematical Sciences, Physics, and Psychology) and the three programs (Artificial Intelligence, Forensic and Investigative Sciences and Neuroscience) of the School, there are over 125 full-time faculty members. The School is the academic home of ~2,500 undergraduate majors, ~400 graduate students, and ~125 post-baccalaureate pre-professional students.

Part I: Student Learning Outcomes for Each Academic Program

The School of Science has been utilizing the Student Learning Outcomes which were reviewed and reaffirmed in Fall 2021. A comprehensive list of SLOs for both undergraduate and graduate education and degree programs can be found in the IUPUI Bulletin https://bulletins.iu.edu/iupui/2023-2024/. In Spring 2019, each program mapped its program level learning outcomes to the new IUPUI Profiles of Undergraduate Learning.

Undergraduate SLOs (B.A. and B.S.)	**Graduate SLOs (M.S. and Ph.D.)**
• Biology • Chemistry • Computer and Information Science • Environmental Sciences • Forensic and Investigative Sciences • Geology • Interdisciplinary Studies • Mathematics • Physics • Psychology • Neuroscience • Artificial Intelligence	• Addictions Neuroscience • Biology • Chemistry • Clinical Psychology • Computer and Information Science • Geology • Industrial Organizational Psychology • Mathematics • Physics • Applied Social and Organizational Psychology • Computational Data Science • Forensic and Investigative Sciences

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

There are several ways that the school has been examining their curriculum and working on course improvement. They are organized in the sections below. First, we have continued to have our general education courses reviewed. Second, faculty have been conducting course improvement activities. Third, departments have received SEED money from SIERI to examine new practices in STEM Education. Finally, faculty share new and best practices in the classroom in our annual STEM education summer showcase.

Part II: Assessment and Continuous Improvement Plans in General Education Courses.

The main focus of this School of Science's annual report is on the efforts undertaken in the last year to assess and develop improvement plans related to student learning outcomes for our *general education* courses. The School of Science has 80 courses on the general education list. Over the last five years, we have had 80 courses reviewed. To gain reapproval, departments must submit a dossier that includes the learning outcomes, and evidence of student attainment of the outcomes. In addition, departments provide information and reflection on DWF rates and submit a plan for continuing improvement. The following data and information provide evidence that we are assessing our programs, and that we are addressing the IUPUI Profiles of Undergraduate Learning and Principles of Graduate Learning in the context of our courses.

Below are listed the courses that were reapproved during the 2022-2023 AY.

BIOL-K 103	Concepts of Biology II
BIOL-N 100	Contemporary Biology
BIOL-N 213	Human Biology Lab
GEOL-G 135	Indiana Rocks!
AST-A 100	The Solar System
FIS 20500	Concepts of Forensic Science I
PHYS 15200	Mechanics
BIOL-N 261	Human Anatomy
BIOL-K 101	Concepts of Biology I
MATH 13000	Mathematics for Elementary Teachers I
MATH13200	Mathematics for Elementary Teachers II
MATH 15400	Trigonometry
MATH-M 119	Brief Survey of Calculus 1

Part III: Course Improvement and Assessment Activities

B110 – Introduction to Psychology

In the honors section of B110 Dr. Debbie Herold has been collecting data on a new honors project focused on addressing common myths and misconceptions in psychology. Students take a myths quiz at the start of the semester. As expected, many if not all endorse commonly held misconceptions about people's behavior. Students then work in small groups to research the topic and then create a presentation by the end of the semester to educate their classmates on the myth. They explore why the myth is so prevalent, what the research actually shows, and suggest things that might be done to dispel the false belief. At the end of the semester, she has them take a post-test quiz to confirm that the assignment actually had an impact.

As part of the project, she has included an assignment that has students ask ChatGPT about the topic. They are asked to see whether they can get it to give them different outputs depending on how they phrase the question. For example, you can get ChatGPT to both tell you that people DO and DO NOT commonly repress traumatic memories depending on how you phrase the question. They evaluate the output to determine how credible they believe it is. She expects that this makes them more skeptical of the answers they get from AI tools.

Examples of some of the myths:

- Subliminal messages can induce people to buy things that they would not ordinarily purchase.
- Students learn best when they are taught in ways that match their personal learning styles.
- Some people are "left-brained" (logical and analytic), while others are "right-brained" (intuitive and holistic).
- Opposites attract: People tend to establish friendships and romantic relationships with individuals who differ from them in their personality, interests, and attitudes.
- Raising self-esteem causes improved academic achievement.
- Individuals commonly repress the memories of traumatic experiences.
- It is better to vent your anger or "blow off steam" than to hold it in.

Interdisciplinary Capstone Course

https://news.iu.edu/live/news/33819-faculty-create-innovative-multidisciplinary

Capstone stats: 31% Male, 61% Female, 8% non-binary/3rd gender. 10% Hispanic/Latino 24% Black/African American.
Capstone Student Majors: Biology, Forensics, Earth Science, Religious Studies (most are double majors)
Capstone Student Minors: Chemistry, Psychology, Sociology, Religious Studies, Business, Environmental Science.

We have developed a model that helps students in guided inquiry research, with assignments that help guide students to develop an ePortfolio with artifacts and reflections on the IUI PLUS standards. Though we haven't implicitly recruited URMs, we have developed a model that does

attract them: with an emphasis on **cooperative/teamwork research**, research that is focused on environmental justice or giving back to the community, such as,

> *"A key consideration is the fit between the cultural values that exist (or are perceived to exist) within science and the culturally connected values of the groups who are traditionally underrepresented in science. In particular, prior research has illuminated the importance to URM students of altruistic or prosocial values of helping society or giving back to one's community. Whereas students from all backgrounds tend to highly value the traditional or stereotypical intrinsic reasons for pursuing science (e.g., curiosity, enjoyment of problem solving, passion for discovery), the career interests of URM students are also more likely to be influenced by prosocial cultural values than the career interests of their peers (Johnson, 2002; Thoman et al., 2015)"*
>
> From, **Science That Matters: The Importance of a Cultural Connection in Underrepresented Students' Science Pursuit**
> Matthew C. Jackson, Gino Galvez, Isidro Landa, Paul Buonora, and Dustin B. Thoman

Math 11100

Dr. Ryann Workman instituted a new activity in her 100 level math course. She instructed her student to split their note page in half and only take notes on the left hand side of the page. After each class, the students were required to copy their notes on the right hand side of the page within 24 hours of class and send her a screenshot of the completed assignment. The results of hits change are quite remarkable. Student test scores increased, DFW rates decreased and her class scored well above the common final average for the semester. By adding this simple structure to her class, she saw highly positive results.

Equity Champions Program

Several school of science faculty have participated in the Equity Champions Program over that last year; some participating as mentors and some as participants to the program. In this program, faculty have the opportunity to have their course assessed through the Ascend survey to assess social belonging, identity safety, and institutional growth mindset. The school has set a strategic goal of encouraging continued participation by faculty and have 20% of faculty complete this program.

Inclusive Teaching Practices reading group

In fall 2023, the school of science organized a reading group of approximately 12 faculty. The group met monthly and read the Hogan and Sathy, "Inclusive Teaching: Strategies for promoting equity in the College Classroom". In addition to reading the book, participants shared what they were learning with their colleagues, conducted a syllabus review and set goals for Spring

semester. We will be following up with participants at the end of Spring 2024 to gauge changes they observed in the class performance.l

Part IV: SIERI

Faculty from 3 departments received STEM Education Innovation and Research Institute (SEIRI) Seed grants to examine student success in their classes.

Designing and Piloting an Urban Field Camp Course

Principal Investigators:
Gregory Druschel - Associate Professor, Department of Earth Science
Kathy Licht - Professor and Chair, Department of Earth Science

Abstract:
Preparing students to work in geological and environmental science should include the urban settings where most of the planet's population lives. Existing capstone experiences, required by 99% of earth science departments for graduate work, are taught mostly in rural and mountainous settings, creating barriers to student participation in these disciplines. Creating capstone experiences in urban settings will allow participants to understand the environment in which they live and help redress continuing racial and ethnic disparities in these fields. We propose to develop an Urban Field Course, having now gathered information from survey instruments and in-person interviews to identify and prioritize career-oriented core concepts and skills needed for a capstone experience. Development of teaching modules to address learning of these core concepts and skills will be done in tandem with efforts to create a community of belonging to enhance diversity, equity, and inclusion of underrepresented groups, integration of ethical practices for personal development and experience in working at the intersection of science and society, and significant community engagement. This will represent a first-in-the-nation capstone course on urban Earth sciences, to test and develop starting summer 2023, with launch of a pilot course set for summer 2024 and the submission of a National Science Foundation GeoPaths proposal to further develop our course as a regional model to support nationwide capacity for this training. Our intention is to provide a model for attracting underrepresented students into the geosciences using innovative, career-focused concepts and skill development to transform urban settings into useful geoscience learning spaces.

Multidisciplinary Undergraduate Research Experiences: Community Engaged Research for Student Success

Principal Investigators:
Patrick Gentry – Lecturer, Department of Biology
Jim Marrs - Professor, Director of Graduate Studies
Kathy Marrs - Professor, Department of Biology
Forrest Brem - Lecturer, Department of Biology

Abstract:
We present an innovative approach to senior capstone projects in Biology that emphasize cross-disciplinary collaboration and community-focused research. Our Multidisciplinary Undergraduate Research Experience includes projects such as habitat restoration, genetic environmental surveillance, studying antibiotic resistance in the soil, and investigating zebrafish developmental biology. This transformative model aligns with PLUS criteria and engaged learning principles, preparing students for meaningful impacts in their campus and community. Workshop participants will explore the importance of diverse perspectives by forming interdisciplinary teams to address simulated problems, and brainstorm ideas for capstone projects that benefit both campus and community, outlining actionable steps for implementation.

Integrating the Nature of Geoscience into Earth Sciences Introductory Courses

Principal Investigators:
Sammy Nyarko – Assistant Professor, Department of Earth Sciences
Anna Jessee – Lecturer, Department of Earth Sciences
Kathy Licht – Professor and Chair, Department of Earth Sciences
William Gilhooly III - Associate Professor, Department of Earth Sciences

Abstract:
The current vision and changes for undergraduate geoscience education emphasize the need to train students, especially those taking introductory courses to understand the nature of geoscience work. Training students to understand how geoscience works does not only promote their interest and community engagement in the field, but also has the potential to promote awareness about what geoscientists do. To address this, some instructors are using implicit practices such as “picture or draw an Earth scientist” and “thinking like a geologist”. The implicit approach places a strong emphasis on practicing science, with the idea that students would gain a more accurate

understanding of the nature of scientific inquiry and knowledge just by engaging in real scientific inquiries. Implicit instruction helps students think critically, think for themselves, and make sense out of given information, however without clear learning objectives and concrete opportunities to apply learning leads to frustration, confusion and heavy cognitive load for students. We will implement a two-aim project that will document undergraduate students' conceptions about the nature of geoscience and implement an innovative, intervention lesson using geo-history and an explicit reflective approach. We anticipate that by the close of this project, other introductory courses in our department and other disciplines in the School of Science will introduce the nature of science concepts into their introductory courses.

Part V: STEM Education Showcase

For several years, Dr. Brenda Blacklock has organized and hosted a summer teaching showcase. Faculty who would like to share new innovations from their classrooms conduct short presentations.

Below is the slate of speakers and topics for Summer 2023.

Time	Speaker	Title
9:20 – 9:30	Brenda Blacklock, CCB, and Dean DiTusa	Opening Remarks
9:30 – 9:40	Brandon Sorge, SEIRI	Opportunities for STEM Education Research through SEIRI
9:40 – 9:52	Tina Chen, PSYCH	IUPUI Equity Champions Program: Overview and Classroom Practices Resource
9:53 – 10:05	Cam Macris, ES	IUPUI Equity Champions Program: A Case Study of Using the Student Experiences Practice Library and Ascend Survey in STEM
10:06 – 10:18	Keith Anliker, CCB, and Pat Clark, BIOL	IUPUI Equity Champions Program: Community of Transformation Reflections
10:19 – 10:27	IUPUI Equity Champions Program Speakers	Question Period
10:28 – 10:38		**Break**
10:38 – 10:53	Thomas Rossbach, ES	Ethics as an Integral Component in Teaching Earth Science

10:54 – 11:09	Barbara Johnson, MS	Adapting to Actual Students
11:10 – 11:25	Ryann Workman, MS	Accountability Measures for Note-Taking and Improved Student Performance
11:26 – 11:41	Marie Nguyen, CCB	Interweaving Study Strategies into General Chemistry II
11:42 – 11:57	Seb Laulhé and Rob Minto, CCB	Inverted Organic Chemistry
11:58 – 12:13	Patrick Gentry	Rethinking Capstones
12:13 – 12:30		**Open Discussion**

Part VI: The Record

There are currently 4 experiences approved for the Record:
Principles of Hydrology/Surface Water Hydrology (GEOL-G 430/G550)
Laboratory Assistantship in Earth Sciences
Learning Assistant for B110 Introduction to Psychology
Internship in Science-Based Field (SCI-I 494)

Part VII: Graduate Program Assessment

1. 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;
(f) Communicating effectively to others in the field and to the general public; and

(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.

2. 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. 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 the 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 actual numbers, approximately 100 students earned the M.S or Ph.D. in the School of Science in 2020-2023.

Part VIII: Assessment Plans for 2024

There are several assessment efforts currently going on in the school. First, we will continue to complete the dossiers to reapprove the general education courses located within science. Additionally, any general education courses at IUPUI suffer from challenging DFW rates and this issue was particularly problematic for our service math courses during the covid pandemic. The math department is working with DUE to hire a 50% faculty fellow who will focus on teaching strategies to improve these rates in the math department. Similarly, the biology department is working towards including PLTL in Anatomy, where the DFW rates have increased following a change in when nursing students complete this course. Science is committing time and resources to address this problem with the math department. Finally, we have constituted a new committee at the school level to focus on student success, particularly at the 100-200 level courses. This committee will focus primarily on the strategic goals set for student success in the Vision 2030 Strategic Plan.