PRAC Report: Assessment of Student Learning
IUPUI School of Science
2019-2020 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 two programs (Forensic and Investigative Sciences and Neuroscience) of the School, there are over 135 full-time faculty members. The School is the academic home of ~2,500 undergraduate majors, ~400 graduate students, and ~165 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 developed during the 2010-2011 academic year for assessing each academic program. A comprehensive list of SLOs for both undergraduate and graduate education and degree programs can be found in the IUPUI Bulletin. 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 (new as of Spring 2021)	• 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?

The main focus of this 2019-2020 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 three years, we have had 64 courses reapproved to be on this list. 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.

COVID Note: As we were forced to pivot to virtual learning in March 2020 and continue that learning mode into the academic year 20-21, assessment of student learning has been challenging. Faculty were forced to assess student learning primarily via the Web and this resulted in a significant increase in academic dishonesty such as student cheating. Faculty have voiced concerns about the impact this behavior will have on subsequent courses; as the curriculum in many programs is scaffolded.

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

The following 17 science courses were evaluated by the General Education Course Evaluation sub-committee of the IUPUI Undergraduate Academic Committee in AY 19-20. To date, as indicated above, 64 science courses have been successfully re-approved as general education courses at IUPUI. As a part of that review, instructors must submit an overview of the continuing improvement efforts, stated learning outcomes and assessment of the course.

AST 103	BIO N212	BIO N251	BIO N214
BIO K102	CHEM C100	CHEM C110	CSCI 201
CSCI N207	GEOL G117	FIS 10101	MATH 13000
MATH 13100	MATH 13200	MATH 13600	PHYS 201
PHY 202			

Below are excerpts from dossiers submitted to the Gen Ed Review Process in AY 2019-2020. Various parts of the dossiers were selected to provide evidence of the attention paid to learning outcomes, assessment, and continuous improvement throughout the Science curriculum.

K102 HONORS - CONCEPTS OF BIOLOGY

4.A Direct and Indirect Measures of Student Learning

There is a considerable amount of direct and indirect learning.
***Direct**: Demonstrate knowledge and skills; tangible, visible and self-explanatory evidence*
***Indirect:** Self-assessment, peer-feedback, end-of-course evaluations/questionnaires*

We have the following components of Direct Learning:

1. **Lecture portion:**
   - 4 objective tests (multiple choice, on-line, in the testing center) and 1 cumulative final exam.
   - Top Hat Classroom Response questions (typically twice per week)
   - Weekly on-line Mastering Biology homework
2. Lab portion:
   - 12 labs with Electronic Lab Notebook report submissions through Canvas (graded by TAs)
   - 4 lab report writing assignments (Peer reviewed and then graded by TAs)
   - 8 Weekly Quizzes (on-line through Canvas – graded by Canvas)
   - Honors Research Project, Paper, and Poster Presentation – Assessing science communication, research skills, experimental design skills
   - Strong emphasis on skill development: New lab techniques and skills, Data Analysis, Biological Imaging and Microscopy and Writing / communication
3. Recitation:
   - Active Problem Solving (weekly; required part of course)
   - Completion of activities in recitation guide (developed by K. Marrs and recitation leaders)
   - 1 Team Project – oral presentation

We have the following components of Indirect learning:

***Indirect:** Self-assessment, peer-feedback, end-of-course evaluations/questionnaires*

1. Lecture portion:
   - Top Hat discussion questions – answers are discussed in class to allow students to get peer feedback and self-assess their understanding
   - End of course evaluations are given in lecture, lab and recitation
2. Lab portion:
   - All labs with Electronic Lab Notebook report submissions through Canvas – Each lab has a required **Reflection slide** to allow them to think about the bigger picture and how the lab connected to lecture or to their career. Students seem to enjoy this Reflection/ self-assessment, based on their written comments.
   - A weekly Pre-lab in their paper lab notebook, making them to make connections about their learning to their career, real-world, or links to lecture material: (See next page)
3. Recitation:
   - Exam Reflections (Discussion: did they do better or worse than they expected; what are

the study methods that worked for them, what would they change in terms of their preparation/study)

Honors Biology K102

4.B Portfolio demonstrates a plan for continuous quality review and improvement.

Honors Lecture:

- **I am strongly committed to the pursuit of first year student success on all fronts**. I work diligently to review, revise and update lecture material, adding information about new scientific findings, new ways to make connections.
- **After each exam,** we look at the statistics for each question to determine where student misconceptions exist, whether to revise instruction, whether to modify a question to better address a topic.
- **After each semester**, I read and think about all student comments, and consider incorporating student suggestions. Students have given me very valuable feedback over the year that allows me to keep up with new tools to incorporate (i.e.,: Top Hat)
- **As a result of student feedback, I have started new options like K101 Breakfast Club**, a 1-hour drop in Office Hour / Help session every Friday before lecture for K101 and K102 students, held in a room adjoining K101 lecture. Light snacks provided.

Honors Lab:

- K101 lab is routinely reviewed each semester to make sure all labs are working as expected, and new labs are piloted and swapped in as needed (usually about 1 lab per semester is 'freshened up'). That also necessitates a change in the lab manual and Canvas site.
- K102 Lab is what distinguishes K101 from K102, and Given the open-ended nature of the authentic research project, continuous quality review and improvement is ongoing, with the K102 faculty teaching K102 meeting regularly to map out the semester and weekly research objectives.

Honors Recitation:

- Similar to K102 Lab, the Honors K102 recitation also focuses on extending the authentic research project, giving more time for discussion. In this peer-mentored section, I also make sure we have continuous quality review and improvement.

Student Results Survey

Experiment #	Absorbance Spectrum	Thin Layer Chromatography	The Hill Reaction
100% success	9	5	5
70- 99% success	6	10	6

36-69% success			4
1-35% success			

CHEM C100 – THE WORLD OF CHEMISTRY

Reflection Prompt: Write a short paper about the impact that an understanding of some chemical principles and materials has had on how you see yourself, how you think about things in your daily life–including your academic life–and about your ability to make smart decisions personally and as an engaged member of society. Explain how your thought processes have changed over the course of this semester to make this growth possible.

Assignment Details: Submit a typed paper that is between 1500 and 2500 words long. The paper should be double spaced and will be uploaded to Canvas. Your paper should have a descriptive title, an introductory paragraph, a body where you provide information, and a conclusion. **Your paper must include specific examples of information learned in Chem C100 or information you have built on from any prior chemistry you've had.** You must have at least 4 references, with no more than two references being from pages in Wikipedia. Your textbook can be one of the references you site.

Instructions

Although it is not stated as a formal learning outcome or competency for Chem C100, a hope that I always have for students is that this course helps them see themselves differently and see the world differently. This includes that they see themselves as being better at math than they often think that they are, or seeing that scientific ways of thinking are applicable to their lives as non-science students. It also includes what one student, in a previous term, said about the impact that learning chemistry has had on them. It was basically: you've ruined my life. I can't do anything without wondering about the underlying chemistry—what is happening and why.

The Individual Project, and the prompt associated with it, was greatly improved over the similar one that I used in Spring 2018. This was a more focused prompt, and one that made it very difficult to cut and paste ideas together. My sense is that they really had to think about the prompt and put their response in their own words. Although most students did very well, there were still some issues with students making non-scientific conclusions or attempting to make philosophical connections to their lives (balancing equations as a metaphor for balance in life with respect to food, family, relationships, religion, etc.) when the paper was really supposed to be about chemistry principles. Coaching may be needed to help them better meet the goal. One option would be having students submit a rough draft and receiving final approval before allowing them to proceed. This will take away some of the students' creativity, but will likely lead to papers that are aligned better with demonstration of course outcomes.

From what they shared, I've realized that they learned a lot of chemistry through the two mini-

projects and the group project that really doesn't get captured by course assessments beyond the projects—for example in quizzes or exams. Also, the other students in the class were not generally held accountable for chemistry that was learned and shared as part of these projects. A potential improvement would be to have students map what they learned in their projects to specific course learning outcomes, and to have them create questions that could be part of the quiz/exam structure of the course. Another possibility would be for their mini-projects to be thought of more as modules that the other students would complete, rather than as a work product that was only peer-reviewed and graded.

The following excerpts from student papers (Individual Project) provide clear evidence of students progressing during the term as Problem Solvers.

Students self-report how they **think critically** about chemicals that they encounter in their daily lives in ways they had not previously done.

Students also point to **new problem-solving approaches** that they use in other courses and in their daily lives.

Some also pointed to the **collaborative nature of the work** that they did in class.

Examples of excerpts of student responses (4 of 18 submitted in the review process)

"Chemistry has enlightened my understanding on how to arrive at a solution through certain procedures and steps. Ideally, chemistry is a discipline, which entails practical ways of arriving at various solutions. Students of chemistry are taught on how to mix various chemicals put up certain procedures and use certain equipment with the view of arriving at a certain goal. This knowledge has been an important aspect in my life as I have been able to apply it in coming up with the various solutions to my problems. Through the integration of procedures, steps and calculated processes, I have found it so easy to solve many problems in my life."

"One of the principles of chemistry is the essence of chemical reactions and the changes that are brought about by chemical reactions. Through the chemistry unit, I have had better enlighten and understanding of what chemical reactions are, types and the results of chemical reactions in our environment. This has given me a different perspective of observing things and being able to appreciate how things occur within the environment. Knowledge on chemical reactions has enabled me to understand why things happen the way they do. For example, I have come to understand and appreciate how leaves change their colors, how food gets cooked and becomes ready for eating, and hoe soap and cleaning detergents gets things cleaned. It is through chemical reactions that many things occur in the world and through these reactions that the world that the environment has been changed. In has come to appreciate the role of chemistry in explaining and illustrating these changes and their influence in the world."

"While taking C100 I have gained a better understanding of chemicals that are main ingredients in products I use on a daily basis and what their purpose is inside of those products. Since I have learned about these chemicals, I can now read a label on the packaging of a product and recognize some of the chemicals and I have also caught myself asking what is that stuff and how does that work more often. Asking myself these questions has helped me grow my knowledge on certain products that I use in my life and what the purpose of the chemicals in those products is. Knowing the purpose of chemicals in products helps me understand if the product is safe and if there could be a potential risk in using that product. Knowing the risks, a chemical can have on my body helps me choose which products I use and if there is a safer alternative to that product that I had been using. Taking this chemistry class has helped me expand my knowledge on the chemicals inside my products and the purpose they serve. Even though this class is not finished I cannot wait to see how much more I can learn about what other chemicals and what their purpose is."

"Before taking this course, I was oblivious to how much we use chemistry in our careers, academic life, daily life in our home, and decisions that we make every day. Since I had not taken a chemistry class prior to this course I did not realize chemistry is so much more than the periodic table and the elements that make up the periodic table. Chemistry is actually so much more when you think about it, we are constantly surrounded by chemistry and we make many decisions with knowledge from chemistry. I am so glad that I took this course and I am now reading labels of products to see what is in them before I use them. I also never realized that chemistry plays a vital role in the health care field. I knew that chemistry was important for pharmacists and the pharmaceutical companies when they are filling prescriptions, creating new medications, making pills and other medications, and testing medications before distributing to them patients. What I did not realize that chemistry plays a role in healthcare in every career within this field because even the janitor in a hospital deals with chemistry when they are cleaning and disinfecting rooms with cleaners."

CSCI – N207 DATA ANALYSIS USING SPREADSHEETS

In the Computer Science department, each general education core course has a course coordinator. The course coordinator serves as a liaison for instructors of different sections. The course coordinator ensures the consistency of teaching materials and learning outcomes and streamlines communications on department policies and various types of course support. The department is committed to continuous support to course improvement as demonstrated from the following:

- Two student teaching assistants are hired in each face-to-face session and one teach assistant is hired for every 20-30 students in online sections.
- At the end of each semester, the department collects feedback from course instructors on performances of teaching assistants and rehire those highly recommended by instructors. The department maintains a pool of high-quality teaching assistants and provides training every semester.
- The department hires tutors for walk-in tutoring service everyday Monday through Thursday.
- The department also provides matching funds or course release for the IUPUI

curriculum enhancement grant. A curriculum enhancement grant was awarded in 2017 to explore machine-learning technology to promote instructor just-in-time feedback in online sections.

- The department provides support for experimental and disseminate innovative methods to improve online learning. Virtual classroom teaching technique was explored in Spring 2019 and has proven to be successful. The department will provide travel support for the course coordinator to present a paper at 20th International Conference on Educational Technologies held in Brazil in February 2020.

For future improvements, the Computer and Information Science Department plans on holding a training session for all teaching assistants of this course at the beginning of each semester. The department also realizes the importance of student feedbacks and will figure out a way to better use them.

FIS - FIS 10101 – INVESTIGATING FORENSIC SCIENCES LAB

Evidence of Student Learning

FIS10101 uses hands-on laboratory activities, open book quizzes, and two exams as assessments. Students also have no-credit "practice" quizzes that to help students learn and to assess whether desired learning outcomes have been attained. The exams consist of true/false and multiple-choice questions. Approximately ten questions per topic on the exam directly correspond to the Student Learning Outcomes.

FIS10101 Spring 2019

	Quiz grades	In-class Assignments	Case Assignments	Final Exam	Overall grade
Outstanding	17.64	47.06	29.41	11.76	27.45
Satisfactory	68.63	45.1	52.94	62.74	66.67
Unsatisfactory	13.73	7.84	17.65	25.5	5.88
	100	100	100	100	100

Reported Grades

A	14
B	23
C	11
D	2
F	1
Total	51

The table below is a summary of the Student Learning Outcomes for the Forensic and Investigative Sciences Program for the FIS10100 course taken from the course surveys. Students are asked to rate their FIS 10100 experience at IUPUI and their level of confidence on understanding the concepts. With a rating of 5 being very confident and a rating of 1 being never heard of it. Average scores for each topic range from 3.9 to 4.4, which indicated the students are fairly confident in their understanding of the material and its application.

FIS Student Learning Outcomes	SP16	FA16	SP17	FA17	SP18	SU18	Average
Be able to describe crime scene investigation procedures	4.2	4.3	4.6	4.5	4.4	4.5	4.4
Describe methods for collection and preservation of physical evidence from crime scenes	3.8	4.5	4.5	4.5	4.4	4.4	4.4
Define the tools of forensic science in crime scene investigation	3.2	4.2	4.2	4.1	4.1	4.3	4.0
Recognize and understand the application of physical matches	4.4	4.4	4.5	4	4.3	4.5	4.4
Describe and apply forensic techniques used to analyze questioned documents	4	4.4	4.5	4	4.2	4.4	4.3
Recognize and understand the application of impression evidence such as tiretreads, footwear and toolmark analysis used in forensic science	4.2	4.5	4.6	4.4	4.3	4.5	4.4
Explain, evaluate, and identify characteristics of fingerprints	4	4.4	4.8	4.3	4.4	4.5	4.4
Perform physical and chemical means to develop fingerprints	3.4	4.2	4.4	4.2	4	4.3	4.1
Understand how to recognize, collect, and preserve biological evidence	3.8	4.2	4.5	4.2	4.1	4.5	4.2
Describe the principles and techniques of blood spatter pattern analysis	4	4.4	4	4.3	4.1	4.4	4.2
Understand the techniques associated with DNA extraction and quantitation methods	3.2	4.1	4	4.1	3.9	4.2	3.9
Interpret different methods used to analyze DNA	3.6	4.2	4	3.9	3.8	4.2	4.0

Explain and interpret the principles, instrumentation and applications of DNA typing techniques	3.6	3.9	4	3.9	4.1	3.9	3.9
Understand how commonly encountered trace evidence is analyzed in a forensic laboratory	3.8	4.1	4.2	4.3	3.9	4.3	4.1
Describe the chemical composition, origins and significance of the most commonly encountered types of trace evidence such as ink, paint, fibers, explosives, ignitable liquids and glass	3.8	4	3.8	4.1	4.2	4.2	4.0
Understand how to characterize and identify different types of illicit drugs through analysis	4	4.3	4.1	4	4.4	4.1	4.2
% students responding to survey	9.8	33	44	80	66	57.9	

Reported grades also reflect that the majority of students understand and can apply the concepts outline in the learning objectives. Grades generally below a "C" are due to non-attendance and failure to turn in assignments. Students rarely withdraw from this course.

Plan for Continuous Improvement

The plan for the continuous improvement of FIS10101 as a General Education Science elective consists of the following:

1. Continue to evaluate lecture materials: Alterations have been made to presentations for clarity, and in some cases simplicity based on student and TA comments. Improvements and alterations to lecture materials have been made based on student responses on the exam(s).
2. Continue to evaluate learning objectives for the course: Adjustments have been made to better align the lectures with the course level and learning objectives. While some forensic science analysis can be very simply explained, many of the details of more complex forensic science analysis are not necessarily appropriate for this course level.
3. Yearly faculty reviews of the course and instructor to improve the quality of the course presentation have been scheduled on a rotational basis, so every instructor will evaluate other instructors, and themselves be evaluated regularly.
4. Monitoring of the TAs is performed on occasions as a means to evaluate strengths and weakness of the TA's knowledge and ability to convey information accurately.
5. Continue to analyze student feedback about the course provided in response to open ended questions on the course evaluations.
6. Add a mid-term course evaluation for students to complete on the course. Typically, casual conversations with students provide feedback for improvement. However, a more formalized method is preferable and will be implemented as of the Fall 2019 semester.

G117 Final Project Fall 2019: Simonton Has A Problem!

[This assignment addresses the following Profiles of Learning for Undergraduate Success (IUPUI +):

1) Communicator: Evaluates Information, Listens Actively, Conveys Ideas Effectively
2) Problem Solver: Thinks Critically, Collaborates, Analyzes, Synthesizes, and Evaluates
***3) Innovator: Investigates, Makes Decisions*]**

This assignment is based on a real situation faced by a small town west of Houston, Texas. Flooding and erosion along the Brazos River is forcing the town to consider de-annexing, as it doesn't have the tax base to address this problem. Flood control measures proposed by the U.S. Corps of Engineers may not be feasible because of erosion issues. You need to use real data to determine possible alternatives to deal with this problem.

Background: Simonton Has a Problem[1]

The City of Simonton is a small town located on the Brazos River floodplain, approximately 25 miles west of Houston, Texas. It was established in 1957 and incorporated in 1979. In 1997 it consisted of 195 homes with an assessed value of approximately $13.5 million dollars. Almost the entire city is located within the FEMA 100-year floodplain.

Floods along the Brazos River in October, 1991 and December, 1994[2] caused serious damage in the Simonton area (Houston Chronicle, March 23, 1997-attached). Approximately 100 homes were flooded in 1991; 125 homes flooded in the 1994 flood. The latter flood caused approximately $2.5 million dollars damage. Flood insurance claims for the subdivision since 1978 total approximately $4.5 million dollars. Clearly Simonton has a problem!

An interim report by the U.S. Corps of Engineers suggests that flood-control levees might be feasible for at least some of the houses (Figure 1). Levee system A would protect 156 houses in sections II and II; levee system B would protect the remaining 39 houses in section I. The town of Simonton is planning a meeting soon to discuss the frequency and magnitude of the flooding and erosion hazards posed to their community by the Brazos River, and to discuss the possibility of building levees. You have been requested to provide student input at that meeting.

Part A: Determining the Probability of Flooding in the Future?

Before any analysis can be done to evaluate alternative methods of flood control (e.g. levees, flood-proofing, buy-outs), we must determine how likely is it that floods, equal to or larger than those which occurred in 1991 and 1994, will occur in the future. Unfortunately, there is no gaging station at Simonton. For this reason, we must use the historical maximum annual daily

[1] © 2004, William R. Dupre´, Department of Geosciences, University of Houston; this assignment has been modified from the original

[2] The hydrologic community uses a water year, which extends from Oct. 1 - Sept. 30. Thus the October 1991 and December 1994 floods occurred during the 1992 and 1995 water years respectively, and are so recorded on the table on the next page.

discharge data (Table 1) obtained from the Richmond gaging station, where Highway 59 crosses the Brazos River, approximately 12 miles downstream from Simonton.

First rank the maximum annual daily discharge data provided in the table on the next page from largest (m=1) to smallest. *(note that you only need to rank those floods with discharges equal to or greater than the 1991 and 1994 floods)*. Then use the equations provided below to determine the recurrence interval (RI) and annual exceedance probability (P) of each flood.

1) $RI = (N+1) / m$ N = total number of years of record

m = rank (largest flood of record = 1)

2) $P = 1 / RI$

The recurrence interval (RI) of a flood of a particular magnitude is a measure of the average time between events of equal or greater than that discharge.

The annual exceedance probability (P) is the probability that a flood of that magnitude or greater will occur in any given year.

[Apply basic observational, quantitative, or technological methods to gather data and generate evidence-based conclusions]

Part B: Delineating Areas of Critical Erosion

One of the major problems in the Simonton area is erosion of the river bank during floods. Your job is to delineate areas of critical erosion, and make estimates of rates so as to help predict the results of the erosion over the next few decades. In particular, you must evaluate the implications of the Corp. of Engineers requirement that any levee built for flood control must be designed to last 50 years.

1. Trace the east (Fort Bend Co.) side of the river in 1958 onto the 1995 map. Delineate areas of net erosion over that time interval (1958-1995) in RED, and areas of net deposition in GREEN. Calculate rates of erosion in area of concern by dividing the amount of river migration by the time interval over which that erosion has occurred.
2. Make a prediction, based on the historical erosion rates, as to the location of the east bank of the river 50 years from now. How does your prediction compare with the changes seem by comparing the 2019 image with the 1995 tracing? Any idea why the results may be different (answer using 2-3 sentences below; you should include this in your final report as well)?

[Apply foundational knowledge and discipline-specific concepts to address issues or solve problems.]
[Use current models and theories to describe, explain, or predict natural phenomena.]
[Explain how scientific explanations are formulated, tested, and modified or validated.]

Part C: Create a Flood Risk Map for this Region

1. **Risk Map – Flood Hazard:** Trace the outline of the 100-year flood plain found on Figure 7 onto a street-view map of Simonton, TX (Figure 8).

[Use current models and theories to describe, explain, or predict natural phenomena.]

2. **Risk Map – Vulnerability: You will now plot vulnerable infrastructure on top of the flood zones.**
    a. Using Google Maps (be sure to zoom in far enough to see the detail of these locations when searching!), locate the following vulnerabilities on Figure 8. (you will need to discuss additional social vulnerabilities in your final report as well, see **Part D**):
        i. Major transportation routes
        ii. Major bridges
        iii. Hospitals
        iv. Retirement homes
        v. Schools
        vi. Airports
    b. Once vulnerabilities are located using Google maps, or other resource, use symbols to place the vulnerabilities on your map (Figure 8).
    c. Include a key.

[Locate reliable sources of scientific evidence to construct arguments related to real-world issues.]

3. **Risk Map – Combined:** You have now combined the flood hazard map and vulnerability map into a new map (Figure 8). You will use this composite map to determine levels of risk. Risk (in this context) is where a natural hazard overlaps with a vulnerable system (e.g., homes, schools, populations, bridges). You should decide based on variables such as amount of people in such locations, resource locations, etc., to interpret the level of risk. For example, a hospital in a flood plain might be interpreted as at very high risk to flooding; whereas, a cabin only inhabited during summer months in a flood plain might be interpreted as a lower risk since there are less people and resources affected. A flood plain with no resources would not be designated as "no risk."

    Follow these steps to complete your risk map:
    a. Make observations of your composite map of flood hazard and vulnerabilities.
    b. Determine areas of the following levels of risk, and color them in on Figure 8:
        i. High risk (red)
        ii. Moderate risk (orange)
        iii. Low risk (yellow)
    c. Include a key
    d. Explain reasoning for risk level assignment here (2-3 sentences; you should include this in your final report as well):

[Apply basic observational, quantitative, or technological methods to gather data and generate evidence-based conclusions]

[Apply foundational knowledge and discipline-specific concepts to address issues or solve problems.]

Part D: Recommendations and Mitigation Strategy

Summarize your conclusions about the frequency and magnitude of flooding, as well as the likelihood and consequences of flood-induced erosion in a 1-2 page typed report (and attached map of erosional and depositional changes), addressed to the mayor of Simonton, to be presented at the up-coming town meeting. You should also include your Flood Risk map, and a discussion of social vulnerabilities and how they would impact your flood risk map if were you to take them into account. End your report with a recommendation for flood mitigation techniques that should be applied in Simonton and the areas nearby in order to reduce the risk of flooding. You should find 1-2 outside sources on mitigation techniques to supplement the information from your map. You should include in-text citations and a reference list with information about the outside sources. Be sure to include the EPA website in your reference list as well.

1. Access information about social vulnerabilities using the EPA Environmental Justice Screening and Mapping Tool: https://ejscreen.epa.gov/mapper/

[1.1 Produce texts that use appropriate formats, genre conventions, and documentation styles while controlling tone, syntax, grammar, and spelling.]

GEOL-G 117 Student Reflection

It is extremely important to receive feedback from students during a course, so that the instructors can evaluate and revise, but also to determine how the course impacted students learning and mindsets regarding the topic. We incorporated a set of two reflection questions at the end of the student's final projects, which were worth 5 points to give an incentive to get the most feedback from a majority of students.

Reflection Questions

1. Thinking back over your semester in GEOL-G117, describe something new you learned about the Earth, and how we relate to our environment. What do you think about what you learned? Was it surprising? Why or why not?

2. In what way did this course impact the way you understand and think about science and the scientific method? Does science and the scientific method impact your own life? Why or why not?

Analysis of Responses

The student responses to these two reflection questions indicate their growth as problem solvers and innovators, two of the IUPUI+ profiles, as described in the sections below.

Understanding of the Earth and how we relate to our environment

Many of the students commented on a specific aspect of the course that they learned about – from rocks, to volcanoes, estimating flood risk, erosion, groundwater pollution, etc. Overall the students mentioned that there were aspects of these topics that surprised them, especially how connected the topics are to their lives, and a number mentioned that they noticed these concepts in other aspects of their lives after learning about them, such as on the news or in their other classes/overall major. Others mentioned that after this course they felt they could be more informed citizens, as they learned about how our resources/building materials are formed and where they come from, and also how hazards or the way the ground behaves can affect houses/buildings where they live and work. Also, a number of students were surprised that they could identify rocks! Their responses showed changes in their perceptions about their ability to identify rocks, understand principles of land use/behavior of Earth materials, and overall essentially think like a scientist. Many students described an increase in their understanding of geology in general, as well as how it relates to their life. These comments show the development of the IUPUI+ profile of being a problem solver. The students are connecting the concepts they learned in lab together with their everyday lives, the ideas they are learning about in their majors, and attempting to solve problems or that they will potentially be able to solve problems that they face in their life as they get older. Other students mentioned how they learned to communicate

Also, a number of students commented on how they learned that many of the Earth's systems are connected to one another, and that the actions we take as humans have a significant impact on the Earth. Students mentioned that they learned about how much oil we use as an energy resource, and how important sustainability and renewable resources are becoming. These comments show that these students are developing the IUPUI+ of being an innovator, because they are thinking of large-scale problems and are on their way to not only coming up with new ways of thinking about them, but also coming up with innovative solutions to reduce our impact on the Earth. Other students mentioned how they learned that many of Earth's processes are connected, such as the processes involved in plate tectonics being related to volcanic eruptions and earthquakes. These comments show their growth in problem solving, by connecting many different complex ideas together to mitigate natural hazards such as earthquakes and volcanic eruptions.

A number of students commented on how surprised they were to be able to learn the material so well in a hands-on environment like a lab. Many comments included phrases like "it just clicked more" or "I didn't realize what a hands-on learner I am until this class." One student mentioned how they had never felt/touched rocks or soil before this lab, and enjoyed learning about these topics. This shows these students developed the IUPUI + profile of being a problem solver, especially in the scientific environment of the lab setting of this course, by making observations through seeing/touching Earth materials, and then using those observations to draw conclusions about how they formed and how they behave.

Understanding of science/the scientific method and how it impacts your life

Many students reflected on the fact that their understanding of the scientific method increased after taking this lab course. These students often commented on how they use science every day or how science affects them every day, indicating they are growing in being problem solvers in their everyday lives and grew in making observations of the world around them through taking the course. One notable answer said:

"I'm not very good at science but this class made me understand it more. It taught me how science affects communities, such as volcanic eruptions, flooding, sinkholes, etc. Science affects everyone's lives! Everything that goes on in the world around has to do with science."

Others indicated how they now notice that many of their everyday processes are affected by science/geology. Some students took this even further by describing how they learned many principles of science/geology that connected very well with their major. An example of this is given in the following answer:

"I had not thought about science much and the scientific method was just something I heard my science major friends talk about before this class. This class has been really interesting, and I was able to connect many of the labs to the stuff that I do in my own major. I am a construction management major and I had no clue how much soils and other labs would have connected so well to my future line of work. I also realized you can use the scientific method for other scenarios other than just figuring out a science problem which I thought was pretty cool. I now know that science has a huge impact on my life whether I knew it or not and I look forward to seeing how I recognize it in my future endeavors."

Overall, a majority of students mentioned how the lab course helped them to realize how connected everything on Earth is by the scientific method and topics covered in the course. Examples are given below:

"Science is present in everything we do. I never realized before quite how relevant it was to everyday things, such as house construction and the marketing of many different products. This course helped me to connect how interrelated everything on the earth is."

"It opened my eyes to mow much we, as humans, actually do impact our environment. I still have my own opinions about some things science related but I now have a better understanding on how even though our actions may seem harmless, sometimes the reactions are bigger than we realize."

Other students commented on their attitude towards their ability to "do" science or mentioned that before this course they didn't look at science in a positive way, but after taking the lab course they are more interested in scientific topics. One student in particular mentioned that they grew in critical thinking through the course, as described in their answer below:

"This course really forced me to think critically about all aspects of science – it's not just memorization, there's a lot of implementation and hands on experience. Although I am a liberal arts major, I do use these sorts of skills in my life, even if I don't really think that I do. This sciences lab has also made me work on my concentration (+ patience!)."

These comments indicate that the students were definitely impacted in their ability to problem solve during the course and may be indicators that the students will use these skills to be innovators in their fields someday!

Plans for Course Improvement Based on Student Reflections
A few students mentioned in their reflections that they would like to have more hands-on experiments throughout the lab course. Others mentioned that they didn't like the lab manual, however they didn't provide much specific detail, making it hard to know which aspects of the lab manual they were hoping we would address. As mentioned above, a number of students really felt that they learned well from the "hands-on" feel of the experiments that were designed that way, such as the mineral, rock, and soil lab exercises. Based on this feedback, we are planning to improve the course by incorporating more experiments, measurements, and observations of physical materials the students can touch and make observations of, as compared to calculations on paper.

MATH 13000 – Mathematics for Elementary Teachers

The MATH 13000 Mile Marker Assignment consisted of three open-answer questions on the final exam for MATH 13000. The questions asked students to model fractions and the sum of fractions; and to model, solve, and justify solutions of applications involving whole numbers, integers, including a problem with two unknowns. The original General Education Proposal for MATH 13000 correlated the course objectives with the IUPUI Principles of Undergraduate Learning (PUL), and the Mile Marker Assignment addresses four of those principles. Since the proposal was written, the Principles of Undergraduate Learning have been replaced with Profiles of Learning for Undergraduate Success (PLUS), and the Mile Marker Assignment contributes to two of the profiles. In addition, the Mile Marker Assignment addresses five competencies in Indiana's Analytic Reasoning Domain.

Contributions to the Principles of Undergraduate Learning
The Mile Marker Assignment addresses the following IUPUI Principles of Undergraduate Learning: Core Communication and Quantitative Skills, Critical Thinking, Integration and Application of Knowledge, and Intellectual Depth, Breadth, and Adaptiveness. Core Communication and Quantitative Skills are addressed through the written justification of the solutions of the problems as well as through the mathematical manipulations necessary to answer the questions. Critical Thinking, Integration and Application of Knowledge, and Intellectual Depth, Breadth, and Adaptiveness are addressed through the problem-solving process. Students chose a problem-solving strategy for each application and then successfully implemented that strategy. They had not seen the problems before the test, so they had to adapt what they had previously used to a new problem situation. In addition, the problems represented application of knowledge specific to their intended future profession, since they were elementary mathematics applications directly related to the Indiana Academic Standards for Mathematics.

The rubric used to evaluate the Mile Marker Assignment demonstrates attention to Core

Communication and Quantitative Skills through explicitly drawing attention to and requiring the student to explain the reasonableness of answers and to justify solutions. In addition, the rubric indicates that the student must demonstrate accurate mathematical manipulations to successfully complete the assignment. The rubric also demonstrates attention to Critical Thinking, Integration and Application of Knowledge, and Intellectual Depth, Breadth, and Adaptiveness by directing students through a problem-solving process, which includes modeling, solving, and justifying results.

Contributions to the Profiles of Learning for Undergraduate Success

The Mile Marker Assignment contributes to the Communicator and Problem Solver Profiles of Learning for Undergraduate Success. Through their explanations of the reasonableness of answers and through their justifications of their solutions, students demonstrated that, as Communicators, they could convey ideas effectively. This required not only understanding of mathematics vocabulary but also logic and reasoning skills. Additionally, by solving applications, students demonstrated that, as Problem Solvers, they could analyze a problem situation, evaluate an appropriate approach to that problem, and carry through that approach to a solution.

The rubric used to evaluate the Mile Marker Assignment demonstrates student development of the profiles of Communicator and Problem Solver. The rubric explicitly directed students to explain the reasonableness of their answers and to justify their solutions, thus demonstrating their development as Communicators. The rubric also required students to analyze problem situations by drawing models, to explain an appropriate approach for solving the problems, and to carry out that approach to solutions of the problems. As students showed the work described on the rubric, they demonstrated their development as Problem Solvers.

Development of Competences in Indiana's Analytic Reasoning Domain

The Mile Marker Assignment also addresses five competencies in Indiana's Analytic Reasoning Domain. First, students interpreted information presented in mathematical form when they were given diagrams of fractions modeled with centimeter rods. Second, they represented information in mathematical form when they were asked to draw diagrams for the sum of fractions and to model applications. Third, they demonstrated skill in carrying out mathematical procedures in order to solve the problems. Fourth, students were asked to justify their answer, requiring analysis of their mathematical results to determine the reasonableness of their solution. Finally, modeling and justifying solutions of problems required clear explanations of representations, solutions, and interpretations of mathematical problems.

Scores and Interpretation of Mile Marker Assignment

The scores for the 58 students in the three course sections who took the MATH 13000 final examination in Spring 2019 are shown in Appendix C. Six samples of high-scoring mile marker assignments (18 – 20), six samples of mid-scoring assignments (14 – 17), and six

samples of low-scoring assignments (0 – 13) are submitted as a separate document. These samples are from sections taught by both instructors.

Of the 58 students, 29 students (50%) achieved high scores on the mile marker assignment, corresponding to a grade of an A (90% or higher). There were 21 students (36%) whose scores were in a middle range, corresponding to grades of C to B (70% – 89%). The remaining 8 students (14%) had scores in a low range, corresponding to grades of D or F (0% – 69%).

Student scores, on average, were highest for the drawing and solution of Question 37, indicating a facility with modeling and solving problems containing whole numbers and demonstrating competency in carrying out mathematical procedures. However, the average scores for explaining the reasonableness of the solution were lower than the scores for modeling and solving the problems, indicating less progress toward competency in analyzing mathematical results. On average, the scores were lowest for modeling Fraction B in Question 35, which required a solid understanding of the area model for fractions as well as a deep conceptual understanding of the meaning of the numerator and denominator of a fraction used to model part of a whole.

Course Modifications Based on Mile Marker Assignment
The Mile Marker Assignment results included in this dossier were from Spring 2019. The Fall 2019 sections of MATH 13000 have been modified based on the analysis of the results. An increased emphasis on all parts of the problem-solving process, including analyzing results and coherently justifying results, has been integrated throughout the semester as a problem-solving unit with a corresponding problem-solving project as an assessment. In addition, we plan to increase attention to the meaning of the numerator and denominator of a fraction through exploration, multiple representations of fractions, and research-based activities designed to deepen comprehension of fractional representations.

PHYSICS - P201 GENERAL PHYSICS I

In this course, the student learning is tested using multiple methods:

i. Modified Think-Pair-Share method (TPS)

a. According to several studies, collaborative learning reaps richer rewards compared to competitive learning. The aim is to create a learning environment for students that encourages student This can be done by engaging students in group discussions/activities, debates, group assignments etc. This approach very helpful in building stepwise rational thinking, decision making and collaborative learning and inculcating the three "A"s: *Ask, Analyze, Answer*. TPS is a collaborative learning strategy, which has been slightly modified to suite this course, and consists of the following steps:

- A question is presented in class based on what has been taught. This question is typically

posed in form of a multiple choice question. The students are first encouraged to think about the problem on their own ("think") and answer the question using a colored ABCD card provided at the beginning of the semester. This gives the instructor a fairly good idea regarding the number of students who grasped the concept correctly.

- If most students get the answer correctly, then the answer is explained once more by the instructor, and the next question is posed.
- If at least 25% answer the question incorrectly, the instructor explains the topic again and sometimes gives useful hints. This time the students are supposed to make small groups ("pair"), and share their ideas with their classmates ("share"). This leads to interesting debates, makes the class more engaging and interesting for the students.
- Based on their discussions, the students are once again asked to vote. It has been noticed that the students often get the correct answer after they have discussed their answers with another student, leading to the idea that collaborating is one of the most efficient ways to learn a subject.

ii. Quiz:

a. Once a week, students are given a quiz based on what they have learnt that week. Typically, the quiz takes between 3-5 minutes to complete. This provides the students with checkpoints along the way and helps them identify the topics they need to learn better,
b. This also provides a feedback to the instructor about how the students are faring on a particular topic. If need be, they revisit the topic once more in class.

iii. Exams:

a. Students are required to take three regular semester exams and one comprehensive final exam. Each regular exam consists of multiple-choice questions, which test their knowledge of concepts as well as problem solving, andfree response problems, which test their ability to solve multistep word problems using the formulas provided on the formula sheet given with each exam. The final is double in size, and consists of only multiple-choice questions which test their knowledge in both concepts and problem-solving, along with a formula sheet.

iv. Recitation sessions:

a. In addition, recitations provide a more casual way of gauging overall student performance. The class is typically given four to six word-problems. The students may work in groups and use the formula sheet, the textbook, and any other print resources to solve the problems. They may not use the internet. Those groups struggling to solve these problems may confer with an instructor. One of the advantages of this type of recitation is the interaction between the instructors and the students. In many ways, these sessions resemble a tutoring session or a one- on-one meeting with an instructor during office hours. Since the students in PHYS201 are from non-Physics background, each problem is solved on the board step by step after the students have attempted it.

Faculty Involvement and Course Improvement

Most of P201 students are pre-medical students, majoring in Life sciences or Chemistry. One of the strongest motivations for this course is to train students to understand and appreciate the underlying physical mechanisms in nature, and connect them to their own field of study.

However, unlike Physics/Engineering majors, who go through several courses of Physics, and Physics related research-work during their undergraduate years, for most of the students in this course, their only intersection with Undergraduate level Physics are PHYS 201 and PHYS 202. It is only natural that many of the students struggle to see or appreciate the connections between the lectures and the real life, even though it is emphasized during the lecture sessions. In addition, since the instructors are typically from a more traditional Physics background, the examples given in the class tend to strongly reflect that. We have started including examples rooted in biological mechanisms, to explain the different concepts in Physics for this course, for topics such as optics and have received good feedback from students**.**

Efforts at continuous improvement are based on improving students' performance on exams, problem-solving abilities as witnessed in recitation, written student reviews of the course, and other mechanisms such as informal discussions with students. Based on student responses from previous semester, there are three general areas about which many students had raised concerns:

1) **The level of difficulty:** Students have complained that the course is too challenging, that it should have easier exams. It is expected that the course should be challenging given that most students will be appearing for MCAT or pursue graduate studies. This course is intended to prepare them for the same. We use MasteringPhysics for the homework. This is particularly helpful because MasteringPhysics includes several questions for past MCAT exams, in addition to MCAT-like questions.

2) **Implementation of interacting learning method and the educational technology:** From the student survey (included in the review), 91% students found the interactive sessions in class helpful (Course Satisfaction ratings: graph #3). One of our educational researchers (Prof. Gavrin) has also found that most students favor the use of educational technology and tend to raise their grades as a result. Given Prof. Gavrin's research, the department will continue to use such technology for years to come. Currently, we are using MasteringPhysics for its online homework technology and other educational

resources. Over the past ten years, we have changed technology through the years primarily to improve the quality and, secondarily, to reduce the cost per student.

3) **Difficulty with problem solving in Physics:** About 83% of the students think more clearly about how to approach problem-solving in Physics, which is a huge improvement over 69%

for P202 in Spring 2019. In order to address this problem, the number of problems solved in the lecture class has been increased in Fall 2019. The problem is broken down into smaller, more doable chunks. The students are asked to solve each part in groups, and then the correct solution is demonstrated, once again tying the problem to the theory they have just been taught. This method has clearly worked.

Part III: 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)

This is an area of improvement for the school. Over this next year, we will identify and encourage at least one experience from each department be added to the record.

Part IV: 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 135 students earned the M.S or Ph.D. in the School of Science in 2019-2020.

Part V: Assessment Plans for 2019-2020

Assessment Plans

There are several large 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. As noted above, 64 courses have been reapproved, and the final 16 will be reviewed this upcoming academic year. After this initial round of reviews is completed, the process of reapproval will begin again.

Second, the capstone courses and a mid-career course in each program within the school of science will be assessing their courses and assignments for alignment with the ***IUPUI Profiles***. These reports will be due in Spring 2021 and will be incorporated in the 20-21 PRAC report.

The final assessment effort, going on in the school, is the departmental or program review. These reviews were delayed for a year because of the pandemic. Over the course of the next three years, each of our departments/programs will go through the review process coordinated by Stephen Hundley's office. Psychology and Math will be reviewed in Fall 2021; Biology and Chemistry in Spring 2022; Earth Science and Physics in Fall 2022; Computer Science and Neuroscience in Spring 2023; and Forensic and Investigative Sciences in Fall 2023.