

# Academic Program Review BA Earth Science

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**APRC Recommendation to Faculty Senate**  
**BA Earth Science**

The Academic Program Review Committee (APRC) affirms that the Department of Geology has completed program review as per policy, including self-study, external review, internal review, and action plan submission for the BA Earth Science. APRC recommends that the next program review be scheduled for six years from Faculty Senate approval; or, should the College of Natural Sciences and Mathematics decide to schedule a college-wide program review, the next program review will occur at that time.

APRC Chair: Jeffrey Brodd, Professor of Humanities and Religious Studies



# SACRAMENTO STATE

## Geology Department

### AY 2021-2022 Program Review Fall 2021 Self-Study

Date: February 28, 2022

Date of Last Review: Academic Year 2016-2017

Academic Unit: Geology Department, College of Natural Sciences and Mathematics

## Introduction

The self-study component of the five-year program review offers our department a chance to gather data and reflect on how effectively our programs are leading our students toward educational and professional goals. Since the last self-study in Fall 2016, our department has gone through a number of changes, including several retirements and new hires. This current self-study, undertaken in Fall 2021, is the product of several hours of discussion as a faculty of the whole, one-on-one conversations, and three workgroups which focused on three questions:

1. How can we recruit a more diverse student body?
2. How can we more effectively "close the loop" on assessment?
3. How effective is the Geology Master's program?

In this report, we offer a brief overview of degree programs, review assessment and student success data, then use them as data to answer these questions. Because of the timing of the self-study, one full-time faculty member did not participate due to sabbatical leave, and another was on parental leave for a majority of the semester.

## I. Department overview

### A. University, college, and academic unit missions

Our mission of the Geology Department is to provide "the best possible undergraduate education." This takes place within the University mission, which is "As California's capital university, we transform lives by preparing students for leadership, service, and success. Sacramento State will be a recognized leader in education, innovation, and engagement."

### B. Degrees offered

The Geology Department offers four degrees, with our most popular degree, the Geology BS, recently split into two concentrations:

[Geology BS \(concentration in General Geology\)](#)

[Geology BS \(concentration in Hydrogeology\)](#)

[Geology BA](#)

[Earth Science BA](#)

[Geology MS](#)

The Geology BS (General Geology) is our core degree and is the best preparation for employment as a professional geologist or as preparation for graduate school. It requires a semester of chemistry and calculus, a full year of physics, and required upper division courses in earth materials, optical mineralogy, petrology, sedimentology, field geology, and structural geology, along with a 5-week summer field mapping course. With the appropriate electives, students in the General Geology degree track are well prepared to take the board certification "Geologist in Training" exam after graduation.

The Geology BS (Hydrogeology) is a new degree plan implemented in AY 2020-21 designed for those who plan to work in hydrogeology-related fields. In comparison to the General Geology concentration, it requires an additional semester of chemistry, hydrogeology, and a selection of water-focused upper division courses. It does not require the summer field course. With the appropriate electives and planning, students are qualified to take the board certification "Geologist in Training" exam after graduation with the Hydrogeology concentration.

The Geology BA is a more flexible program that may interest future resource managers, geologic planners, environmentalists, and geology-related businesspeople. It has lower math, chemistry, and physics requirements

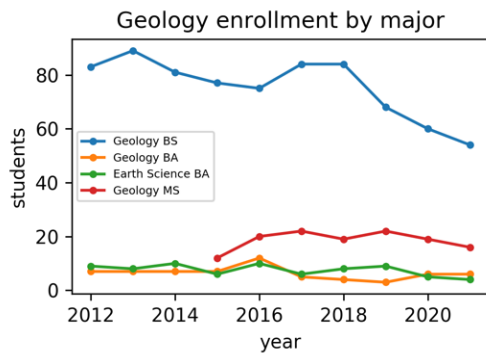
## Geology Department Fall 2021 Self Study

than the Geology BS. It can be an option for those who are pursuing a double-major in another field. As with the Geology BS, the BA degree requires upper division courses earth materials, petrology, structural geology, and field geology. With the appropriate electives and careful planning, students are qualified to take the board certification “Geologist in Training” exam after graduation

The Earth Science BA is designed for future teachers and students who are interested in the broader geosciences. It provides extra breadth in the sciences by requiring electives from a list of astronomy, weather and climate, anthropology, and biology classes. This is often combined with a teaching credential, although this requires additional coursework through the College of Education or a similar Single Subject Teaching Credential preparation program.

The Geology MS serves both traditional research-focused students and working professionals. Classes are held in the evening and both thesis and non-thesis degree tracks are offered.

Most students in our department are enrolled in the Geology BS with fewer enrolled in the Geology BA and Earth Science BA (Figure 1). Because of the small number of students enrolled in the BA programs and the recent creation of the BS Geology concentrations (AY 2020-21), data from all bachelor’s programs have been combined for much of the analysis presented in this report.



**Figure 1.** Geology Department enrollment by major. The Geology BS includes both the General Geology and Hydrogeology concentrations.

### C. Minors offered

The Geology Department offers a single minor:

[Minor in Geology](#)

The minor only requires students to take physical and historical geology (GEOL 10/10L and GEOL 12/12L) plus 10 units of upper division coursework. Students pursuing a minor in Geology often are majoring in Environmental Studies, Geography, Chemistry, and Engineering.

### D. Service to or from other departments, degree programs, and/or general education

The Geology Department offers lower- and upper-division general education courses, a writing intensive course, and courses that serve as electives in other departments.

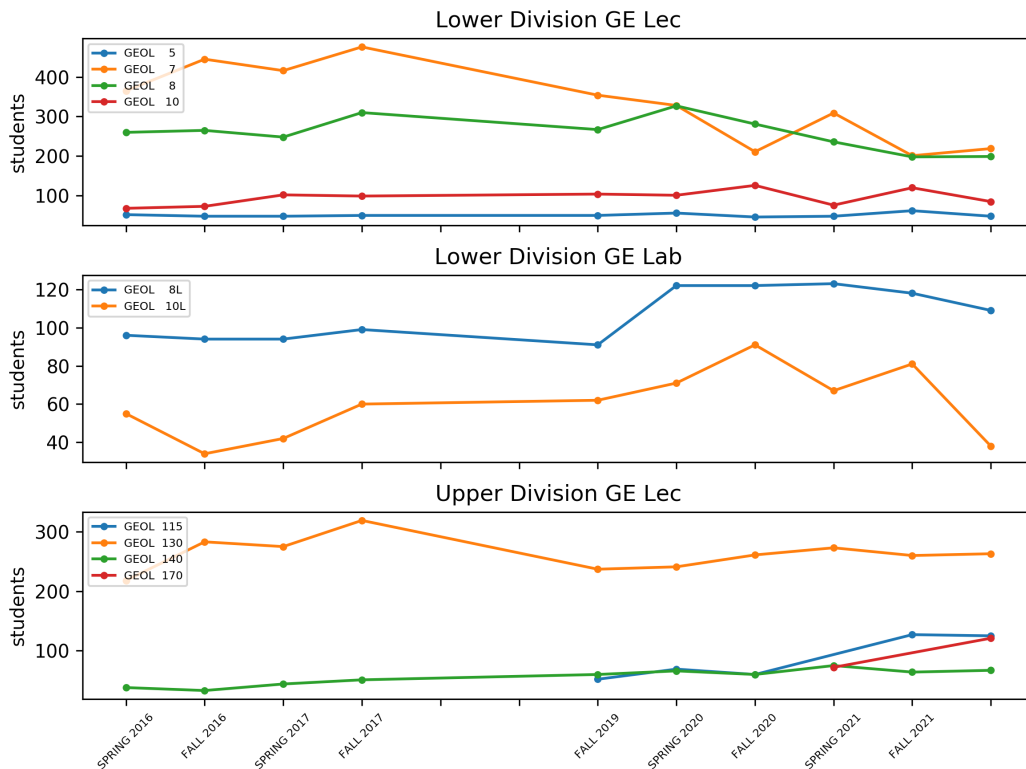
## Geology Department Fall 2021 Self Study

Area B1: Physical Science	Area B3: Laboratory	Area B5: Further Studies in Area B
GEOL 5. Geology of Mexico (also B3) GEOL 7. Natural Disasters GEOL 8. Earth Science GEOL 8L. Earth Science Lab (also B3) GEOL 10: Physical Geology GEOL 10L: Physical Geology Lab (also B3)	GEOL 5. Geology of Mexico (also B1) GEOL 8L. Earth Science Lab (also B1) GEOL 10L: Physical Geology Lab (also B1)	GEOL 115: Volcanoes: An Introduction GEOL 130: Oceanography GEOL 170: Age of Dinosaurs GEOL 180: Water Planet
Writing Intensive GEOL 140: Geology and the Environment		

**Table 1.** General education courses. Enrollments can be found in Figure 2.

Enrollments in lower-division general education courses (Areas B1 and B3) has historically been high (Figure 2). Over the past five years, enrollment in GEOL 7 Natural Disasters, GEOL 8 Earth Science, and GEOL 10L Physical Geology Lab has been on a downward trend. For upper-division general education courses (Area B5), GEOL 130 Oceanography has been our most popular course, with smaller enrollments in other relatively new upper-division general education courses.

The Department offers one general education course in Area D (The individual and society), GEOL 140 Geology and the Environment, which is also our writing intensive course. This is a very popular course that typically has a full waitlist each semester. Enrollment has remained static since only two sections are offered



**Figure 2.** Enrollment in general education courses separated into lower-division lecture (mostly B1), lower-division lab (mostly B3), and upper-division lecture (B5 and Area D WI). Course names can be found in Table 1 with course descriptions in the general catalog.

Geology also offers courses that are electives for the [Environmental Science BS and BA](#).

### **E. Geology faculty members**

The Geology Department has nine [faculty members](#) that cover a broad suite of geoscience specializations. We note that since the last program review in 2016 several faculty members retired or moved to other positions: Dave Evans (hydrogeology/geophysics), Lisa Hammersley (mineralogy/igneous petrology), Tim Horner (sedimentology/stratigraphy), and Judith Kusnick (geoscience education). These faculty members were replaced by four new hires: Julie Griffin (sedimentology/stratigraphy), David Dralle (hydrology), Kurt Burmeister (field geology/structural geology), and Katie Ardill (mineralogy/igneous petrology). David Dralle has since left to take a job with the US Forest Service, leaving a teaching gap in surface hydrology.

### **F. External educational partnerships**

Dr. Vankeuren runs a Hydrology Research Experience in partnership with San Diego State University and Humboldt State University that is funded by a National Science Foundation Pathways into the Earth, Ocean, Polar and Atmospheric, & Geospace Sciences (GEOPATHS) Undergraduate Preparation Award. Faculty members from all three institutions collaboratively wrote the NSF proposal and are running the research experience with 24 students spread across the three institutions. The goal of the Hydrology Research Experience is to recruit and retain a diverse group of students to the field of Hydrology. Students will build career-relevant skills including research design, project management, and communication, and gain hands-on field experience. Students participate in a year-long Hydrology learning ecosystem that begins with a 1-unit spring class in which students learn about Hydrology research and careers and develop research hypotheses and approaches. Students then implement those approaches during a 10-day summer Hydrology field experience at the Angelo Coast Range Reserve, the site of the NSF-funded Eel River Critical Zone Observatory. The experience culminates with a 3-unit fall course in which students will work with data collected during the field experience to answer research questions and develop research and professional skills. Topics include hypothesis development and testing, data analysis and interpretation (including common statistical tests, trend identification, etc.) using Excel, and creating scientific figures and presentations. Students will also meet industry professionals and learn about Hydrology career paths, build their resumes, and apply for a paid hydrology internship. At the conclusion of the course, students will present their research findings to Forestry Service partners. Faculty at the three institutions are co-leading the spring preparatory course and summer field experience and will rotate through teaching the fall research course.

This research experience is designed to reach diverse students in several ways:

- 1) Students are recruited from a variety of disciplines (e.g., Biology, Engineering, Geology, Geography, and Environmental Studies)
- 2) Students are recruited through minority serving student groups or campus success centers (e.g., MESA, SACNAS, Indian Natural Resources Science and Engineering Program, etc.)
- 3) Students are paid a stipend for the summer field experience so that working students are able to participate
- 4) Students are mentored by both faculty and peer-mentors – initially graduate students and then alumni from prior years of the program
- 5) Students are encouraged to develop a learning community to support each other

### **G. Major structural changes in academic unit since last review (new, moved, or discontinued degrees, concentrations, minors, etc.)**

Since the last review the Geology BS was split into two separate concentrations (General Geology and Hydrogeology) to reflect two different career pathways often taken by our students. Most students are continuing to pursue a degree in Geology with the General Geology concentration, although the Hydrogeology concentration has started to gain popularity.

## Geology Department Fall 2021 Self Study

We also have effectively placed our BA Earth Science degree into hiatus by advising students away from that major due to changes in the California K-12 science education structure. We are currently in discussion about what to do with the degree. Options include discontinuing the degree, updating it to be an Earth Systems Science degree, and keeping it as is with very few students majoring in the degree per cohort.

### II. Program Learning Outcomes and Assessment

This section presents both program learning outcomes (PLOs) and assessment data for our undergraduate and graduate programs (Table 2). The PLOs focus on technical mastery, solving geologic problem, writing, and geologic mapping. The Geology BS and BA have similar program learning objectives, while the Earth Science BA is a subset of those program learning outcomes.

Program Learning Outcomes as of Fall 2021

BS Geology	BA Geology	BA Earth Science	MS Geology
<ul style="list-style-type: none"> <li>•Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems</li> <li>•Students will be proficient in solving geologic problems</li> <li>•Students will be proficient in using quantitative skills to solve geologic problems</li> <li>•Students will be proficient in understanding and producing geologic maps</li> <li>•Students will be proficient writers, skilled in the genres of scientific and technical writing</li> <li>•Students will be proficient oral communicators, skilled in presenting scientific topics</li> </ul>	<ul style="list-style-type: none"> <li>•Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems</li> <li>•Students will be proficient in solving geologic problems</li> <li>•Students will be proficient in using quantitative skills to solve geologic problems</li> <li>•Students will be proficient in understanding and producing geologic maps</li> <li>•Students will be proficient writers, skilled in the genres of scientific and technical writing</li> <li>•Students will be proficient oral communicators, skilled in presenting scientific topics</li> </ul>	<ul style="list-style-type: none"> <li>•Students will master a set of fundamental earth science concepts essential to understanding and solving geologic problems</li> <li>•Students will be proficient in solving geologic problems</li> <li>•Students will be proficient in introductory skills of understanding and producing geologic maps</li> <li>•Students will be proficient writers, skilled in the genres of scientific and technical writing</li> </ul>	<ul style="list-style-type: none"> <li>•Students will be able to read and digest complex scientific papers in the discipline, assess competing hypotheses and reach rational and logical conclusions.</li> <li>•Students will be able to evaluate and interpret real-world data sets and use discipline-specific analytical tools to generate insight into discipline specific geologic problems.</li> <li>•Students will develop presentation skills and the ability to relay technical data and scientific concepts to diverse audiences.</li> <li>•Students will demonstrate the ability to obtain, assess, and analyze information from a variety of sources.</li> <li>•Students will demonstrate an understanding of professional integrity</li> <li>•Students will demonstrate relevant knowledge and application of intercultural and / or global perspectives.</li> </ul>

**Table 2.** Program learning outcomes for each program in the Geology Department.

Because of small number of students in each of the BA programs and because of the similarity in PLOs the BA and BS in Geology are assessed together. We realize that having such similar PLOs is not appropriate and the department Assessment Committee plans to lead Geology Department discussions in Spring 2022 to revise our PLOs in the following ways:

- 1) Begin with verbs that make them actionable and assessable
- 2) Make PLOs degree (not department) specific, so there will be greater distinction between the PLOs for the BA Earth Science, BA Geology, and BS Geology
- 3) Make sure our assessments are explicitly aligned with our PLOs



## Geology Department Fall 2021 Self Study

- 4) Look at the Chancellor's Office CSU comprehensive assessment plan and use it as a template for our own plan

The assessment methods for these PLOs are a mix of standard exams, field assignments, course problem sets, and reports from major's classes. The assessment standards and schedule are also noted in the Appendix I.

### III. Assessment during last review cycle

#### What was assessed?

During this program review cycle, we assessed the following Program Learning Outcomes for our undergraduate and graduate degrees. Because of small number of students in each of the BA programs and because of the similarity in PLOs the BA and BS in Geology are assessed together.

#### Undergraduate degrees: BS in Geology, BA in Geology, BA in Earth Science

- 2016-2017 Problem Solving
- 2017-2018 Written Communication
- 2018-2019 Overall Disciplinary Knowledge
- 2019-2020 Data collected for Overall Disciplinary knowledge
- 2020-2021 Data collected for Overall Disciplinary Knowledge and Quantitative Reasoning

#### Graduate Degree: MS in Geology

- 2016-2017 Oral Communication
- 2017-2018 Oral Communication
- 2018-2019 Written Communication
- 2019-2020 Written Communication
- 2020-2021 Data collected for Written and Oral Communication

#### What did the assessment show?

As part of this self-study, we reviewed the last five years of departmental assessment results. For the period of this self-study, results for all undergraduate programs are aggregated, due to the low number of students in BA Geology and the BA Earth Science, as well as the failure to differentiate between which program students were enrolled in during the assessment process. We have since altered our assessments (such as our Student Knowledge Inventory) to include a question about the student's program so that in the future we can differentiate between programs. To address the low number of students in the BAs (and thus low number for assessment analysis), in the future we will aggregate results from different years rather than from different programs.

#### Undergraduate program results (BS in Geology, BA in Geology, BA in Earth Science)

Geologic problem solving (PLO 2) was assessed in 2017 using a field report from our capstone GEOL 188 Advanced Field Mapping course. For purposes of assessment, we have defined problem solving in terms of specific skills associated with geologic mapping: producing a map that accurately shows geologic content, interpreting that geologic content in a stratigraphic column and cross section, and writing a coherent geologic history based on that interpretation. Performance standards (70% of students earning a score of at least 70% on each item of the rubric) were met in all categories of the report, indicating that by the conclusion of the program, students are sufficiently prepared to solve geologic problems.

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Disciplinary knowledge (PLO 1) is assessed annually and analyzed through a longitudinal study of student performance every 5 years, which last occurred in 2019 (Table 3). Disciplinary knowledge is assessed via a Student Knowledge Inventory given to Juniors when they start their upper division geology coursework (in GEOL 100 Earth Materials) and to Seniors within a semester of graduation (in GEOL 110A Structural Geology). While Senior students were at or above our performance standard (70% of students answering correctly) for most content areas, there were a couple critical exceptions: senior student performance was consistently below the performance standard for igneous rocks and the geologic timescale. Results for igneous rocks indicated that students tended to lose sight of the more common rocks and processes after being exposed to more complex topics in advanced classes. Recommendations to address these deficiencies included incorporating relevant aspects of these topics into additional coursework to help students reinforce and retain critical concepts.

To that end, we added Geology of California (GEOL 121) as a required course for both the BA Geology and BS Geology. This course emphasizes the geologic and tectonic history of California and the most important rocks and processes throughout California that students will see in their careers. This will also help students to be more prepared for the California-Specific Professional Geologist Exam.

	Student performance was consistently above the standard	Student performance fluctuated around the standard	Student performance was consistently below the standard
Geologic timescale			X
Basic chemistry	X		
Plate tectonics	X		
Fold problem		X	
Sedimentary rocks		X	
Metamorphic rocks		X	
Igneous rocks			X
Rock, mineral, or element	X		

**Table 3.** Summary of Student Knowledge Inventory results (2015-2019).

Written communication (PLO 5 for Geology and PLO 4 for Earth Science) was assessed in 2018 using the Geologic History section of a report in the Junior-level GEOL 111A Field Geology course. Student performance was evaluated using the Written Communication AACU Value Rubric. Results showed that Junior-level students did not meet the performance standard of 70% of students performing at the Milestone 3 level in any category. It is likely that performance would have been better had the assessment been implemented in a senior-level course rather than a junior-level course, but regardless, this disappointing finding led to several questions about technical writing within our program: Do students see examples of technical writing before they are expected to write things themselves? Are the writing expectations consistent throughout the core classes? Are students receiving meaningful feedback on their written work? Are grading rubrics discussed with students? Unfortunately, these questions were never addressed by the faculty as a whole, in part because the faculty member who did the assessment analysis retired and their work was not communicated to the rest of the department.

## Geology Department Fall 2021 Self Study

In 2020, our plan to assess Quantitative Reasoning (PLO 3 for Geology) through an assignment in Structural Geology in the Spring of 2020 was derailed by COVID mitigation and the sudden shift to virtual instruction. This quantitative reasoning assessment was delayed until Spring 2021, when it could be assessed using a question in the GEOL 110A Structural Geology final exam. Student performance was evaluated using the AACU Quantitative Literacy Value Rubric. Results from this assessment will be analyzed by the Assessment Committee in Spring 2022.

In 2020-2021, we deviated from our typical assessment of students' ability to understand and produce geologic maps and oral communication (PLOs 4 and 6; PLO 3) to focus on ensuring that virtual instruction was still properly preparing our students for entering the geology workforce. This included researching the field course requirements that students must meet in order to take the Geologist-in-Training exam on the way to licensure as a Professional Geologist. There were also extensive department discussions on how to a) teach Field Geology courses virtually in a way that prepared students for their careers as geologists and met program learning outcomes, and b) design face to face field experiences that could be implemented safely despite COVID-19 mitigation limitations. As a result, despite receiving primarily virtual instruction for their last 3 semesters, students that graduated from our program in 2021 do qualify to take the Geologist-in-Training exam.

### *Graduate program results (MS in Geology)*

For the MS in Geology, in 2017 we assessed Oral Communication (PLO 3) using a modified Oral Communication AACU VALUE RUBRIC on final presentations in GEOL 290 Regional Geology of the Western US. This is a required course taken by all students in the program. Results indicated that all students performed above the standard for Topic Knowledge, Language Use, and Delivery, but not all students were at the mastery level for Organization or Audience Adaptation. To improve student performance in these areas, it was planned for students to receive further instruction on how to organize oral presentations, and how to adapt the presentation to the audience. An iterative approach was also implemented in which students send a draft presentation in advance and instructors provide feedback on presentation organization prior to the student giving the presentation.

In 2019 and 2020 we assessed written communication using a modified Written Communication AACU VALUE RUBRIC on the introduction/background section of students' research proposal in their required writing course (GEOL 200 Research Methods) and an independent research project report written for GEOL 213 Advanced Structural Geology (PLO 1). We duplicated assessment of Oral Communication because the relatively small graduate class size requires aggregating multiple years' worth of data to produce a representative sample. The data suggest that students are proficient or better in most categories (determination of the extent of information, accesses information effectively, evaluate information and its sources critically), and reach mastery of ethical use of information, but are not proficient in using information to accomplish a specific purpose. In particular, students struggled with developing focused research questions that can be answered with available data. It was proposed that additional instruction on developing a research question be added to the GEOL 200 Research Methods course.

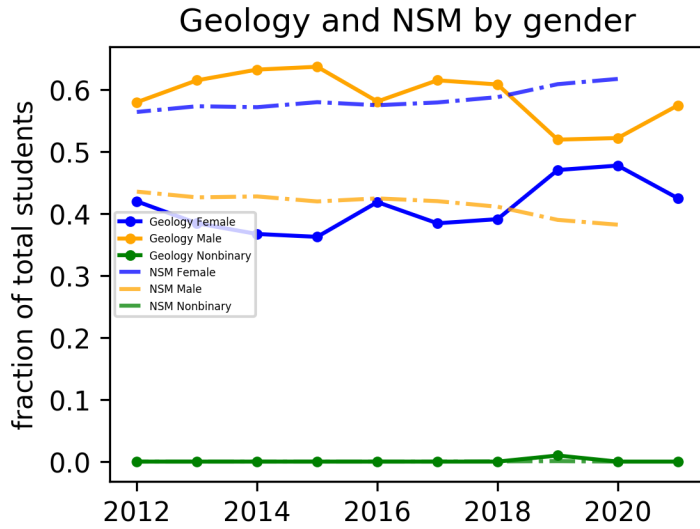
In 2020-2021, we again collected Oral and Written Communication assessment data. In the future we will continue to collect these data on an annual basis for aggregation and analysis every 5 years, but we will also collect and evaluate assessment data for other the graduate PLOs.

## **IV. Student Success Data**

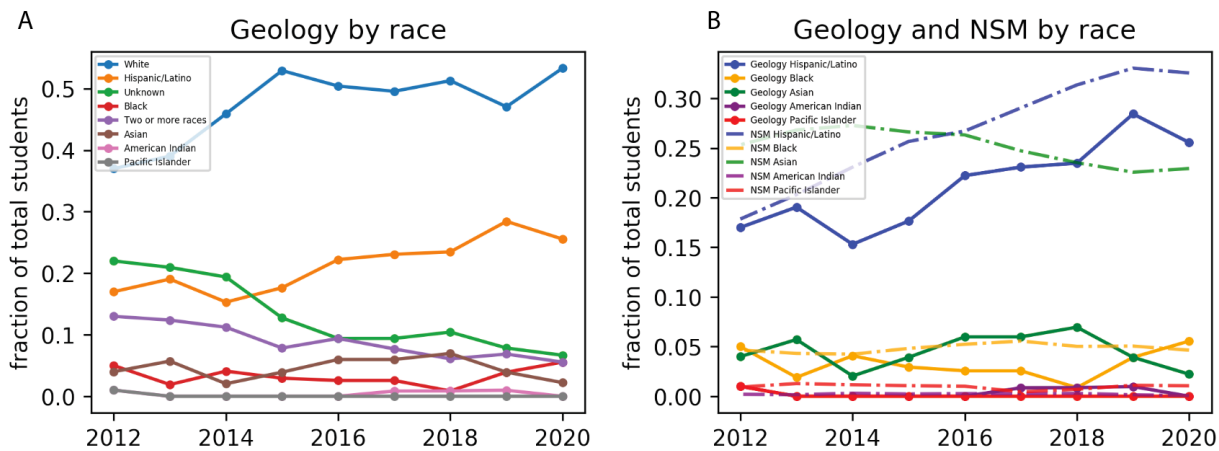
### **A. Enrollment**

## Geology Department Fall 2021 Self Study

Enrollment data showing the gender and race of students in our program covering a period from 2012 onward were compiled from University sources (Figures 3 and 4). Because of the small size of non-Geology BS majors, data from all majors along with the MS degree were combined in this analysis.



**Figure 3.** Comparison of Geology and NSM student enrollment by gender for 2012 to 2021.



**Figure 4.** Geology program student population by race. A. Geology students by race, plotted as fraction of total students B. Comparison of fraction of total minority students by race for Geology and NSM (Unknown and two or more races are not shown). Data from 2012-2020

Our program has more men than women, with a gender ratio as of this year of 57% men and 42% women (Figure 3, solid lines). This is different from the gender ratio in NSM as a whole, which is 38% men and 61% women (Figure 3, dashed lines). Since our last program review in 2016, the number of women has increased, with up to 47% women in both 2019 and 2020 but is down slightly in 2021.

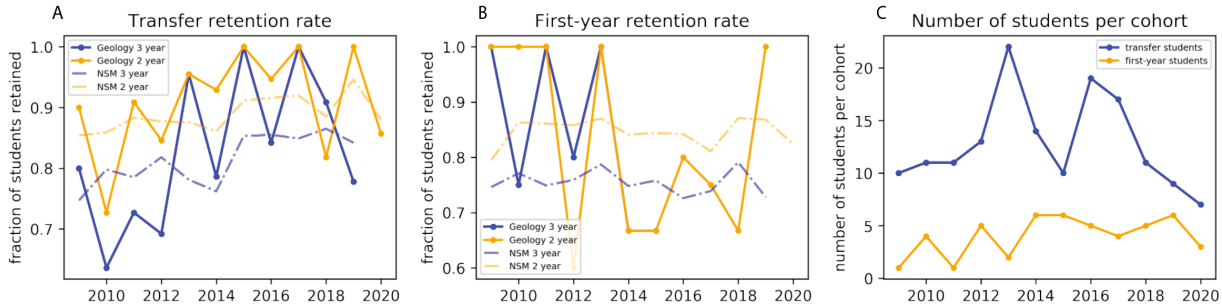
In terms of race, our department is still struggling with a lack of all minority groups (Figure 4A). Our program is 53% White, compared to 25% in NSM, as of 2020. While we continue a long-term increase in Hispanic/Latino students (25%), the number of Black (5%), American Indian (0%), Pacific Islander (0%) students are low, although comparable to NSM as a whole (Figure 4B). Asians, while not considered an underrepresented group, are 2% of our students compared to 22% in NSM.

## Geology Department Fall 2021 Self Study

The lack of minorities and underrepresented minorities is a recognized problem nationwide in the geosciences (Bernard and Cooperdock, 2018, Nature Geoscience). This data led us to consider the effect of recruiting on gender and race as one of our focused study questions later in the report.

### B. Retention data

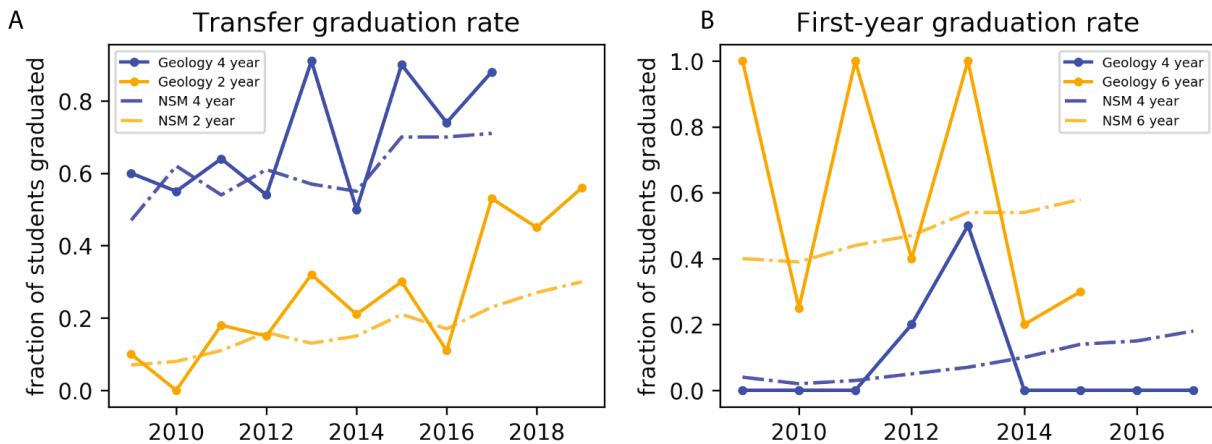
Retention rates were compiled for transfer students and are similar to the NSM average (Figure 5). Retention rates for students that started their first year at Sac State are slightly lower than NSM retention rates, but the data are difficult to interpret due to a low number of students (1-6) per cohort.



**Figure 5.** Retention rates for transfers and first-year students compared to NSM. A. Geology retention rates have been equal to or above NSM retention rates in the 2- and 3-year window. For transfer students there are between 9 and 22 students per cohort. B. Geology first-year retention rates are lower than NSM retention rates. Data is difficult to interpret because there are only 1 to 6 students per cohort. C. Number of students per first-year and transfer cohort. There was no data for the 4-year retention rate for either Geology first-year or transfer students.

### C. 4-year and 6-year time-to-graduation data

First-year and transfer time-to-graduation rates were plotted and compared to NSM averages (Figure 6). For transfer students, the number of students finishing within 2 and 4 years has been steadily increasing. Geology generally outperformed the NSM average for transfers. First-year student cohorts ranged from 1 to 6 in size making this data difficult to interpret due to the small number of students.



**Figure 6.** Transfer (A) and first-year (B) graduation rates for Geology (all majors) by cohort year. See Figure 5C for the size of each cohort. Transfer time-to-degree has been increasing and has been higher than the NSM average. First-year time-to-degree is irregular because of small numbers but is currently lower than the NSM average.

### D. Analysis on admission, retention, and graduation data, and how to maintain success and improve time to degree.

## Geology Department Fall 2021 Self Study

Data shows enrollment has been declining (Figure 1), reflecting national trends in geosciences. This appears partly due to a large decrease in transfer students coming into the department from community colleges (Figure 5C).

Transfer graduation and retention rates have been steadily increasing, equal to or above NSM graduation rates (Figure 5A and 6A). First-year retention and graduation rates (Figure 5B and 6B) are worrisome and will need to be addressed by the department. It is speculated that the 4-year graduation rate for first-year students is low because many first-year students cannot go directly into calculus or chemistry courses or need to retake these courses in order to count as a prerequisite course. 6-year retention rates are highly variable to the small number of freshman declaring geology as a major. In the most recent year of data, of the 6 incoming freshman, half of them continued in geology and the other half transferred to other majors such as Environmental Science or Geography, which have lower math and chemistry requirements.

Some of our success in success with retention and graduation rate is due to our ongoing advising program, which requires students to meet with a faculty advisor once a semester. This is a mandatory meeting as registration is blocked if the student does not complete the meeting. The meeting allows us to track student progress through lower-division degree requirements (math, chemistry, physics) in order to successfully enter upper-division course sequencing.

Based on the data for first-year retention, we may be losing students that come to Sac State as geology majors. One possible reason why this may be happening is that a large number of math and physical science courses are required before entry into the upper-division course sequences. We plan to have continued discussions about this. The faculty are trying to reach out to community college programs to help with better advising so students transfer into the Geology program ready to go directly into their upper division geology courses.

### **E. Summarize current partnerships in success efforts (Advising, Writing Center, Library Student Success Center, internship sites, etc.) and consider ways to better work together to maintain success and improve time to degree.**

As noted above, we have an active major advising program. While we advise students to use the Writing Center and Student Success Center, we do not have active programs to connect students to those programs. Many of the new faculty in the department have not had any formal advising training. Therefore, some of our faculty have attended, or plan to attend, advising workshops put on by NSM to learn best practices and advice for better advising our students.

## **V. Focused-study questions**

The Geology faculty met as a whole (minus one full-time faculty member on sabbatical and one on paternal leave) to determine areas of further investigation. Once these areas were determined, smaller workgroups met to consider the questions in additional detail and offer recommendations.

The faculty chose to study three questions:

- 1) How can we ensure that issues developed by assessment are addressed?
- 2) How can we improve departmental diversity via recruiting and retainment?
- 3) Are students succeeding in our Master's program?

Other questions were considered, such as the role of the field program, enabling undergraduate research, and revision of the BA Earth Science degree.

### **A. Diversity and recruiting**

## Geology Department Fall 2021 Self Study

The self-study data on the size and diversity of our programs was humbling. Student enrollment is down (Figure 1), and the diversity of the department does not fully reflect the diversity of the University or the College (Figures 3 and 4). It is important to think about how the size and diversity of the program affect our students.

Diversity is critically important in a program. Diversity is important for student learning because of its ability to bring different perspectives to the table; for practice in real-world collaboration; and for returning knowledge back to all communities that make up our society. While diversity encompasses many things, including gender, race, and socio-economic status, we focus here on racial and ethnic diversity.

The size of our program has a direct effect on student learning. As the number of students increases, we can offer more electives and more sections of the core courses (two lab sections instead of one). With a smaller number of majors, the department can only offer 2-3 electives per semester in contrast with the 3-4 electives per year semester when the department was larger. Because we have a history of offering Hydrogeology (GEOL 127) every spring and Computer mapping in Geology (GEOL 150) every fall, that leaves only 1-2 slots per semester for other electives. This problem continues into core courses, where small numbers in courses mean fewer assigned faculty members. This can be seen in our field courses; for large courses (generally 24 students or more), two faculty members are able to co-teach. With smaller courses, there is only one faculty member, potentially affecting both student learning and safety.

Initially, we tried to address recruiting and increasing diversity separately. But through conversations we've realized that these are parallel problems, with closely-linked solutions. Furthermore, based on data presented earlier (Figure 5), we believe recruiting and not retention is the main factor in the small size and low diversity in the department.

There appears to be a general decrease in enrollment across geoscience programs. We don't have direct evidence, but through discussion with colleagues, it is possible that students may be enrolling in the Environmental Science/Studies programs in place of Geology programs. We also appear to have lost recruiting mechanisms directed at first-year students that existed in the past.

In terms of diversity, what may be causing this problem? We considered a few possibilities:

### 1) What is geology?

- Because of the lack of a stand-alone geoscience course in most California high schools, students come in unfamiliar with geology as a concept. For many students, the last time geology was covered in a course was in their 6th grade earth science course.
- At the same time, students know that many of the critical problems confronting society such as climate change, the health of oceans, and the sustainability of natural resources are related to Earth Sciences.
- When combined, prospective majors may think that we teach about mining and oil instead of problems relevant to society or geology is just about rocks.

### 2) Can a geology degree lead to jobs?

- When asked, how did you become a geologist, many of our current students might say "because we like the outdoors" whereas in other majors they might say "because I want a job." For students with a practical streak this may be a problem.
- We haven't been consistently able to establish the direct link between a geology major and the large number of government or environmental jobs that available in the Sacramento area for Bachelor's graduates.

## Geology Department Fall 2021 Self Study

- 3) Are there cultural barriers?
  - There is the concept of a geologist being a "bearded guy on top of a mountain wearing flannel and hiking boots" (Goldberg, 2019, New York Times).
  - We have also heard that immigrant cultures may push students toward jobs which are perceived as white collar, instead of ones involving field work, even if it is scientific in nature.
- 4) Are there economic barriers?
  - In addition to the cost of tuition, the Geology BS has an added \$3000 cost of GEOL 188, our 5-week senior-level summer field mapping course. In addition to this course, there is a 10-day junior-level field course (GEOL 111B; current course fee of \$165 but there is a proposed increase to ~\$500) and various weekend field trips for courses which result in lost income and time away from family.
  - Appropriate, good-quality, field clothing and supplies can be a real cost and potentially an economic barrier for some students. If students cannot afford quality gear, such as hiking boots or a good sleeping bag, poor-quality equipment can negatively impact the overall learning experience for students and may impact long-term retention.
- 5) What are we not considering?
  - To add to this, all of these are what us, as faculty members, think are the problems. Our perception of these problems come from backgrounds that may be dissimilar to those of our students. We have not formally polled students or prospective students on what they think.

### **Possible solutions to recruiting and diversity**

The solutions to diversity really follow from the above discussion of the problems.

- 1) Restructuring our approach toward General Education courses by linking geology with jobs (Addresses problems 1, 2, 3)
  - For many of our students, the GE course is their only exposure to geology.
  - We plan to add content to GE courses on careers in the Geosciences.
- 2) Active outreach (1, 2, 3)
  - Department info night; outreach to community colleges; exploring first-year courses; First-year experience with camping
  - Offer more cross-disciplinary programs to expose students in other science fields to geoscience.
- 3) Reducing the cost of a geology degree (4)
  - Implement additional fundraising to create more scholarship programs for students. Could we raise enough to help subsidize a portion of the cost of the summer field course?
  - The new Hydrogeology concentration in the Geology BS should help reduce the cost of a degree because it does not require the summer field course.
- 4) Collecting data (5)
  - We plan on holding focus group sessions with students and creating surveys that can be used on our GE students.

### **B. Closing the loop during assessment**

As part of this program review, we examined assessment data for the last five years. We found the assessment process itself seemed to be going relatively smoothly. Each year data was collected, analyzed to assess a PLO, then compiled into a report which included an action plan. In general, the conclusions drawn from



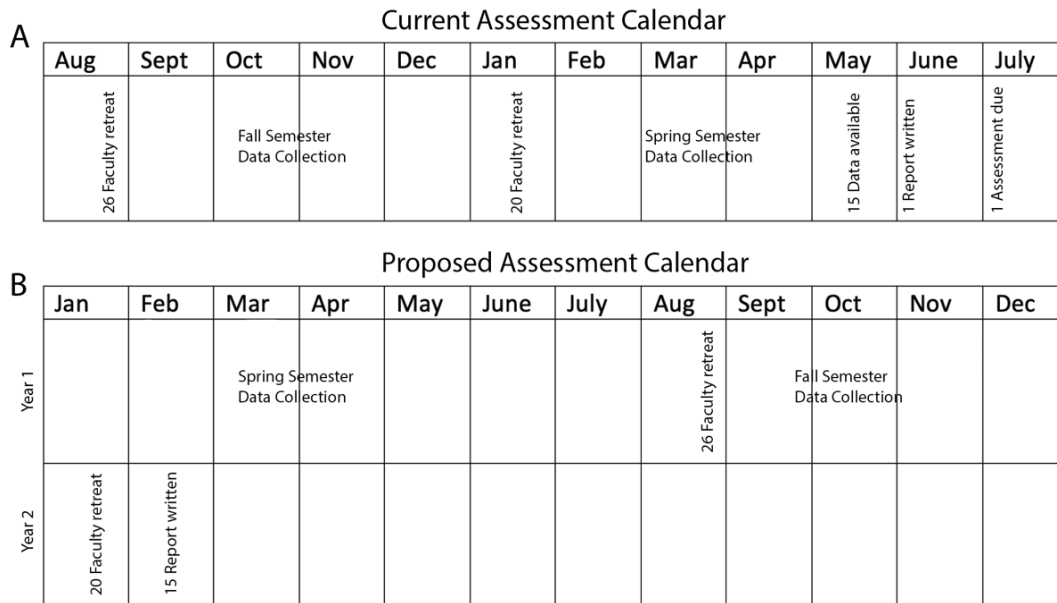
## Geology Department Fall 2021 Self Study

the assessment were things that we had suspected about our program, but which we had no data. The annual assessment provided data to back up these suspicions.

The problem came after the report was generated. We found that while conclusions were reported to the Office of Academic Program Assessment, the conclusions were never actually used by the department. In fact, it seemed that the report was only read by a handful of faculty members. This hole in "closing the loop" reduces the effectiveness of the entire assessment process, rendering it a bureaucratic exercise. Based on this realization, we here consider how we can improve the process of implementing assessment recommendation and close the loop.

During discussion within our workgroup, it became apparent that the problems with closing the loop could be broadly classified into two general areas: structural problems and implementation problems. By structural problems, we mean issues that arise due to the annual schedule of the assessment workflow. By implementation problems, we mean the actual translation of recommendations into changes at the course level. Below, we will first discuss structural problems, then discuss the implementation problems.

Structural problems were rooted how the assessment cycle intersects with the academic year calendar. In a typical year, the assessment is due on July 1. In order to meet that deadline, we have been collecting data for an academic year, then compiling the report at the end of the semester (Figure 7A). This led to problems with 1.) data being hurriedly analyzed at the end of the academic year; 2.) the Assessment Committee Chair being unfairly tasked with putting the report together at the end of the year; 3.) the assessment report not being read by other faculty members; and 4.) recommendations make it to faculty at the beginning-of-the-year retreat when it is too late to be used.



**Figure 7.** Current and proposed Geology Department assessment calendars. Numbers are approximate day of the month for each important event. A. The current version has a complete cycle in one academic year, with data collected over a Fall-Spring cycle and the report prepared just before it is due. Summer break separates the report from the next semester. B. Proposed version, with data collected over a Spring-Fall cycle, data discussed at the faculty retreat at the start of the Spring semester, and a report written in early Spring.

To address the structural problem with assessment, we will shift the entire assessment schedule by half a semester (Figure 7B). Data will be collected in the Spring and Fall. The data will be evaluated by the Assessment Committee in the Fall semester and any issues that arise will be communicated to all faculty (both tenure-track

## Geology Department Fall 2021 Self Study

and part-time faculty) in the late fall. This will allow faculty to have time to brainstorm possible solutions prior to our Spring faculty retreat. Ideally, we will agree on any necessary program changes at the retreat. During the spring semester, the Assessment committee will write up the Assessment Report, including recommendations. Implementation of recommendations can take place that Spring or, if necessary, in the Fall. In our Fall retreat, instructors will report back on any changes they have made. We will circle back to each PLO every 3 years to see if changes to the program were effective at addressing the identified issues.

This schedule will be much more effective than the previous schedule. All faculty members will see the assessment data and help in generating recommendations, increasing faculty engagement and buy-in with the assessment process. The individual faculty reports of what changes are being implemented will ensure that improvements are made; and there is a scheduled follow-up that will add an accountability piece to assessment.

Implementation comes at the course level, when an instructor takes a recommendation from the assessment report to make changes to a course. How does theory get translated into practice by course instructors? Here, we will use the planned changes from the AY 2017-2018 assessment of written communication as a template for discussion. While changes will vary from year to year based on which PLO is assessed, we expect most programmatic changes to follow a scaffolding-style approach like the following:

- GEOL 10 (Physical Geology) Essay questions on exams that use critical thinking skills
- GEOL 12 (Historical Geology) Lab assignments that require compare and contrast discussion; begin to use geologic descriptions and terms
- GEOL 100 (Earth Materials) Students write their first technical paper, with review of primary literature and standard citation methods. This is accompanied by a visit to the library reference section.
- GEOL 103 (Sedimentology/Stratigraphy) Students generate data and write a technical lab report that uses simple statistics and presentation of data tables and charts. Expectations for citing Tables and figures in a technical report are discussed.
- GEOL 111A (Field Geology) Students practice writing sections of a geologic report and receive feedback during the semester. This builds to the final report for GEOL 111B, where students write their first comprehensive geologic report.
- GEOL 111B (Field Techniques) was chosen to evaluate Written Communication for our Junior-level students. At this point BA students in Geology have had five geology classes that require some technical writing, and they are entering senior year.

Some issues in implementing these changes became apparent in retrospect:

- 1) The recommendations in the report were only communicated to some of the course instructors.
  - a. As noted earlier, the results of the assessment were prepared and submitted at the end of the Spring semester (Figure 7A). Except for a brief mention in the Fall faculty retreat, they were generally not brought up again, except in Assessment Committee meetings.
  - b. The new calendar (Figure 7B) should solve these issues by making all faculty members active participants in generating solutions. This serves the dual task of making instructors aware of the results and increasing buy-in to the conclusions of the report.
- 2) In some cases, such as for GEOL 10, 12, and 100, the instructors in affected courses were part-time faculty who only taught the course for one or two semesters.
  - a. Implementing programmatic changes in courses with temporary faculty members may be more difficult. Most of the time, the instructor is not consistently teaching the same course and must spend significant time preparing to teach, and thus does not have time to think about higher-level department needs. This has been a problem for our department as we have had part-time

## Geology Department Fall 2021 Self Study

faculty members teaching our majors courses during the last few years of high faculty turnover. While we expect GEOL 12 and 100 to have permanent faculty instructors going forward, some sections GEOL 10 will likely always be taught by part-time faculty.

- b. To address this, we plan to cast recommendations as changes to course learning objectives, then incorporate these learning objectives into standard syllabi templates given to instructors. This will ensure that part-time faculty members know what content is expected to be in the class. We will also produce standard assignments and rubrics that can be used by part-time faculty members in classes.
- 3) There are workload issues with adding content to a course
    - a. Making changes to course content is time consuming and can lead to an increase in workload for instructors. This is due to additional preparation and grading for new assignments and can be amplified for content that requires an additional cycle of feedback and revision.
    - b. One way of dealing with this is to encourage faculty members to substitute—instead of adding—content. For example, in upper-division courses, an entire week of lecture-lab can be devoted to the writing-feedback-revision cycle, replacing other course content. For lower-division courses, a lecture (or lab) period can be replaced with a short writing workshop. While there is a loss of existing content, it is replaced by activities that are a priority for the department.
    - c. There are other strategies that we considered to make changes more efficient such as using peer feedback to reduce grading workload and having students bring in work that has feedback from earlier classes.
  - 4) There was no follow-up with implementation and no assessment of whether the changes were effective.
    - a. While there were specific recommendations for classes, there was no follow up as to whether content was adjusted. Furthermore, it was not clear whether implemented changes worked. Data would not be collected and analyzed until the next assessment cycle that deals with that PLO.
    - b. The new calendar should help fix this part of the cycle. As part of the Fall faculty retreat (Figure 7B), we will revisit the previous year's assessment results and ask faculty to discuss what changes have been made. This will provide some sort of accountability for instructors. We will also use this time to review data on changes made during earlier assessment cycles.

### *Proposed changes to the assessment process to effectively "close the loop"*

- 1) Shift the assignment workflow timeline (Figure 7).
- 2) Discuss the assessment data with the entire faculty during the Spring faculty retreat. This will increase faculty buy-in and reduce the workload on the Assessment Committee Chair.
- 3) Change course learning objectives to be in line with decisions. Develop syllabi templates with new course learning objectives. Develop standard assignments that can be used in courses that are taught by part-time faculty members.
- 4) Encourage faculty to substitute, instead of adding content. This will reduce the workload issue.
- 5) Revisit the changes in the Fall faculty retreat. Require faculty members to say how they implemented changes.

This schedule will be much more effective than the previous schedule. Collected data can be analyzed over winter break; all faculty members will see data and help in drawing conclusions; recommendations will be implemented; and there is a scheduled follow-up the next semester.

### **C. Are students succeeding in our Master's program?**

The Geology MS program restarted in Fall 2015 after a brief period of inactivity caused by transfer of the program from the College of Continuing Education back to the stateside College of Natural Sciences and

## Geology Department Fall 2021 Self Study

Mathematics following a state-level audit. The program tries to meet the needs of two groups of students: research-focused students and full-time-employed students. To do this, we offer both thesis and non-thesis track options, with all courses are taught from 5:30 to 8:20 pm on weekdays. A portion of students are funded for their first year only through employment as lecturers/TAs in lower-division labs; however, there is no tuition waiver.

While annual program assessments have been delivered to both the Office of Academic Program Assessment and the Office of Graduate Studies, we have not taken the time to reflect about the program as a whole. This section is also motivated by declining enrollment in the MS program (Figure 1). Because of the recent restart of the program, we were able to study data for every student that has passed through the program. We use this data to answer a set of questions centered around the program structure and student success.

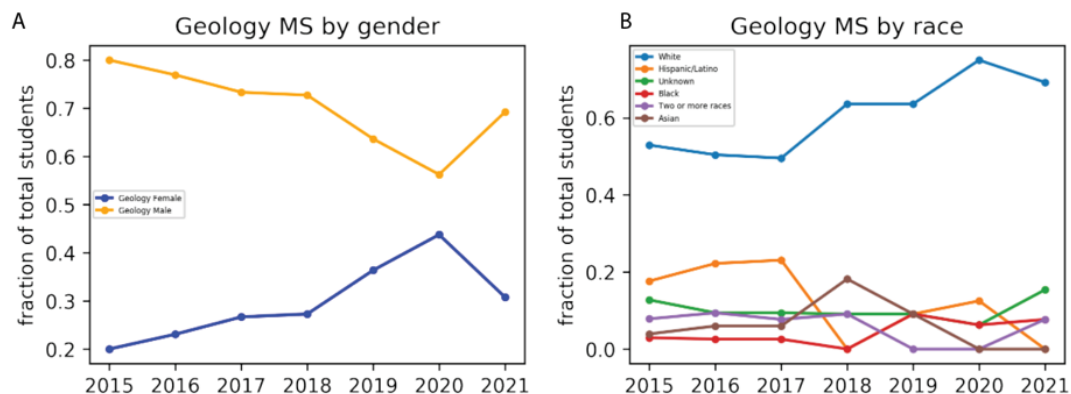
### 1) Who are our students?

Students come from a variety of undergraduate institutions (Table 2). 39% of students received a Bachelor's degree from Sacramento State. A vast majority of students are from California; this is probably due to geographical factors and to the increased cost of tuition for out-of-state students.

Sac State	23	Southern Indiana	1
UC Davis	5	Stanislaus State	1
Sonoma State	3	Humboldt State	1
CSU Northridge	3	Cal Poly SLO	1
UC Santa Cruz	3	Univ of Nevada	1
CSU Bakersfield	3	Oregon State	1
UC Santa Barbara	2	UC Riverside	1
CSU Monterey Bay	1	Univ of Idaho	1
Univ of Florida	1	Long Beach	1
Portland State	1	Univ of Wisc EC	1
Fresno State	1	San Jose State	1
Chico State	1		

**Table 2.** Undergraduate institution for Geology MS students

Students in the MS program are mostly men and mostly White (Figure 8). In recent years there has been an increase in the number of women in the program (Figure 8A), but also a decrease in the number of minorities (Figure 8B). This proportion of women and minorities in the graduate program is less than that in our undergraduate program (Figure 4).



**Figure 8.** Geology by gender and race

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While the cause of the lack of diversity is unclear, we hypothesize that it may be linked to recruiting, and consider that below. There are other important factors, such as the lack of funding or tuition waivers for graduate students, the timing of class sessions, or physical science prerequisites, but we have not had time to fully consider those factors.

Currently, recruiting is done in an ad-hoc fashion, with email sent to regional Geology Departments, usually right before the application deadline. This haphazard approach really does not work, especially since 61% of our students come from departments other than ours. We also do not have a systematic way of recruiting at local geotechnical firms and government agencies. Part of this is because we have not developed a list of point-of-contacts at firms and agencies to internally distribute material.

Instead, a systematic approach to recruiting needs to be developed that targets universities, local geotechnical firms, and government agencies. This will require developing promotional materials and setting up informational sessions to highlight the utility of an MS degree to BS students and to working professionals. We will also have to identify contacts at firm, agencies, and professional societies who can pass on information to potential students.

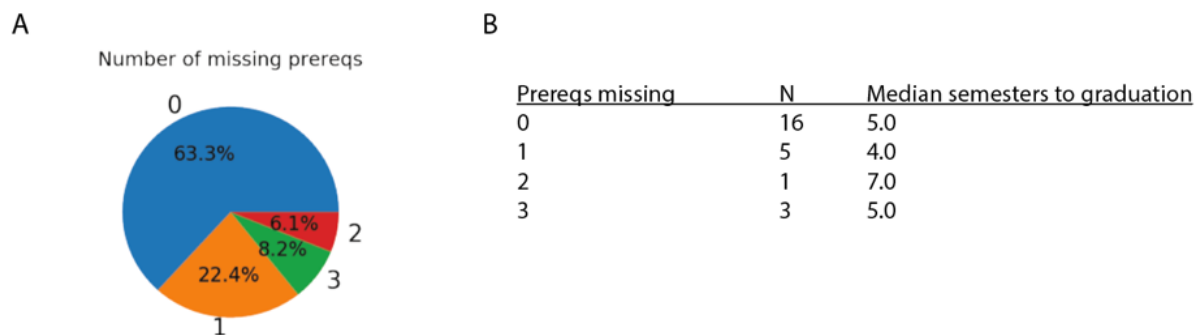
One possibility for targeting Geology Departments at other schools is to an inter-CSUS publication or webpage that will highlight Geology MS opportunities at all CSU campuses. This would give potential students one place to get information and encourage buy-in from departments in getting material distributed to students.

Our hope is that by actively recruiting graduate students, we can create a broader and more diverse graduate program that better reflects the population of our state and local community.

### 2) Are incoming graduate students prepared when they arrive?

We have had concerns that students are arriving missing basic science and math skills. In addition to standard geology undergraduate courses, our program requires two semesters each of undergraduate physics, chemistry, and calculus. Students who have all required coursework are generally admitted as Full Classified students. Those who are missing one or more courses are admitted as Conditionally Classified students, with the requirement that they finish the admission prerequisites within two semesters. In the meanwhile, they are allowed to take graduate courses.

To understand this, we collected data on the number and time-to-graduation of students missing required courses (Figure 9). 63% of students who begin the program with no deficiencies. The other 37% are admitted as Conditionally Classified because they are missing a second semester of physics, chemistry, or calculus.



**Figure 9.** A. Percent of students lacking math and science admission prerequisites. Data only includes students after the Fall 2015 class as admission prerequisites were not enforced for those students. B. Median semesters to

graduation for students missing prerequisites. This data is a subset of that in A because only students that have graduated are included.

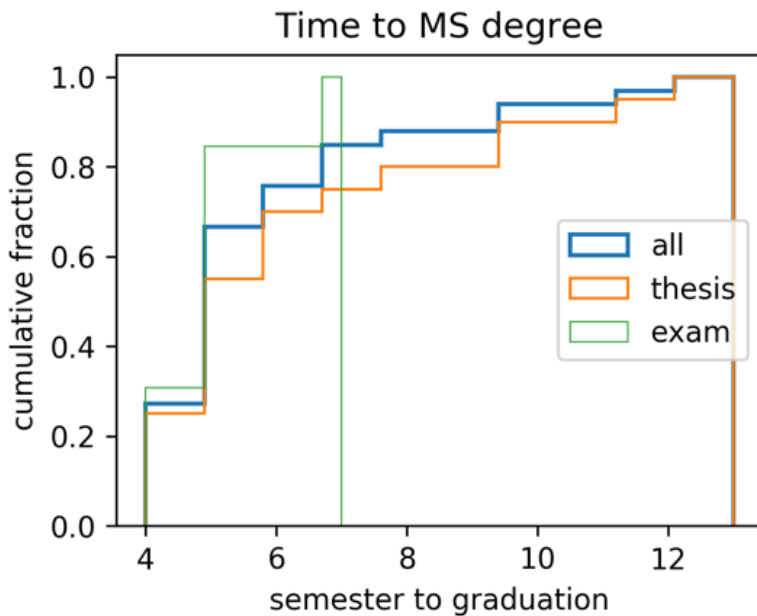
This has two effects on student learning and success. First, students missing chemistry or calculus will have issues with courses such as Aqueous Geochemistry or Advanced Hydrogeology that use higher-level concepts. This can also affect other students when the level of instruction of a course is lowered because too many students are missing prerequisites. Second, students who take a full graduate course load of 2 courses (6 units) will have to take the needed courses at Sac State or at a community college. This can be difficult for those with full-time jobs.

Surprisingly, there is no evidence that students missing prerequisites take longer to graduate (Figure 9B). This may be because students do effectively double-up their load the first year that they are in the program.

Enforcing prerequisites is difficult because there is a need to admit enough students to sustain the program and it is unclear what effect the existing prerequisites may have on diversity. However, in the long term, we hope that increasing the number of applicants by working on recruiting strategies may allow us to increase admission standards and increase the level of math, chemistry, and physics that can be taught in graduate courses.

3) How long are students taking to finish their Master’s degree?

We have had a worry that thesis students are taking a long time to finish their degrees. To evaluate whether this is true, we collected data on time-to-graduation for students on the thesis and non-thesis tracks (Figure 10).



**Figure 10.** Cumulative histogram of time to degree for thesis students, non-thesis students (exam), and all students. The cumulative fraction shows the percent of students finishing their degree within specified number of semesters.

This data show that the median (cumulative fraction=0.5) for both thesis and exam students is 5 semesters, which is normative time for a student taking a full graduate load (6 units) each semester. However, some thesis students take much longer, with some students taking over 10 semesters. Non-thesis students do not have this problem.

## Geology Department Fall 2021 Self Study

We have implemented several strategies to increase student graduation rates:

- A strict 1-year deadline for removing course deficiencies. This prevented students who entered the program with deficiencies in lower division science classes like Calculus from completing all graduate coursework and then stalling as they struggled to remove their lower division deficiencies.
- Mandatory semesterly advising for all graduate students. Each student must meet with one of the graduate program coordinators every semester to discuss classes prior to enrollment. This ensures students are taking relevant coursework and choosing the most efficient path to graduation.
- Proactively work with students and their thesis advisors to set realistic goals for a masters thesis so the workload does not creep beyond the scope of a thesis.

Additionally, we plan to:

- Require thesis students who have advanced to candidacy to give project presentations at the beginning of the Fall semester. This will give them a target to synthesize their results and move projects forward.
- Make meetings with the Advisor a condition of satisfactory progress toward the degree. This will encourage students to attend meetings and to make firm commitments toward finishing projects. While we have required meetings between the Graduate Advisor and graduate students every semester, there previously was no consequence for missing the meetings.

#### 4) What courses are offered and who teaches them?

We considered the question of what courses and taught and who teaches them (Table 3). Geology 200, 275, and 290 are required courses. Geology 200 is taught every year, while Geology 275 and 290 are taught every two years to allow students to finish in nominal time. We try to offer a balanced program by offering one "water" course and one "rock course" each semester. Electives are taught on a faculty-available basis, with holes in expertise filled in with part-time faculty.

200: Graduate Research Seminar*	7	Skinner	8
290: Regional Geology of Western US*	3	Wagner	5.5
275: Quantitative Methods*	3	Shimabukuro	3
202: Aqueous Geochemistry	3	Vankeuren	3
227: Advanced Hydrogeology	2	Hausback	2
208: Groundwater Modeling	2	Griffin	1.5
218: Applied Geophysics	2	Evans	2
213: Adv Structure and Tectonics	2	Domagalski (PT)	2
220: Surficial Processes	2	Hodges (PT)	1
240: Special Topics: Controversial Ideas	1	Dralle	1
240: Special Topics: Volcanology	1	Cornwell	1
214: Advanced Volcanology	1	Gooch (PT)	1
230: Seminar In Geology: Paleoclimatology	1		
240: Special Topics: Paleoclimatology	1		

**Table 3.** A. Number of times courses have been taught since Fall 2015. Asterisk indicates required course. B. Number of times each faculty members have taught graduate courses. Courses that are co-taught are counted as 0.5 courses. PT: part-time instructor

We noticed a few patterns. First, we have a wide selection of "water" courses (GEOL 202, 227, 208) which are regularly taught, but presently only have one instructor (Vankeuren) who has availability to teach these courses. We also have a course, Surficial Processes (220), for which we do not currently have an instructor. This has led to us hiring part-time instructors to fill the teaching slots. With the current faculty make-up we would expect this practice to continue. Second, Steve Skinner and Amy Wagner have taught nearly 50% of the courses

in the graduate program. This imbalance is not good for students because of the inherent loss of breadth of education caused by having the same instructor for multiple classes.

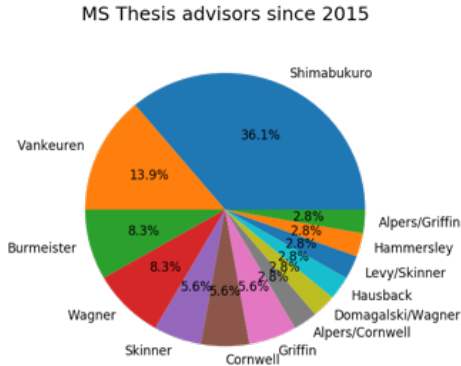
One challenge in scheduling instructors for the graduate courses was that there was not a long-term plan for which electives would be offered each semester. In order to facilitate advanced planning of faculty schedules and ensure that faculty are available to teach courses when they are offered, an elective schedule was developed projecting out classes for the next 5 years. Additionally, program changes were implemented to broaden the graduate course descriptions. This will allow a wider variety of faculty to teach each course by enabling faculty to incorporate their varied expertise into the courses while still achieving PLOs.

However, it is clear that the graduate program, as currently structured, needs a full-time faculty member who can teach some mix of surface hydrology, aqueous geochemistry, and surficial processes. This will bolster the "water" side of the teaching faculty and is at the top of our hiring request for next year.

Some part of the problem with the lack of instructors is the evening time slot for courses. We plan to consider whether moving classes to the daytime might increase the number of faculty willing to teach them. This could be supported by cross-listing courses as both undergraduate and graduate courses, either with existing courses or newly developed courses. This would also have the effect of increasing enrollment in courses such as quantitative methods which could be useful to advance undergraduates.

5) Who advises thesis students?

The MS program has both thesis and non-thesis tracks. There are many more students following a thesis track (61%) than the non-thesis track (39%). To understand who is supervising thesis students, we collected data on all the advisors for all students that have finished or are currently in the thesis track (Figure 11).



**Figure 11.** Primary thesis advisors for students in the program (N=51). Alpers, Levy, and Domagalski are full-time employees at the USGS California Water Science Center.

The data show a few things. There is a large imbalance with David Shimabukuro acting as primary advisor to 36% of students doing theses. This is mostly because Shimabukuro has funds from a large, multi-year USGS Cooperative Agreement. There are also several theses with a primary scientific advisor in the USGS California Water Science Center that have a Geology Department faculty member as the formal thesis advisor.

This type of imbalance is not good for our graduate program. A lack of advisors willing to take on students reduces incentives for students to come into the program, decreasing the number of students. Inability to find an advisor can also lead to frustration for students who are here and searching for an advisor to work on a thesis project.



## Geology Department Fall 2021 Self Study

Several factors cause this. The most important is the lack of grant funds to pay for graduate students. While students can work as lower-division lecturers this funding only lasts for one year and does not come with a tuition waiver. This also can support a limited number of students. A second reason is that supervision of these is not compensated for by any reduction in workload.

Our program will need to think of a way to incentivize faculty to take on additional thesis students. One way would be to develop a template for students supervising projects without funding or supported by small, external grants. This would remove the funding barrier for supervising students. Another way would be incentivizing faculty by giving supervisory work units to faculty. This is currently supported by the Academic Senate but is not implemented in our college.

### *Graduate Program Summary*

This is the summary of recommendations for our graduate program:

- 1) We need to understand the causes of lack of women and minorities in our graduate program and correct this problem.
- 2) At least part of the cause of lack of diversity is the absence of systematic graduate recruiting. We will revise our recruiting strategy with an effort to target colleges, local geotechnical firms, and government agencies.
- 3) We need to do some careful thinking about the enforcement of admission prereqs. While we would like students to have math, chemistry, and physics, in order to handle topics like geochemistry and hydrology at a higher level, it may have a detrimental effect on diversity. We hope that increasing the number of graduate applicants may be able to let us both increase admission standards and increase diversity.
- 4) Time to degree needs to be sped up for thesis students. We plan to enforce mandatory advising and require annual or one-a-semester presentations for graduate students that have advanced to candidacy.
- 5) Too few full-time faculty members are teaching graduate courses. We need to figure out how to incentivize faculty members to teach graduate courses, perhaps by allowing courses to be taught during the daytime, or by increasing buy-in by having more faculty have graduate students.
- 6) Thesis supervision is imbalanced. Fixing this will require a pathway for developing projects that only require paying a student's salary and compensating faculty for thesis supervision.

## Appendix I.

### Geology Department overall program goals

- I. Students are prepared for professional and/or graduate study involving the geosciences;
- II. Students develop a deep understanding of Earth systems: how Earth systems work and how they interact;
- III. Students develop their ability to solve geologic problems through the use of scientific method;
- IV. Students develop their technical communication skills: seeking and processing technical information; and communicating technical information and conclusions in both oral and written form.
- V. Students develop the quantitative skills necessary to solve geologic problems;

### Summary of Assessment Data:

- Student Knowledge Inventory
- Geology 188 field maps and assignments
- Geology 111B field maps and assignments
- Embedded quantitative assignments from majors courses
- Writing rubrics from required assignments

### Summary of Assessment Tasks for 2019-2024

Year	Periodic Tasks	Yearly Tasks
2019-20	Quantitative review	1) Administer SKI; compile results & review. 2) Collect GEOL 188 rubrics, cross-sections and select maps 3) Collect GEOL 111B rubrics, cross-sections, and maps. 4) Collect writing rubrics 5) Collect oral presentation rubrics 6) Collect embedded quantitative assignment from one course
2020-21	Oral communication review	
2021-22	GEOL 188 and 111B review	
2022-23	Written communication review	
2023-24	SKI longitudinal review	

## Geology Department Program External Review

### External Reviewers:

Todd Greene, Professor and Chair, CSU Chico ([tjgreene@csuchico.edu](mailto:tjgreene@csuchico.edu))

Mara Brady, Associate Professor and Chair, CSU Fresno ([mebrady@csufresno.edu](mailto:mebrady@csufresno.edu))

Department Name: Geology Department

Degrees: Geology BS (concentration in General Geology), Geology BS (concentration in Hydrogeology)  
Geology BA, Earth Science BA, Geology MS

Site Visit Dates: April 7 and 8, 2022

### Review of Assessment Elements

STAGE	DESCRIPTION
Initial	The program is at a preliminary stage in this practice. The program shows the need for additional policies, resources, or practices in order for it to provide the education program to which it is committed or aspires. Insufficient data is available to make determinations.
Emerging	The program partially satisfies the criterion. Some data is available documenting this dimension. The program has many, but not all, of the policies, practices, and resources it needs to provide the educational program to which it is committed or aspires.
Developed	The program satisfies this criterion, with developed policies and practices. The program has the availability of sufficient resources to accomplish its program goals on this dimension. Data demonstrates accomplishment of this criterion.
Highly Developed	The program fully satisfies this criterion. The program may serve as a model and reference for others on campus. The program's practices, policies, and/or its resources contribute to program excellence on this dimension.

Element One: Department Mission and Institutional Context	
Inquiry	Stage
Does the department have a mission statement or statement of program goals that is appropriate?	E
Is the department mission and its programs aligned with CSUS and college missions and strategic priorities?	D
Is the department supportive of the CSUS general education program and/or general graduate learning outcomes?	HD
Does the department engage key constituencies and campus partners in academic and strategic planning, including faculty, professional colleagues, current and prospective students, and the community?	D
Does the program have policies and procedures that facilitate articulation with community colleges and/or other external educational partners?	n/a
Comments: <i>We did not review information or data related to articulation. The Geology Department has strong connections to local agencies and professionals. They have a clear sense of how their degrees can lead to Professional Geology certification.</i>	

<p>Recommendations: <i>The department is encouraged to leverage their strong connections with local agencies and professionals as a selling point for prospective students. We also encourage the department to keep better records of alumni in order to showcase their success in post-graduate employment to help with recruiting efforts.</i></p>	
<p><b>Element Two: Learning Outcomes and Assessment to Maintain Success and Engage in Continuous Improvement</b></p>	
Inquiry	Stage
Does each degree program have appropriate and measurable learning outcomes that reflect current standards in the discipline?	I
Does each course have appropriate and measurable learning outcomes that allow students to achieve program learning outcomes?	n/a
Are the curriculum and graduation requirements for each degree reflective of current standards in the discipline?	D/HD
Does each degree's curriculum and graduation requirements appropriate for the degree level and reflect high expectations of students?	D
Is the assessment loop regularly being closed for each of the degree's program learning outcomes?	I
Is the learning assessment data being used to maintain Success and Engage in Continuous Improvement?	I
Do students feel connected to academic support services (writing, math, tutoring, library, etc.)?	n/a
<p>Comments: <i>N/A is listed for items we did not review.</i></p>	
<p>Recommendations: <i>We recommend the Geology Department review the goals and outcomes of each degree program so they are clearly distinguished in terms of assessment and so that students are aware of the unique aspects of each degree pathway. The department has a plan to more meaningfully engage in department assessment and we encourage the university to provide support in doing so, especially given the logistical/timing challenges raised in their self study. We also encourage the department to include part-time faculty (lecturers) in the assessment process.</i></p>	

<p><b>Element Three: Student Success and Assessment to Maintain Success and Engage in Continuous Improvement</b></p>	
Inquiry	Stage
Does each degree program use aggregated and disaggregated data to understand admission trends and manage enrollment with an eye to diversity, impactation, or address program specific concerns?	E
Does each degree program use aggregated and disaggregated data to consider ways to improve retention?	E
Does each degree program use aggregated and disaggregated data to consider ways to improve time to degree or close graduation gaps?	E
Does the program provide appropriate opportunities for students to participate in curricular-related activities, such as research and creative opportunities, service learning experiences, performances, and internships?	HD

Does the program provide or partner with other entities to provide appropriate co-curricular activities for its students, such as clubs, field trips, lectures and professional experiences?	HD
Does the program provide adequate student advising?	n/a
Do students feel connected to student success support services?	n/a
<p>Comments: <i>We did not review information or data specific to student advising and support services, especially those outside the department. The students interviewed were in strong consensus that the faculty were very supportive and invested in their success. The department hosts internal workshops and seminars that support student professional development.</i></p>	
<p>Recommendations: <i>The seminar/workshop series is funded by an external grant. We recommend the university help support the department in identifying institutional resources to continue this program. The department engages students in research experiences and field trips. We recommend the university continue to support these efforts through research/lab maintenance and staffing of field courses. We encourage the department to consider how to support students who are not able to participate in the summer field course - this could involve targeted advising to make students aware of other field opportunities and/or seeking outside and university resources to support scholarships for students to participate in field courses.</i></p>	
<b>Element Four: Developing Resources to Ensure Sustainability</b>	
<b>Inquiry</b>	<b>Stage</b>
Does the program have faculty in sufficient number, and with appropriate rank, qualification, and diversity to allow students to meet the program learning outcomes and deliver the curriculum for each degree program?	D
Does the program employ professional staff and/or appropriately partner with campus partners (graduate studies or College of Continuing Education) to support each degree program?	I
Are its facilities, including offices, labs, practice and performance spaces, adequate to support the program?	E
Does the program have access to information resources, technology, and expertise sufficient to deliver its academic offerings and advance the scholarship of its faculty?	D
Does the program seek and receive extramural support at the appropriate level, including grants, gifts, contracts, alumni funding?	HD
Has the program identified other concerns that impact budget and resource planning?	D
<p>Comments: <i>Gap in surface hydrology expertise among faculty due to loss of a faculty member. Research infrastructure support needed to upgrade equipment and labs; this was identified as a theme during the site visit. These labs support student and faculty research collaborations and some student research projects are delayed due to lack of access to equipment. Some faculty mentioned the lack of consistency in scheduling leading to too many new-preps which leads to courses not adequately developing and evolving through the years.</i></p>	
<p>Recommendations: <i>We encourage the department to consider long-term planning and making priorities for research equipment upgrades and maintenance. We encourage the university to help connect them with resources for support since active research supports student learning and success.</i></p>	

<b>Element Five: Planning to Maintain Success and Engage in Continuous Improvement</b>	
<b>Inquiry</b>	<b>Stage</b>
Does the academic unit engage in planning activities which identify its academic priorities and their alignment with those of the college and the University?	D
If appropriate, does the program have an advisory board or other links to community members and professionals? Does the program use community professional input for program improvement? Does the program maintain a relationship with its alumni?	D
Does the academic unit have a strategic plan, and other long-term plans (5 year hiring, facilities, etc)?	n/a
Does the academic unit have regular processes to revise plans and timelines.	D
Do plans include engagement with needed campus partnership and external entities to accomplish goals?	n/a
Comments: <i>The faculty participate in two retreats each academic year. Our review focused on the three questions more so than the strategic plan or alumni engagement, although a plan could help them prioritize how to gather information and evaluate progress related to the three questions.</i>	
Recommendations: <i>We recommend the faculty create a plan on how to maintain their positive relationships with 2-year colleges if/when Theron Sowers moves on from CSUS. We also recommend the faculty include part-time faculty (lecturers) in their strategic planning so they feel a part of the process. We also highly recommend the department invest in improving their introductory labs. First and second year students who are undeclared and a significant untapped resource for recruiting purposes.</i>	

## **Review of Self Study Questions**

### **Question 1. How can we recruit a more diverse student body?**

#### BS Geology, BA Geology, BA Earth Sciences

In the self study, the Geology department identified the challenges of (1) decreased enrollment and (2) lower racial/ethnic diversity than the NSM on average, as well as a smaller proportion of female students compared to the NSM. While these trends are consistent with nationwide trends in geoscience departments, the department at Sacramento State is uniquely poised to be part of the solution to increasing the representation of racially-minoritized individuals in geoscience careers, given the racial/ethnic diversity of the university and college. The Geology department should be commended for identifying this as a major question and direction for future study and information gathering. Moreover, during the site visit the students explicitly mentioned that the faculty worked to create inclusive learning environments and that the overall culture of the geology department was more inclusive than other courses they took outside the department.

The self-study includes specific potential challenges and solutions, which suggests the department is motivated and well-prepared to tackle these challenges, with sufficient time and resources. The goal of recruiting a more diverse student body is aligned with the CSU mission and GI2025 goals as well as the mission of Sacramento State to “prepare students for leadership, service, and success.” Moreover, a key selling point of a degree from the Geology Department at Sacramento State is the department and university’s close ties to local agencies and professionals in the capital region. We encourage the department to leverage potential university efforts and funding sources aligned with these missions to support their continued growth and increased racial/ethnic diversity of their enrolled students. In the self study, the department identified the following challenges. We briefly summarize them below along with potential solutions identified by the department and additional considerations

offered by the external reviewers. The focus of these recommendations is on the undergraduate students since that was the focus of this content in the self study.

#### *Awareness of Geoscience Majors and Careers*

Very few students enter the university as first time freshmen geology majors. The department identified that this likely reflects the lack of awareness of what's involved in a geology major and what career opportunities exist post graduation. This may also reflect the emphasis on certain traditional science courses (i.e. chemistry, biology, physics) in high school curriculum. The department identified possible solutions of increasing outreach efforts to potential students as well as using GE courses and first year seminars as potential recruiting opportunities for existing students. We agree these are useful directions to investigate and the department would benefit from existing university support/guidance on first year experience development and course re-design.

In terms of recruiting new students, we recommend the department consider exploring dual-enrollment courses, where high school students take Geology courses that count for college credit and towards the geology degree programs. These courses would be taught by instructors certified to teach at the college level, either existing faculty or high school teachers with appropriate credentials (CSU-Bakersfield has a successful model that was initially funded by an external grant). And we encourage the university to help connect them to relevant outreach efforts. In terms of recruiting transfer students, we encourage the department to leverage the network of existing lecturers who may teach at nearby community colleges and/or have colleagues there. In terms of recruiting currently enrolled students to the geology majors, the department may want to look at the example of Cal Poly-Humboldt's Klamath Connections first year experience. Moreover, the site visit revealed that graduate students and some faculty are motivated to re-design introductory course labs. These labs and the graduate students who teach them are a potentially untapped resource for attracting and retaining a diverse student body to the geology majors. Supporting graduate student TA's financially and through professional development will alleviate economic burdens of those graduate students as well as improve the experience of the undergraduates in the lab. Additionally, the department may be able to leverage existing outreach programs and partner with them to create awareness of the geosciences for pre-college students (some of these programs may be found here: <https://www.csus.edu/student-affairs/centers-programs/hispanic-serving-institution/>). Finally, we recommend that the department needs support in addressing the lack of Geology courses built into cohort auto-enrollment. We gathered from the site visit that the new auto-enrollment cohorts have led to a decline in enrollment in Geology GE courses, which further compounds their recruitment challenges. If the department courses could be built into these cohort blocks, that would support their recruitment efforts.

#### *Cultural and Economic Barriers*

The persistent lack of racial/ethnic diversity in the geosciences has plagued our community for decades (Bernard and Cooperdock, 2018), which suggests intentional and persistent efforts are needed to create an inclusive environment in geoscience departments for racially-minoritized individuals. Moreover, the self study proposed that the motivation of many faculty and current students for pursuing a geoscience degree (e.g. love of the outdoors) may not be the same for populations of students we have failed to recruit (e.g. giving back to their community, addressing social justice issues like climate change, increasing economic mobility). In addition, the Geology Department recognizes the significant financial burden of the summer field course as a barrier for at least the Geology B.S. degree. The department suggested collecting data to better understand their students and motivations through surveys and focus groups. They also suggested exploring potential scholarship or funding opportunities to support students pursuing the summer field course and noted the additional option of a Hydrogeology concentration alleviates the burden of students that cannot participate in the summer field course.

Recent work suggests that increasing awareness of geoscience career opportunities and the potential altruistic factors of these careers may be an important strategy for increasing diversity in geoscience fields (Carter et al. 2021). Additional work in STEM fields, in general, suggest that doctoral students from underrepresented minority backgrounds are more motivated by altruistic values and giving back to their community (Gibbs et al. 2013, Thoman et. al 2015). Therefore, as Geology Department faculty consider re-designing intro courses and increasing recruitment efforts, we recommend they consider highlighting to students the value of geoscience careers to solving important societal challenges and how geoscience careers can help students give back to their community after graduation. The department can also leverage their connections to local agencies and professionals in the capital region, who could speak to these points as well (e.g. seminar speakers and workshops).

We encourage the department as a whole to leverage the new systems and structures created through external funding by at least two faculty members (Shimabakuro and Vankeuren were highlighted in the self study and site visit). Based on the information we reviewed, these two faculty members have created programs that support mentoring, training, and career development. We encourage the department to consider what elements of these programs could be institutionalized to more formally recruit and retain students in the geology department. We encourage the university to support them in helping to sustain some of the new structures and programs created by this external funding.

To support potential solutions to the challenges outlined above, and aligned with other recommendations in this report, we encourage the department as a whole to consider participating in URGE (<https://urgeoscience.org/>, Unlearning Racism in the Geosciences), by working through the exercises and discussing the topics together (the program is no longer live, but you can access all of the materials on your own time). The URGE curriculum provides templates for action items that are aligned with many of the potential solutions the department identified to these challenges. Moreover, an NAGT traveling workshop that brings in outside experts to facilitate department-wide discussions of program recruitment and retention, along with curriculum/program review could be extremely beneficial. We encourage the department to include all faculty, including temporary lecturers, in these discussions, as feasible, given time and resource constraints. We encourage the university to help the department identify sources of funding or support that could help account for the time investment of these potential department wide discussions and action plans (e.g. GI 2025 funding, CSU Equity in Action, faculty learning community funds, course-redesign grants)

### MS Geology

The recommendations above are geared toward the undergraduate students, which may support an eventual pool of applicants that could increase the racial/ethnic and gender diversity of the graduate program. We note that the URGE curriculum also includes some guidance for graduate programs on addressing racial bias and creating inclusive learning environments. Moreover, this issue could also be discussed at a potential NAGT workshop, which can be tailored to department needs, interests, and priorities. We recommend the department investigate the potential of becoming an AGU Bridge Institution (<https://www.agu.org/bridge-program>) to get access to a broader pool of applicants and resources for training faculty mentors. This program is geared toward attracting students to PhD programs, but master's granting institutions can participate as well.

### **Question 2. How can we more effectively "close the loop" on assessment?**

#### BS Geology, BA Geology, BA Earth Sciences

The suggestions for "closing the loop" in the Self-Study are very good and should help with structure and implementation. Before these changes are made, the department should step back and look at the overarching Program Learning Outcomes (PLOs) first, and either edit or completely start fresh. Without agreed upon PLOs that are able to be assessed, the whole "loop" becomes less meaningful. For example, the very first PLO is problematic: "Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems." This is extremely non-specific. What set of concepts are you assessing? Any concepts? There is no way this approach could be systematic across the curriculum since each class teaches different concepts. Instead, we suggest the department think about how they can be more specific with their PLOs, decide what assessment tool can best assess this goal, determine which classes would be best to either extract an assignment, or input a specific tool, and do this consistently. The same can be said for the second PLO: Students will be proficient in solving geologic problems. What type of problems? How do you assess proficiency? Is this just the grade they get in a particular class? We strongly recommend working Amy Wallace in the Assessment office to work on creating program goals and outcomes that can be assessed at various levels of the curriculum, such as introduced, practiced, and developed stages.

There is also very little difference in the Program Learning Outcomes and Goals between the BS in Geology and the BA in Geology. It is difficult to see how the different degrees lead to different outcomes for students or why a student would pursue one degree over the other. This leads to a lack of identity for students in the BA program compared to a student in the BS program, or even worse, it could lead to BA students thinking they have less abilities or less options as a graduate. Similarly, the BA in Earth Science seems equally lacking in purpose. This degree has no program learning goals (only outcomes) and the outcomes are almost identical to those of the BA in



Geology and BS in Geology. In addition, the BA in Earth Science does not have any outcomes relating to oral communication (only writing) or quantitative skills.

Based on feedback from faculty, it appears assessment is treated as a bureaucratic necessity within the past 2-3 years that has very little benefits to the department. Although this is a common faculty response in many departments, we feel that assessment could be treated more rigorously if more resources were made available. For example, if assessment contributions were made part of the RTP requirements, more faculty may take the effort more seriously. Or, if more AWTU or funds were made available to the assessment coordinator, assessment reports could be more comprehensive than simply answering questions on university questionnaire forms. Or, if faculty dedicated more time to learn from each other what the learning outcomes are for each of their required courses (assuming each course has well-defined learning outcomes), a more coherent understanding of the overall curriculum could lead to more buy-in when fitting their courses to the program assessment. Finally, we suggest involving temporary faculty in either implementing the program learning goals and outcomes. As of now, temporary faculty feel they are not part of the department vision and are only included when the T/TT faculty ask them to participate. They have resources, expertise, and professional connections that could be used to help redesign the program goals.

If the department is open to the idea of reinventing program goals and learning outcomes of their three programs, I encourage them to consider working with the National Association of Geoscience Teachers to explore the possibility of hosting a Building Strong Geoscience Departments Traveling Workshop (please see links below). While requiring considerable effort, working to establish a new department-wide program goals will help to produce programs that avoid getting caught in the weeds of a content-driven knowledge base and allow more focus on building core competencies. In such a model, emphasis on innovative use, application, and communication of the things students are learning will result in more streamlined and vigorous curricula while still ensuring it meets student needs (e.g., Geologist In Training requirements and ASBOG exams).

Workshop details: [https://nagt.org/nagt/profdev/twp/trav\\_departments.html](https://nagt.org/nagt/profdev/twp/trav_departments.html)

Resources: <https://serc.carleton.edu/NAGTWorkshops/departments/index.html>

If the department has not already had an opportunity to do so, we strongly suggest reviewing a recent 2021 American Geoscience Institute publication by Mosher & Keane (eds.) entitled, *Vision and Change in the Geosciences, the Future of Undergraduate Geoscience Education*. This paper is a good resource for insight regarding contemporary approaches to geoscience education. Mosher and Keane provide examples of the many ways geologic processes actively impact society and highlight the ways these impacts will challenge the global community in coming decades. Examples include, increasing occurrences and severity in natural disasters, impacts of rising sea levels on coastal environments, the effect of climate change on essential resources, and growing challenges associated with resource availability.

The document also underscores the fact that future geoscientists will need educational experiences that provide them with the new tools, technologies, and approaches (e.g., the ability to work with complex systems, to process complex natural datasets, and temporal and spatial acuity) that they will need to work in the interdisciplinary, multidisciplinary teams that will ultimately tackle these problems. For example, to be competitive on the job market, future geoscientists will require a new range of skills and competencies to solve the problems they will encounter. The ability to identify, collect, analyze, and evaluate uncertainty in large data sets, apply creative critical thinking and problem-solving skills, communicate effectively to different audiences, and work well in teams will help students succeed in these work environments (Mosher & Keane, 2021). The knowledge and skills needed for success will change throughout a career, so creating programs that encourage students to develop the flexibility to adapt to change will be important. This flexibility will likely play an increasing role in our ability to work across cultures and communicate effectively with diverse audiences.

### M.S. Geology

The program learning goals of the MS Geology program are much more well-defined and specific than those of the BS or BA programs. However, assessment reports from the past 3 years are not well linked to these goals and outcomes. For example, the 2019/2020 assessment report assessed “written communication” even though there is nothing about written communication in the program goals or outcomes. In addition, having 16 different program learning outcomes could present great challenges to the faculty and assessment coordinator. We

strongly suggest the department heed their own advice in the 2020/2021 report when asked about the type of assistance they need from Academic Excellence:

- 1) Guidelines for what the new assessment and program review methodology should include.
- 2) Guidance on how to revise PLOs to be more appropriate for the MS degree;
- 3) Information about the comprehensive assessment plan that we should be following.

Based on feedback from faculty, it appears assessment is treated as a bureaucratic necessity within the past 2-3 years that has very little benefits to the department. Although this is a common faculty response in many departments, we feel that assessment could be treated more rigorously if more resources were made available. For example, if assessment contributions were made part of the RTP requirements, more faculty may take the effort more seriously. Or, if more AWTU or funds were made available to the assessment coordinator, assessment reports could be more comprehensive than simply answering questions on university questionnaire forms. Or, if faculty dedicated more time to learn from each other what the learning outcomes are for each of their required courses (assuming each course has well-defined learning outcomes), a more coherent understanding of the overall curriculum could lead to more buy-in when fitting their courses to the program assessment. Finally, we suggest involving temporary faculty in either implementing the program learning goals and outcomes. As of now, temporary faculty feel they are not part of the department vision and are only included when the T/TT faculty ask them to participate. They have resources, expertise, and professional connections that could be used to help redesign the program goals.

### **Question 3: How effective is the Geology Master's program?**

#### Geology, MS

Based on the feedback from the graduate student interviews, it is clear that the MS Geology program has many positive attributes. The students are clearly appreciative of the faculty's dedication, time, effort, and open-door attitude towards their advisees. The students realize how much of a sacrifice it is to keep graduate research going through funding and innovative projects and they are deeply grateful. The graduate student handbook is also very helpful in keeping them on track to finish. They are also very thankful for the state agencies and USGS connections which was a major draw to the program. The Self-Study presented a very good summary of the MS Geology program including some suggestions to improve the program. In general, we agree with these suggestions but after hearing directly from faculty, students, and administration, we believe there are further steps that could be implemented to increase the effectiveness of the program.

First and foremost, more investment in faculty time and mentorship must be made by the administration. As for now, only 3 WTU as "dean supervisory units" can be used per semester for the entire department to help compensate faculty which is entirely too little to make any appreciable difference. We recommend 0.5 WTU per student per semester as long as the graduate student is enrolled (i.e. not adjunct status). This appears to be the standard at other CSU's and CSUS should be no different. Advising graduate students is very time-intensive, especially if they are to take advantage of the great opportunities to work with state agencies and secure adequate funding for the research. This workload issue for faculty is a serious problem that will only continue to fester if the administration doesn't provide more support.

Second, the facilities to accommodate research are in need of a serious overhaul. Basic equipment to make thin-sections, for example, are not usable. Many other obstacles exist such as not having a rock-preparation room, ventilation problems, and insufficient infrastructure for equipment requiring 220V. Graduate students also feel the burden of having to maintain equipment without having adequate resources. Although the department has some newer equipment including drones and a 3-D printer, most of the items have not been integrated into usable research inventory yet. In addition, very little office exists for graduate students beyond a small room in an adjacent building with only 3 desks and no windows. All of this leads to more costs to send samples out of the department for analysis, increased wait times that inhibit progress, and putting the department at a competitive disadvantage when applying for grants.

Third, we recommend offering more graduate level classes during the daytime. Based on the cohort we spoke with, many consider the evening course times a burden on their lives. If some courses could be scheduled during the day, more faculty would be able to teach these courses, and you could possibly gain more senior-level undergraduates to take courses for credit toward their BS or BA degrees. In addition, when we asked the students if

having only a limited number of faculty teach the courses was a problem as the Self-Study suggested, most thought this was not an issue at all and that they were pleased with the variety of instructors.

Fourth, many graduate students feel the work level and responsibilities for being a Teaching Assistant (TA) for introductory courses is problematic. In general, TAs feel unsupported when taking on a lab course and many agree the labs are in need of a major overhaul to limit the amount of tedious grading. Although TA positions are limited to the introductory graduate class, we believe the department could benefit from allowing TAs to continue to teach into their second year in order to take advantage of their experience. However, based on our discussion, this would only happen if the aforementioned suggestions to improve the introductory labs occurred.

## **Summary**

### **Commendations:**

- faculty are collegial and work well together
- faculty are dedicated to student learning and creating an inclusive environment, and this is highly recognized and appreciated by the students
- faculty are research active, supported by external grant funding which, in turn, supports student learning and engagement in authentic research experiences
- department has strong ties to local agencies, and degree programs create pathways to professional geologist certification
- connection to two year schools is very strong and the department is highly dependent on these connections

### **Recommendations and Specific Considerations to Improve Learning and Student Success For Each Degree:**

#### BS Geology

The current curriculum supports undergraduate learning in foundational geologic knowledge and field skills. We recommend the department:

- define program learning outcomes and goals as, 1) distinct from other BS and BA programs, 2) more aligned with current skills required by geologic professions, and 3) more consistent with modern, inclusive pedagogies
- redefine assessment tools that can effectively address the new program learning outcomes
- consider funding/scholarship for summer field course, which may include working with development office staff
- apply and participate in an NAGT Building Strong Geoscience Departments traveling workshop
- work with campus partners, assessment office, alums, and the college to secure funding for all of the above recommendations

#### BA Geology

This degree emphasizes earth systems science and the BA distinction. Currently some students feel a lack of identity in the BA program compared to a student in the BS program. During the site visit, faculty and students mentioned this program was for students that couldn't do the summer field course and that the BA distinction may make this degree appear less rigorous than the BS degree. We recommend that the department:

- define program learning outcomes and goals for this degree as distinct from other BS and BA programs
- consider the unique value of this program and what it offers to students
- be able to articulate potential post-graduation opportunities for this major and how it compares to others
- further explore conversations started during the site visit where faculty mentioned the possibility of creating a BS in geosciences that was more interdisciplinary and systems-focused; this option might elevate the perception of the degree among students and potential employers.

#### BA Earth Sciences

This degree has no program learning goals (only outcomes) and the outcomes are almost identical to those of the BA in Geology and BS in Geology. In addition, the BA in Earth Science does not have any outcomes relating to oral communication (only writing) or quantitative skills. We recommend that the department:

- consider unique value of this program and what it offers to students and whether this program is needed, especially in the context of current credentialing requirements in California
- be able to articulate potential post-graduation opportunities for this major and how it compares to others
- define program learning outcomes and goals as distinct from other BS and BA programs

MS Geology

Graduate students reported being attracted to the program based on their interest in a particular advisor or project as well as the potential for connections to state agencies and professional organizations in the capital region. We recommend the department:

- investigate University or College support for faculty time on graduate student research, especially given the research productivity of the department as a whole
- create a facilities plan to prioritize equipment upgrades and maintenance that will support faculty and graduate student research
- consider offering more graduate courses during the day
- consider workload for faculty TA's and re-designing intro courses to support their engagement and pedagogical training

**Recommendations and Specific Considerations to Develop Resources to Ensure Sustainability:**

- Work with campus partners, assessment office, alums, and the college to secure funding and appropriate resources for all of the above recommendations
- Create a 5 year facilities plan that prioritizes research infrastructure upgrades and maintenance
- Investigate scholarship/support fund for summer field course
- Consider the unique value, learning outcomes and goals of each undergraduate degree program and consider potential restructuring to better meet the needs of students
- Investigate workload issues of too many new course preparations each semester for faculty and work to ensure consistency of course offerings for faculty (especially in the context of academic unit planning)

**Recommendations and Specific Considerations to Improve Academic Unit Planning:**

- Host an NAGT workshop with outside facilitators to guide academic unit planning, involving all faculty that teach courses in department
  - leverage the expertise and experience of lecturers in more meaningful ways, e.g. participating in academic planning, course and lab redesign, two-year college recruitment
- Consider participating in URGE discussion and action planning, or something similar, to support faculty conversations on increasing the racial/ethnic and gender diversity of their degree programs
- Investigate feasibility of assessment schedule proposed in the self-study and implement as appropriate
- Leverage grant-funded structures and programs that support student recruitment, engagement and professional development and determine which elements are sustainable and can be institutionalized into department programming long term

External Reviewer One Name: Mara Brady

Affiliation: Fresno State

Signature:



External Reviewer Two Name: Todd Greene

Affiliation: CSU, Chico

Signature:



## APRC Internal Review Report

Internal Reviewers: Kisun Nam, Division of Social Work, College of Health and Human Services  
Jana Noel, Undergraduate Studies in Education, College of Education

Academic Unit: Geology Department

College: College of Natural Sciences and Mathematics

Degree Programs Reviewed: Geology BS (concentration in General Geology)  
Geology BS (concentration in Hydrogeology)  
Geology BA  
Earth Science BA  
Geology MS

Date Submitted: June 17, 2022

### I. Self-Study

The Geology Department submitted its self-study in February 28, 2022. It consists of 24 pages and largely conforms structurally to the self-study template provided in the Academic Program Review Guide, with an exception that “Developing Resources to Ensure Sustainability” section seems to be missing. The self-study presents the assessment data analysis and student success outcomes, and concludes with three focus study questions. Authorship is not clearly stated, and we assume that the tenured and tenure track faculty members as a whole have contributed to this self-study. Because of the small number of students in BA degree programs, most of the data have been aggregated into a bachelor's degree (BS and BA) and a master's degree program. While the low enrollment numbers may be understandable, we would think that it would be significant to analyze the data by degree programs in future, since their programs are seeing different trajectories of student growth or decline.

In the Overview section, the self-study briefly mentions the university, college, and academic unit missions. It is noted, however, that the department’s statement is very generic. We would recommend looking at Sac State’s mission, goals, and objectives in a potential re-envisioning of the department mission. The new Strategic Plan will cover 2022-2027, and will highlight several goals important to our university and region. While currently in its draft stage, the final Strategic Plan should provide some useful language that could be incorporated into the Geology Department’s description of itself ([https://www.csus.edu/president/\\_internal/\\_documents/strategic-plan-draft-document.pdf](https://www.csus.edu/president/_internal/_documents/strategic-plan-draft-document.pdf)).

The self-study describes the degree programs (four BS and BA programs and one MS program) and presents the information about the student enrollments in both majors and GE courses. While the charts are useful, without the table-format statistics it is not clear to us that how many students are enrolled in each year per degree program. We would like to see a more complete analysis and course list of their BA and BS programs, similar to what they present in the GE section. This would include list of courses and numbers of students. Also, the diversity of faculty is not discussed in the self-study.

Another point to be mentioned is the lack of discussion about part-time faculty members. The self-study made very little mention of part-time instructors as part of the faculty. They do not mention their part-time faculty until page 16-17, and that is when they describe that part-time faculty teach some of their

courses, and that there is variability among who teach those courses. It is not clear how many part-time lecturers teach courses for the department, or whether they are included in department meetings, votes on policies, etc. The external review committee apparently did not meet with part-time lecturers during their visit, as the agenda clearly states that one session was with “Tenured and Tenure-track Faculty” only. We would recommend that the department make a concerted effort to include part-time lecturers in the department’s self-study and self-reflection process, as well as within the larger functioning of the department. With large GE sections of courses, part-time faculty would seem to be an important part of Geology’s presence within the university.

#### Learning:

The self-study presents the PLOs of BS Geology, BA Geology, BA Earth Science, and MS Geology. We find that the PLOs from bachelor’s programs are very similar, although these are three different degree programs with different purposes (which is discussed in the self-study page 2 to 3). Also, the PLOs are quite generic with no sub-level LOs, and they do not use the action verbs for the measurable outcomes. The self-study acknowledges this issue of PLOs and states that the department will revise the PLOs in Spring 2022 semester. We recommend that the department revises the PLOs into more specific and measurable for assessment, concurring with the external review.

The self-study presents the students’ assessment data for the past five years, using the field report, Student Knowledge Inventory data, and written assignments in several major courses. The self-study reports that many students meet or exceed the performance standards of 70% or higher. To improve the area with lower performances (such as igneous rocks and geologic time scale among seniors), the department has created a new required course. We found this as a self-reflection by the Geology Department based on the assessment data. It is also noted, however, that the assessment strategies are quite generic, not specific by the degree programs, partly due to the very similar PLOs discussed above.

#### Student Success:

The self-study presents the student success data by enrollment, retention, and 4-year and 6-year graduation rates. The self-study analyzes the enrollment data, and points out that the Geology Department has smaller and declining number of enrollment, more male students compared to NSM average, and limited diversity of student body. Retention and graduation data are also analyzed by charts, but the small number of student cohorts yields very fluctuating trends, which makes it difficult to interpret. While the trends of retention and graduation are largely at or above the NSM average, it is noted that the first-year graduation rate has been zero since 2014 (Figure 6B in page 11).

The self-study describes that their degrees prepare students to take a board certification “Geologist in Training” exam after graduation. This is a positive success outcome for students, and we would like to see the data on how many of their alumni do go on to take that exam as well as the pass rate on the exam for their alumni regarding student success outcomes.

#### Developing Resources to Ensure Sustainability:

The self-study does not include the section regarding developing resources to ensure sustainability. However, the External Review contains the discussion about developing resources to ensure sustainability with the faculty members during the site visit.

#### Planning to Maintain Success and Engage in Continuous Improvement:

The self-study discusses three study questions for planning to maintain success and engage in continuous improvement, including:

*1) How can we recruit a more diverse student body?* The self-study acknowledges the diversity and recruiting students into the department, and contemplates several factors such as perception of Geology,

job prospects of Geology major, cultural barriers/misconceptions among minority students, and economic barriers such as fieldwork cost. The self-study proposes that the department will engage in several strategies, such as more contents in GE courses, outreach to community (college and local firms), fundraising for more scholarship, to name a few.

2) *How can we more effectively “close the loop” on assessment?* The self-study acknowledges that the past assessment process is rather bureaucratic, and the assessment results were not actually used by the department. To address this problem and “close the loop,” the self-study proposes to create the new assessment schedule by the department. Additional strategies include the revisions of the core courses to incorporate the assessment results and more involvement of entire faculty in the assessment process including part-time faculty.

3) *How effective is the Geology Master’s program?* The self-study indicates that MS Geology is rather new program (restarted in 2015), with only evening classes currently offered. Small number of faculty members have taught the majority of MS Geology courses. Students are largely male with limited minority students, and some thesis students have taken long time (over 10 semesters) to graduate the program. The self-study presents six recommended strategies that should all be beneficial for the MS Geology program.

## **II. External Review**

The external reviewers were Dr. Mara Brady, Associate Professor and Chair, CSU Fresno, and Dr. Todd Greene, Professor and Chair, CSU Chico. It would seem that they were appropriate choices. They undertook their virtual visit on April 7 and 8, 2022 and submitted the report in May 20, 2022. They met separately with departmental Chair Amy Wagner, departmental Graduate Committee and Chair, tenured/tenure track faculty, part-time faculty (invited), staff, College of NSM Dean Lisa Hammersley, and undergraduate and graduate students in Geology Department. The visit agenda seems to be appropriate, and it is noteworthy that the External Reviewers have a specific session for “Recruiting and DEI in the Geosciences” with at least two faculty members. However, the virtual visit does not have the meeting with the alumni, nor the campus or community partners, such as the agencies within the region. The report responds to most but not all of the questions set forth in the five-element template for the External Review Report in the *Academic Program Review Guide*. We point out that while the external reviewers indicated the mission statement is “Emerging,” we think the department’s mission statement is fine. As noted in page 1, however, we believe that the department’s mission statement is very generic and recommend re-envisioning of the department mission consistent with the Sac State’s mission, goals, and objectives. In addition to the template, the External Review Report presents their assessments and recommendations based on three focus study questions from the self-report. While the self-study does not clearly distinguish the bachelor’s programs in student learning and success analysis, the External Review Report offers the recommendations for each degree program which is consistent with our program review process being degree-specific. The report also offers thoughtful comments and recommendations on the Geology Department. The report commends the Geology Department regarding faculty collegiality, dedication to student learning, active research and external funding, and strong ties to local agencies and pathways to professional geologist certification. The report recommends revising the PLOs in all programs, redefining the assessment tools, considering the unique values of each degree program, articulating post-graduation opportunities for this major, and exploring and investigating the University and College support. The report also points out the limited infrastructure, such as facilities and labs, and the faculty workload issue.

### III. Recommendations

- **To Maintain Success**

The self-study was clearly reflective in the areas of student success. The self-study laid out a number of carefully thought-out plans to improve in multiple areas, backed by many types of data on their student success. In particular, active use of assessment data for formative changes will be helpful, as outlined in the self-study.

- **To Improve Student Learning (consider university/college goals on learning, research/scholarship, diversity)**

**Self-study Question #2: Closing the Loop.** The self-study includes a table of Program Learning Outcomes (PLOs) for the BS in Geology, BA in Geology, BA in Earth Science, and MS in Geology. The department has done a good job reflecting on these PLOs, as they very quickly layout three ways that they can improve the PLOs. The department planned to meet in spring 2022 to make adjustments needed based on the self-study. The external reviewers provided a thorough and useful discussion of how the department could improve its PLOs in their section on “Closing the Loop” (pp. 6-7). We concur with their recommendations to re-examine the PLOs, distinguish clearly by degree, and consider and layout more concretely how the assessment plan will specifically measure the PLOs. In particular, we strongly support the Department’s plans to make the PLOs degree-specific. As the external reviewers explain, this will help to ensure that “students are aware of the unique aspects of each degree pathway.” The self-study indicates also that the department plans to “Make sure our assessments are explicitly aligned with our PLOs.” This is also consistent with the external reviewer recommendations.

The self-study identified the challenge of ensuring that all faculty, especially part-time instructors, are incorporating the assessment strategies into their courses. The external reviewers attributed this to an apparent feeling on the part of faculty that assessment is a bureaucratic requirement, not useful to the actual teaching of courses. The department has a good plan for dealing with this issue: incorporate assessment strategies into the course syllabi, as learning objectives, with standard assignments and rubrics that would be used by all instructors teaching the same course. Some departments utilize a “signature assignment,” with the expectation that each instructor may be asked to produce samples of the signature assignment from each course. This would ensure consistency across courses and may go a long way toward encouraging faculty to see assessment as a regular part of a course, not as a bureaucratic add-on at a later date.

The self-study acknowledges the Department’s difficulties in sharing assessment data and changes in assessment strategies with all of the faculty, including part-time instructors. For example, the assessment of PLO 5 in 2018 was conducted, but the results were not shared because of faculty retirement. The department has developed a good calendar and workflow shift, with a Spring-Fall cycle that will allow presentation and analysis of data during the faculty retreat at the start of the spring semester, giving faculty time to adjust courses for the next academic year.

We do have several questions. How were the PLOs determined? We see that the VALUE rubrics are used for assessment. Were the undergraduate PLOs drawn from the Baccalaureate Learning Goals for the 21<sup>st</sup> Century, or similar university-wide set of goals?

The Department offers a number of GE courses that are either required or could be taken as electives. For GEOL, 10 in particular, they describe on p. 16 that the Department has plans to potentially include GEOL 10 assessments as part of their overall “scaffolding-style approach.” How will the Department ensure that they gather and analyze the assessments of their own Geology majors, when not all first year students will



have declared a major by the time they take this course? Will the Department look back at those students' GEOL 10 assessments? The Department will need to distinguish the assessments of their own majors (who declared their major after the course), as separate from those students who eventually choose other majors.

### **Recommendations for Closing the Loop**

- Develop clearly distinguishable PLOs for each degree. The Department already has a plan to complete this project.
  - Include oral communication in the PLO for the BA in Earth Science, especially since those majors will likely go on to careers such as teachers.
  - Clearly indicate how assessments match PLOs, using a visual to express these relationships.
  - Develop an avenue for sharing assessment planning, strategies, and results, possibly even beyond the faculty retreat.
  - Include part-time lecturers in the Department's planning.
  - For the MS in Geology, develop a long-term plan to achieve the PLOs in the program. This is a newer program (2015), so efforts will need to be made to continue assessing in the future.
- **To Improve Student Success (consider university/college goals on recruitment, retention, graduation, diversity, engagement)**

**Student Success in General.** The self-study presented many forms of data on student success, and the Department has reflected carefully on potential strategies to improve student performance. For instance, they acknowledge that first year students do not graduate in four years (Figure 6B). One possible reason is the need for students to take or retake Calculus or Chemistry courses before moving into upper division Geology major courses. For transfer students, retention and graduation rate are potentially impacted by preparation at the community colleges. The Department has plans to work closely with the community colleges to try to prepare students who transfer to Sacramento State to be able to directly enter the upper division major courses.

We have several questions. Why was 70% used as the measure of achievement in many of the assessments? Is that a common measure used in the field of Geology? Is it based on conversations with the Office of Academic Program Assessment?

Is the transfer to other majors expected? Is there a pathway already in place to help support students who want to transfer to other majors?

The self-study presented an appropriate comparison group when examining retention and graduation: students in the College of NSM. When compared to NSM majors, Geology has a slightly higher retention and graduation rate. However, the self-study also acknowledges that it is difficult to draw conclusions on comparisons, due to low numbers of students in their programs (1-6 per cohort).

The Department recognizes the concerns over combining BA and BS data when looking at student success. For instance, they realized during the self-study that there was a "failure to differentiate between which program students were enrolled in during the assessment process." The Department took an important step by adding a question about program of enrollment in their assessments.

Advising is listed as a reason for good retention and graduation. However, advising appears to be inequitably distributed across faculty, both for undergraduate and graduate students. Geology faculty provide their own advising for students, therefore students do not necessarily go to the University Advising Center or any of the Student Success Centers. The self-study addressed some concerns over this

model. For example, since they have recently hired new faculty, those faculty are participating in training for faculty advisors offered by NSM. In general, the approach to types and numbers of faculty advising students needs to be expanded, especially given the relatively small number of students.

The self-study did not place Geology's programs and student success within the larger University's student success efforts. For instance, there is no discussion of how the Geology Department's efforts tie in with Sacramento State's various graduations initiatives, especially Finish in Four and Through in Two initiatives. Since Sacramento State has been receiving national attention for their improved graduation rate (<https://www.csus.edu/news/articles/2020/10/28/Sac-State-recognized-as-graduation-rates-keep-rising.shtml>), it would benefit the Department to tie their efforts with these larger initiatives.

### **Recommendations and Questions Related to Student Success.**

- Track and report the data on how many alumni take the Geologist-in-Training exam, as well as their pass rate on the exam.
- In future reports, tie the Geology Department's student success rates into the Sacramento State Finish in Four and Through in Two initiatives, along with any other campus-wide or NSM initiatives related to student success.
- For undergraduate advising – Here are some potential strategies to resolve issues discussed in self-study and described above. The Department would need to determine what strategies would work best in their context. (For graduate advising, see section below.)
  - Could provide assigned time for 1-2 faculty, so they can just focus on undergraduate advising for a portion of their workload
  - Could start tying in with peer advising initiatives – PAL, PARC
  - Could incorporate into students' advising plans the other support systems include SEE, STEM pre-teaching, or The Grace Project.

### **Q#3 – How effective is the Geology Master's program?**

The Geology Department identified the MA program as needing further examination. The timing is good, as the program was only moved back into Sacramento State in 2015, and there has been a declining enrollment. The self-study examined which institution their MA students received their BS or BA (overwhelmingly from Sacramento State), and students' race and gender (primarily White and male).

The self-study posited that students may have entered their MA program lacking science and math skills, and that this would impact their time to graduation. Presenting data on course completion and time to graduation, it turned out that missing prerequisite courses did not lead to a longer time to graduate. In examining the time to graduation further, the finding was that some thesis students take up to 10 semesters to complete their thesis, while non-thesis majors complete within 5 semesters. The Department laid out a plan with good ideas to reduce the time to graduation for students writing a thesis.

Another issue studied was the number of times a course is offered, and who teaches the courses. Due to faculty turnover and a lack of long-term planning regarding electives, there are not always tenured or tenure-track faculty available to teach graduate courses. Another faculty issue is the imbalance of which faculty are advising students. As the self-study identified, there needs to be greater incentive to take on graduate thesis advising, beyond being supported by the large NSF grant.

The external reviewers also noted that graduate students are happy with the program, but feel the level of time and work required for serving as a TA is too large and is unmanageable. The external reviewers also noted the need to improve lab equipment and experiences, and to re-consider the evening-only option for course times, to possibly offer some during the day.

### **Recommendations and Questions Related to Effectiveness of MA in Geology.**

- Possibilities for advising
  - Provide assigned time units for faculty who supervise MA theses.
  - Create a new class for MA thesis writing. The faculty member who teaches that class would then be receiving units for their work with MA student theses.
  - MA advising in particular needs to be more proactive. Develop a plan for future equitable faculty advising of graduate students.
- Regarding diversity, many of the same strategies recommended in the next section can be used for the graduate program as well.

**Self-study Question #1: Recruiting and Diversity.** The Department recognizes the need to recruit more students, as the number of students in their BS and BA degrees are dropping recently. They also express the importance and value of increasing student diversity in their programs, as their students are largely White and male. They have proposed a number of good ideas to increase both student numbers and level of diversity.

The external reviewers describe research in their section on “Cultural and Economic Barriers” (on p. 5 of their review) that suggests “increasing awareness of geoscience career opportunities and the potential altruistic factors of these careers may be an important strategy for increasing diversity in geoscience fields.” They go on to say “we recommend they consider highlighting to students the value of geoscience careers to solving important societal challenges and how geoscience careers can help students give back to their community after graduation.” Since the Geology department is trying to increase diversity, this is important background to consider.

**Recommendations.** External reviewers have put forth a number of very good recommendations for recruitment, which we have summarized here.

- Consider exploring dual-enrollment courses, where high school students take Geology courses that count for college credit and towards the geology degree programs.
- Recruit from first and second year GE courses.
- Leverage the Department’s strong connections with local agencies and professionals as a selling point for prospective students.
- Keep better records of alumni in order to showcase their success in post-graduate employment to help with recruiting efforts.
- When partnering with community colleges, utilize the network of existing lecturers who may teach at or have colleagues there
- Leverage existing outreach programs and partner with them to create awareness of the geosciences for pre-college students (some of these programs may be found here: <https://www.csus.edu/student-affairs/centers-programs/hispanic-serving-institution>)
- Highlight to students the value of geoscience careers to solving important societal challenges and how geoscience careers can help students give back to their community after graduation.

We add and expand with the following recommendations.

- To help highlight the value of geoscience careers to society and community, the Department could draw from Sacramento State’s Carnegie Community Engagement Classification in 2010 and 2020 as “An Engaged Campus.” As a nationally recognized engaged campus, “Sacramento State is committed to building a better community for today and tomorrow. Sac State is home to a culture of service where students, faculty, and staff make a difference in the world beyond the classroom” (<https://www.csus.edu/experience/anchor-university/carnegie-reclassification/engaged-campus.html>). The Department could benefit from highlighting how it

gives students the opportunity to “make a difference in the world.” Adding some language to this effect might make Sac State’s Geology programs more attractive to diverse students.

- Partner with the Sacramento State Division of Inclusive Excellence to both tie into and build on their efforts to make the campus a welcoming one for all.
  - Review and incorporate strategies from the Sacramento State Antiracism and Inclusive Campus Plan (<https://www.csus.edu/diversity-inclusion/antiracism-inclusive-campus-plan.html>).
  - The self-study describes how the NSF grant recruits students from minority serving campus centers and student success centers (e.g. MESA). We would recommend utilizing the same recruitment process with these and other educational equity programs (e.g. Full Circle Project, Women’s Resource Center, Multicultural Center, MLK Center, etc.) for recruiting undergraduate students into the Geology degrees.
  - Consider partnering with Sacramento State Admissions and Outreach to draw on their outreach strategies. The Admissions and Outreach Office is also able to prepare discipline-specific outreach materials.
  - Consider extending recruitment efforts into Sacramento area high schools that have a STEM focus, such as George Washington Carver School of Arts and Sciences, and the School of Engineering and Sciences.
- **To Build Partnerships and Resource Development to Enhance the Student Experience (consider university/college goals on university as place, university experience, community engagement)**

The external reviewers found that the Geology Department develops and uses strong partnerships in some areas but not in others. The external reviewers felt that the Geology Department has a “Highly Developed” set of partnerships and connections to local agencies and professionals to ensure student success. Students must complete a number field experiences, including a 5-week summer field mapping course, in order to qualify to take the Geologist-in-Training exam, which is one step toward licensure as a Professional Geologist. While we did not see descriptions of these field experiences being developed and implemented with external partners, it seems that must be the case in order to gain access to sites. We also did not see descriptions of student organizations or clubs, or any reference to letting students know about interesting lectures or other professional experiences they may want to attend. The self-study included a section on the large NSF grant that Dr. Vankeuren runs, and that certainly draws on strong partnerships, but that is the only partnership mentioned. That does not mean the connections don’t exist, just that it was not addressed in the self-study so we couldn’t review those fully.

**On-campus partnerships.** We saw little evidence that the Geology Department utilizes the many campus resources to support their students, other than “we advise students to use the Writing Center and Student Success Center” (p. 12). We see that the faculty conduct their own advising, and that is why they do not refer students to the Advising Center. However, we see no collaborative, supportive partnerships with campus academic, professional, or personal support programs. See our recommendations below for recommended examples.

**External, off-campus partnerships.** We concur with the external reviewers’ statement and recommendation that

a key selling point of a degree from the Geology Department at Sacramento State is the department and university’s close ties to local agencies and professionals in the capital region. We encourage the department to leverage potential university efforts and funding sources aligned with these missions to support their continued growth and increased racial/ethnic diversity of their enrolled students. (p. 4)

Additionally, Sacramento State is an “anchor university,” an effort initiated and strongly supported by President Nelsen.

...embracing the anchor mission fundamentally transforms Sacramento State’s relationship with the community: It sets the University on course to align our resources and efforts so that we cultivate and develop long-term and mutually beneficial relationships with our community partners in pioneering endeavors to address our community’s priorities.

(<https://www.csus.edu/experience/anchor-university/about-the-initiative.html>)

By developing mutually beneficial relationships with community partners, these partners will see value in providing further support for Sacramento State’s Geology programs. If this is already being done, it would be beneficial to see a description of this work.

### Recommendations

- Refer students to the various academic, professional, and personal supports at Sacramento State.
  - STEM initiatives on campus, such as the STEM Scholars Lecture Series, STEM VISTA volunteering program, or the HSI STEM Zone;
  - Centers for Diversity and Inclusion or other student identity spaces;
  - Library’s collection of Geology & Earth Sciences materials (<https://csus.libguides.com/c.php?g=768135&p=5510892>);
  - NSM centers or initiatives such as PAL, SEE, STEM pre-teaching, or The Grace Project.
- The “large number” of government and environmental jobs available in the Sacramento Area for BS/BA graduates needs to be explored for local connections.
- Geotechnical firms and government agencies are potentially strong connections, especially for the MS programs.
  
- **To Improve Strategic and Budget Planning and Operational Effectiveness and to Ensure Sustainability (consider university/college goals on innovative teaching, scholarship, research, university as place, university experience)**

The external reviewers gave the department a “Developed” rating for the question “Does the department engage key constituencies and campus partners in academic and strategic planning, including faculty, professional colleagues, current and prospective students, and the community?” Unfortunately, we were unable to learn about this well-developed area, as the self-study did not include sections on building partnerships and resource development to enhance the student experience.

On the other hand, external reviewers indicated n/a on the question of “Do plans include engagement with needed campus partnership and external entities to accomplish goals?” During their campus visit, the external reviewers did not meet with community or agency partners, which may be an indication that external partners are not a significant part of the department’s planning and operations. We could not find any discussion in the self-study about how the department meets with or draws on partners (i.e. agencies) in their planning.

### Recommendations

- The University offers several opportunities for internal grants to support program development, course design, etc.
  - Anchor University grants,
  - Curriculum Redesign grants,
  - UEI grants,
  - Pedagogical Enhancement Awards.

- Further grant support should be garnered for funding opportunities for students' research, since both the self-study and the external reviewers cite economic barriers as one of the problems in diversity recruitment.
- The Geology faculty could also develop a Professional Learning Community (PLC) through CTL. These 1-2 semester-long programs allow faculty to develop their own topic, plan, and deliverables, as a way to support their work in any area.

### **Final Summary of Recommendations**

Many recommendations have been made in this review and the external review. We will highlight in this concluding section some of the most significant recommendations that should benefit the department as they work to achieve continued student success. We concur with the recommendations from the external reviewers, and have added a few more.

### **Across All Programs**

#### **Recruiting and Diversity**

- Revise Department's public presence to highlight the value of Geology careers to make a difference in solving societal issues and to help students give back to their communities after graduation.
- Partner with the Sacramento State Division of Inclusive Excellence to both tie into and build on their efforts to make the campus a welcoming one for all.
- Review and incorporate strategies from the Sacramento State Antiracism and Inclusive Campus Plan (<https://www.csus.edu/diversity-inclusion/antiracism-inclusive-campus-plan.html>).
- Partner with Admissions and Outreach to learn and build on their strategies. Continue the connections with local community colleges, and expand reach out into local high schools.
- Increase efforts to recruit from first and second year undergraduates.
- Partner with the many Educational Equity Centers on campus (see list above) to recruit both undergraduate and graduate students.
- Partner with agencies and businesses in the field of Geology to recruit graduate students.

#### **Student Success and "Closing the Loop"**

- Consider the BS and BA programs separately when analyzing for trends and needs.
- Re-examine PLOs to clearly identify the outcomes for the BS, as distinct from the BA.
- Create a clear connection and visualization of how assessments address specific PLOs.
- Consider a revised vision of advising (see above for specific ideas)
- Refer students to the various academic, professional, and personal supports throughout campus (see above for lists)

#### **Overall Department Recommendations**

- Work with campus partners, community partners, and the Office of Research, Innovation, and Economic Development (for grants) to increase funding to engage in continued improvement strategies.
- Consider creating PLCs with CTL to further reflect on and make action plans for the Department.
- Include part-time lecturers as members of the faculty who can contribute to planning.

**Program-specific Recommendations.** All student success recommendations also apply to the individual programs (i.e. PLO revision applies to each program). The additional recommendations here are from the external reviewers.

**BS in Geology**

- All recommendations listed above.
- Try to get funding or scholarships for the summer field course.

**BA in Geology**

- All recommendations listed above.
- Be able to articulate what this degree offers that is unique, and what the program's graduates can expect to do in their careers.

**BA in Earth Science**

- All recommendations listed above.
- Add a PLO on oral communication, since these students will likely enter fields such as teaching.
- Be able to articulate what this degree offers that is unique, and what the program's graduates can expect to do in their careers.
- Be aware of any changes in CA teacher credentialing that might cause a needed change in this program.

**MA in Geology**

- Seek university or college incentives and support for faculty to serve as thesis advisors.
- Consider reducing grad student TA's time and workload.
- Prioritize upgrades in equipment.
- Consider offering more graduate courses during the day.

Action Plan

Program: BA Earth Science

College: NSM

Date: 9/29/2022

Program Review Finding	2 YR	4 YR	6 YR
<b>To Maintain Success</b>			
<p>Faculty are collegial and work well together. Faculty are dedicated to student learning and creating an inclusive environment and this is highly recognized and appreciated by the students. A strong department community is tied to student success.</p>	<p>Continue creating opportunities for faculty and students to come together formally and informally.</p> <p>Involve temporary faculty in department discussions and events.</p>	<p>Increase the involvement of Alumni in a formal capacity to better prepare our students for the workforce and in an informal capacity to increase networking opportunities for current students. Ensure this programming meets the needs of BA Earth Science students as well as other students in the department.</p>	<p>Evaluate sense of belonging among faculty (including temporary faculty) and students, paying particular attention to how BA Earth Science students feel, and adjust efforts if necessary.</p>
<p>The department has a plan to engage in assessment more meaningfully and we encourage the university to provide support in doing so, especially given the logistical/timing challenges raised in their self study.</p>	<p>Shift assessment cycle to proposed cycle in self-study; Collect data in spring and fall and write report during spring; discuss results and plan of action at fall faculty retreat.</p> <p>Include temporary faculty in assessment process.</p>	<p>Continue cycle of collecting assessment data during spring/fall and write report in spring; discuss department results and reassess plan of action during spring semester with all instructors; verify plan at fall retreat.</p>	<p>Evaluate impact of improved assessment process through program review.</p>



**To Improve Student Learning**


<p>We recommend the Geology Department review the goals and outcomes of each degree program so they are clearly distinguished in terms of assessment and so that students are aware of the unique aspects of each degree pathway.</p>	<p>Clearly articulate the program goals for the BA in Earth Science that reflect the anticipated career pathways for graduates of the program.</p>		
<p>Develop clearly distinguishable PLOs for the BA in Earth Science.</p>	<p>Apply for NAGT workshop for building strong Geoscience departments to develop/refine new degree-specific PLOs for the BA in Earth Science.</p>	<p>Survey graduates and employers to assess whether PLOs are meeting student needs upon leaving the program.</p>	

**To Improve Student Success**

<p>Consider a revised vision of advising.</p>	<p>Develop a consistent department advising strategy.</p> <p>If BA Earth Science enrollment remains low, consider one faculty advisor for all students. Train department faculty on their role as an advisor.</p> <p>BA Earth Science advisors should be in contact with the College of Education to be current in teaching pathways.</p> <p>Continue with mandatory advising every semester.</p>	<p>Migrate department advising to the EAB platform to maintain better records and build a standard for advising.</p> <p>Use EAB to track student migration into/out of the BA Earth Science program to better understand the student demand for the program.</p>	<p>Evaluate the effectiveness of department advising and adjust as needed.</p>
<p>Develop strategies to recruit and retain students, including those from traditionally underrepresented groups, into the BA Earth Science program.</p>	<p>Work with community college partners to promote Earth Science career paths and recommended lower division transfer courses.</p> <p>Create materials that highlight the career pathways for graduates of the BA Earth Science Program.</p>	<p>Track changes in BA Earth Science population size and demographics.</p> <p>Track graduation rates and career paths.</p>	<p>Evaluate the necessity for a BA in Earth Science. Consider elimination or what major structural changes may be necessary.</p>

<b>To Build Partnerships and Resource Development to Enhance the Student Experience</b>			
Be aware of any changes in CA teacher credentialing that might cause a needed change in the BA Earth Science.	Develop plan for collaboration with the College of Education. Reengage with on campus teacher education resources such as The Center for Math and Science Education.	Bring in local teachers for a career panel for our BA Earth Science students as an addition to the department's seminar series.	Evaluate the strength of our partnerships and identify areas for improvement.
<b>To Improve Strategic &amp; Budget and Operational Effectiveness and to Ensure Sustainability</b>			
Leverage grant-funded structures and programs that support student recruitment, engagement, and professional development.	Identify which internal grants are appropriate to apply to for PLO redesign; identify which faculty will be lead on these programs.	Evaluate if the BA Earth Science degree is the most operationally efficient way to serve future teachers in the area or if we could better serve this community need through periodic workshops.	

Department Chair: Steven Skinner

Signature: 

College Dean: Lisa Hammersley

Signature: 