

**Institutional Effectiveness  
2022-2023**

**Program:** Geosciences BS

**College and Department:** College of Arts & Sciences, Department of Earth Sciences

**Contact:** Jeannette Luna

**Mission:**

The Earth Science Department strives: (1) To provide a robust undergraduate learning and research experience for geoscience students; (2) To demonstrate the importance of the geosciences to society; and (3) To promote faculty research, scholarly activity, and interdisciplinary collaboration.

**Attach Curriculum Map (Educational Programs Only):** \*See Appendix 1.

**PG 1: NUMBER OF MAJORS AND GRADUATES**

**Define Outcome:**

PG 1: The number of geoscience majors and graduates will be reviewed annually to ensure that program enrollment is sustainable with an average of more than 40 majors and 10 graduates per year.

**Assessment Methods:**

The Department tracks the number of geoscience majors and graduates each semester.

**Criteria for Success (Thresholds for Assessment Methods):**

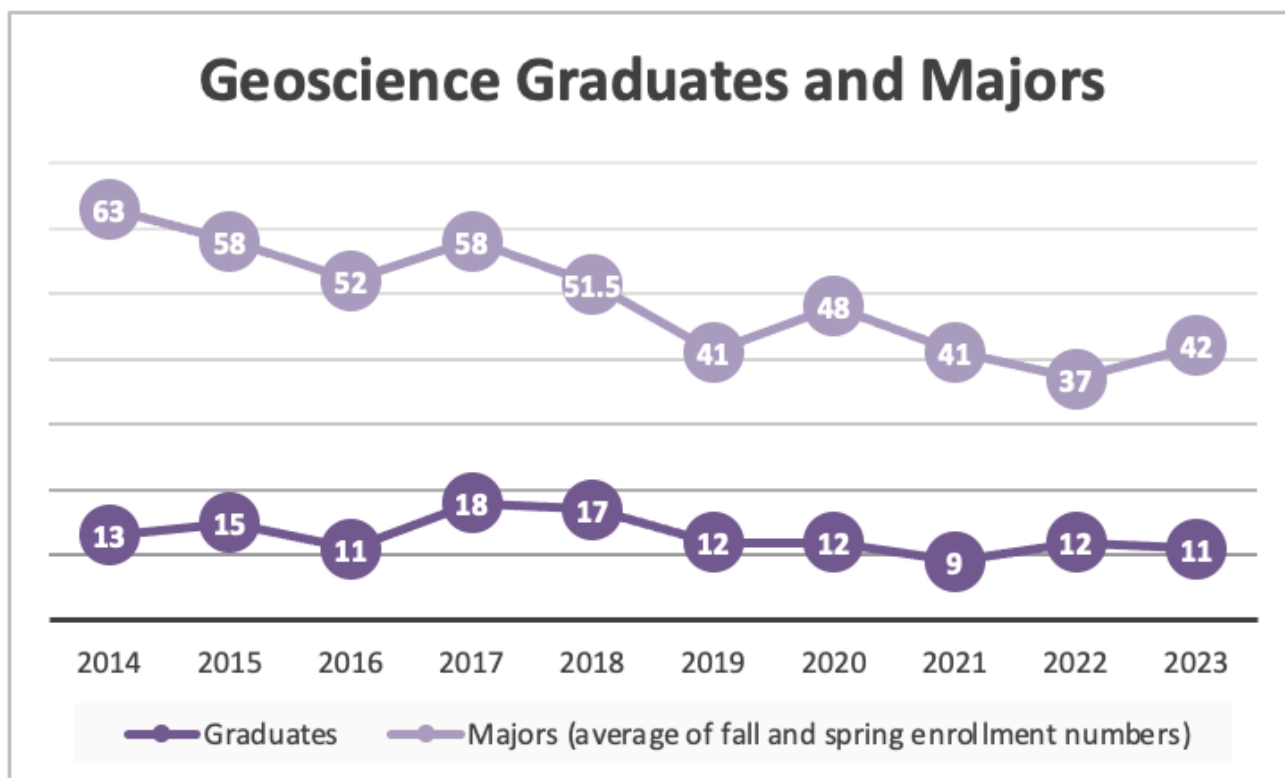
*Majors:* The number of geoscience majors will average more than 40 majors per year for the preceding 5 year period.

*Graduates:* The number of geoscience graduates will average more than 10 graduates per year for the preceding 5 year period.

**Results and Analysis:**

*Majors:* The number of majors in the Fall 2022 semester was 41; it increased to 42 in spring 2023. The average number of majors over the preceding 5 year period is 41.8, above the targeted threshold of 40 majors.

*Graduates:* The number of geoscience graduates during the 2022-2023 academic year was 11. As of summer 2023, the average number of geoscience graduates over the preceding 5 year period is 11.2, above the targeted threshold of 10 graduates.



### Use of Results to Improve Outcomes:

Enrollment declines in 2019-2022 are likely linked to declining undergraduate enrollment at Tennessee Tech and challenges posed by the Covid-19 global pandemic. To meet these challenges, the department continues aggressive recruitment and retention of geoscience majors. Some general education courses are now cross-listed to offer online and in-person options (GEOL 1040, GEOL 1045, GEOG 1120, GEOG 1130). Each class includes at least one lecture showcasing geoscience careers and highlighting the curriculum pathways for geology, environmental geology, GIS and geography. The Department anticipates that these actions will help recruit geoscience majors and thus, increase the number of graduates.

### SLO 1: SUFFICIENT GEOSCIENCE KNOWLEDGE

#### Define Outcome:

SLO 1: Graduates will demonstrate sufficient geoscience knowledge that allows them to either pursue a graduate degree or enter the geoscience workforce.

#### Assessment Methods:

Exit exams are used to assess a student's understanding and retention of fundamental knowledge and help us identify content gaps in our curricula.

1. *The Department Exit Exam for all Majors* is administered to geoscience graduates in all concentrations.

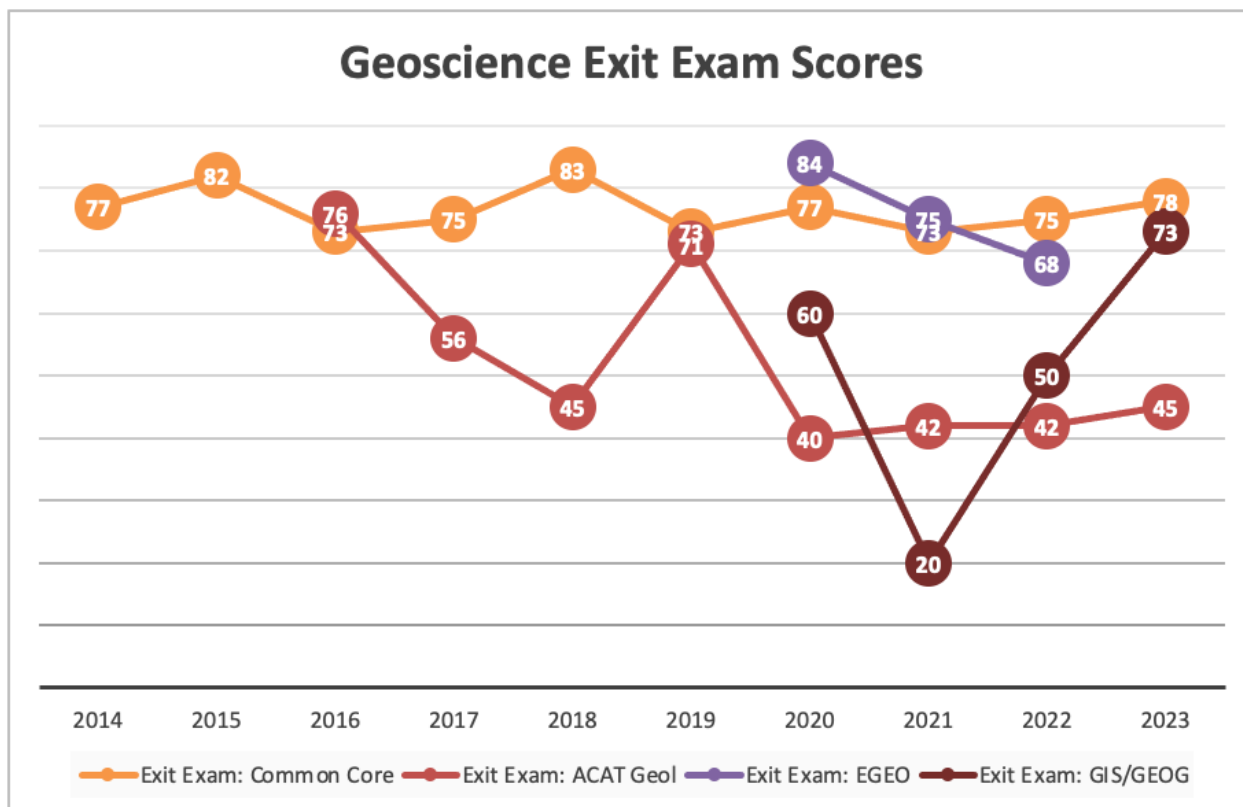
2. *The National ACAT Exam* is administered to geology concentration students.
3. *An Environmental Geology Concentration Exam* is administered to environmental geology concentration students.
4. *A GIS/Geography Concentration Exam* is administered to GIS and geography concentration students.

**Criteria for Success (Thresholds for Assessment Methods):**

- *Department Exit Exam*: 90% of graduates will meet or exceed expectations (>70%) on the departmental exams. The departmental exams evaluate core knowledge for all students and concentration knowledge.
- *ACAT Exam*: GEOL concentration graduates should score above the 50th percentile on the national ACAT Geology exam. The ACAT measures multiple areas of geology knowledge including: Geomorphology, Stratigraphy, Physical Geology, and Structural Geology.
- *Environmental Geology and GIS/Geography Exams*: The EGEO and GIS/GEOG exams have less than 5 years of data. A threshold will be set once additional data is collected.

**Results and Analysis:**

- *Department Exit Exam*: All graduating seniors took the department exit exam in academic year 2022-2023. The exam average increased slightly from the previous academic year, from 75% to 78%. This is above the targeted threshold of 70%.
- *ACAT Exam*: For the 2022-2023 academic year, GEOL concentration majors (N=8) scored in the 45th percentile on the national ACAT Geology exam, an increase from the previous year. This is our eighth year of data for this exam. This is below the targeted threshold of 50%.
- *Environmental Geology and GIS/Geography Exams*: For the 2022-2023 academic year, there were no EGEO graduates. The GIS/GEOG mean exit exam score was 75% (N=2), an increase from an average of 50% (N=1). This is our fourth year of data for the EGEO and GIS/GEOG exams.



#### Use of Results to Improve Outcomes:

A decrease in department exit exam scores from 2019-2022 may be due to additional demands on students during the Covid-19 pandemic. We now have seven years of data for GEOL majors taking the ACAT exam and four years of data for EGEO/GIS/GEOG majors taking exams in their respective concentrations. We continue to collect these scores to analyze content mastery from year-to-year. The ACAT exam also allows us to compare our GEOL majors to national averages and determine content gaps in our curricula. We have added two new courses (Mineralogy and Economic Geology) to improve student understanding of these fundamental fields, and we expect an increase in ACAT scores to meet our targeted threshold in the coming years.

### SLO 2: PROFICIENCY IN COMMUNICATION AND CRITICAL THINKING

#### Define Outcome:

SLO 2: Graduates will demonstrate proficiency in communication and critical thinking.

#### Assessment Methods:

1. The California Critical Thinking Skills Test (CCTST) is used to evaluate critical thinking. The test is administered to all graduating students at TTU.
2. Graduates are also required to complete a thesis project: Senior Thesis 1 and 2 (GEOL 4930 and 4931). The course grade issued by the advisor reflects a student's critical

thinking and communication ability, as well as their thoroughness, initiative, and effort. To better assess only the critical thinking and communication components, faculty use the grading rubric below.

### **Communication Skills**

- 90-100 - Graduate School level of communication proficiency, strong technical writing skills, strong oral communication skills.
- 80-89 - Above-average ability, technical writing required editing, oral communication needed some improvement.
- 70-79 - Average ability, technical writing required significant editing, oral communication skills needed improvement.
- 60-69 - Below average ability, weak technical writing skills, weak oral communication skills.
- < 60 - Little to no ability, very weak technical writing skills, very weak oral communication skills.

### **Critical Thinking Skills**

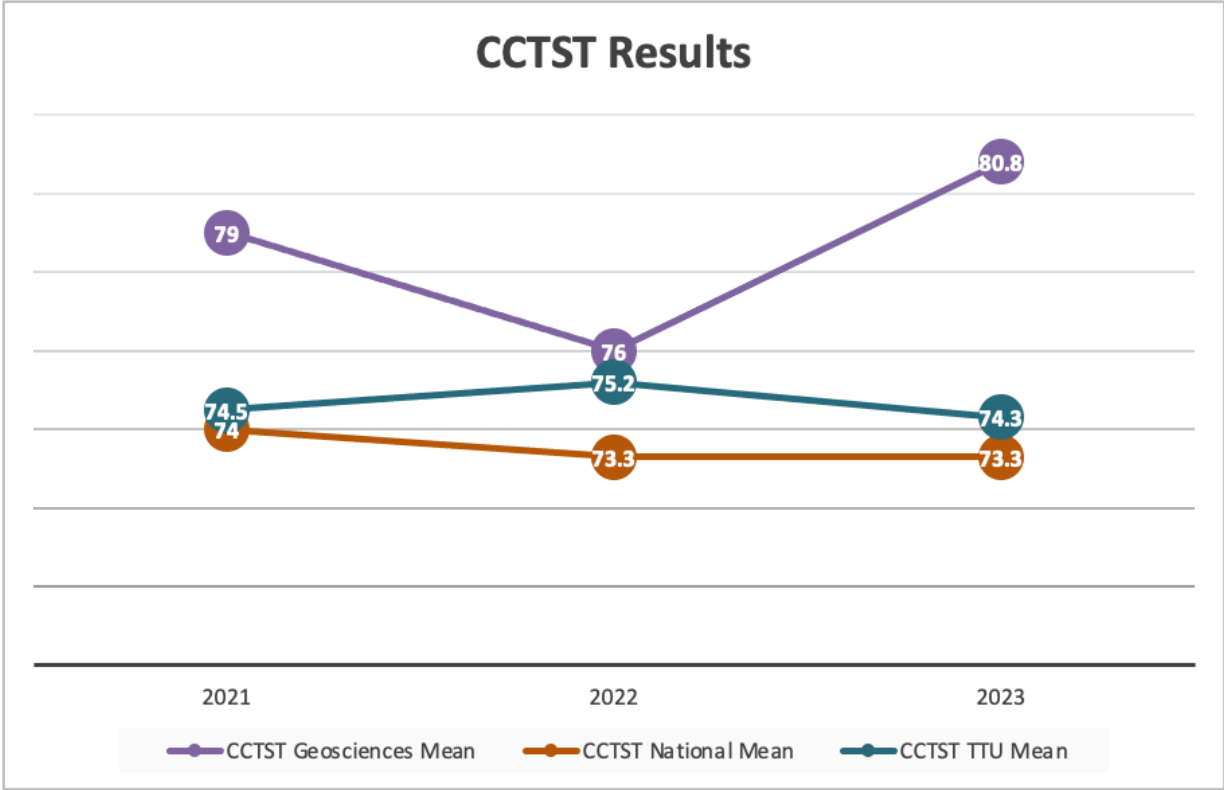
- 90-100 - Student exhibited creativity and independent motivation to complete research.
- 80-89 - Student needed some guidance with research but generally worked independently.
- 70-79 - Average research abilities.
- 60-69 - Student required significant guidance throughout the entire research project.
- < 60 - Abilities below that of a D.

### **Criteria for Success (Thresholds for Assessment Methods):**

- *CCTST Results:* Geoscience graduates should score above the TTU mean for the current academic year.
- *Communication Skills:* Geoscience graduates should score above 70% for the current academic year.
- *Critical Thinking Skills:* Geoscience graduates should score above 70% for the current academic year.

### **Results and Analysis:**

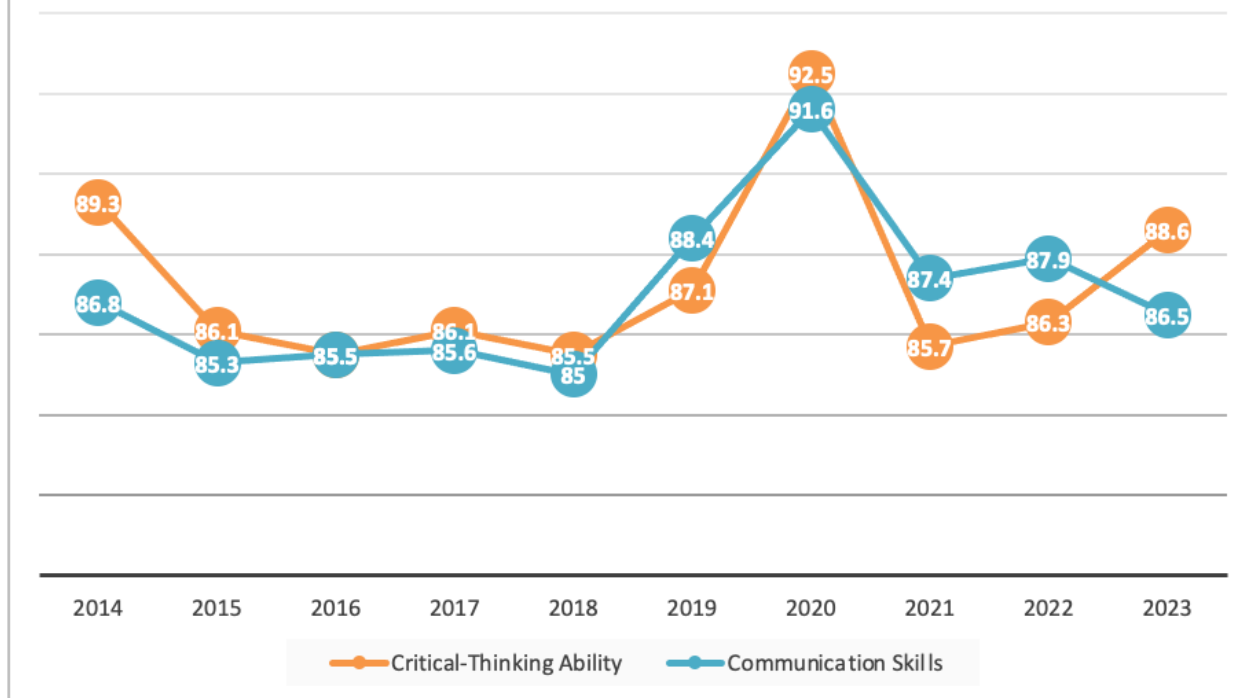
*CCTST Results:* For the 2022-2023 academic year, geoscience graduates (N=11) scored an average of 80.8% on the CCTST. This is higher than the national mean score of 73.3% and exceeds the threshold TTU mean score of 74.3%. Note that the scoring system was changed to a 100-point system in 2021 so only three years of data are shown below.



*Communication Skills:* For the 2022-2023 academic year, geoscience graduates achieved a mean communication score of 86.5%, higher than the threshold of 70%.

*Critical Thinking Skills:* For the 2022-2023 academic year, geoscience graduates achieved a mean critical thinking score of 88.6%, higher than the threshold of 70%.

## Communication and Critical Thinking



### Use of Results to Improve Outcomes:

Faculty adopted the following grading rubric to assess critical thinking and communication skills developed during Senior Thesis 1 and 2 (GEOL 4930 and GEOL 4931). This is now incorporated into the assessment of this outcome.

Score	Communication Skills (Written and Oral)
(90-100)	Graduate-school level of communication proficiency, strong technical writing skills, strong oral communication skills.
(80-89)	Above-average ability, technical writing required editing, oral communication needed some improvement.
(70-79)	Average ability, technical writing required significant editing, oral communication skills needed improvement.
(60-69)	Below average ability, weak technical writing skills, weak oral communication skills.
(<60)	Little to no ability, very weak technical writing skills, very weak oral communication skills.

Score	Critical Thinking Skills
(90-100)	Student exhibited creativity and independent motivation to complete research.
(80-89)	Student needed some guidance with research but generally worked independently.
(70-79)	Average research abilities.
(60-69)	Student required significant guidance throughout the entire research project.
(<60)	Abilities below that of a D.

### SLO 3: UNDERGRADUATE RESEARCH

**Define Outcome:**

SLO 3: Graduates will demonstrate the ability to independently develop, conduct, and complete a novel research project.

**Assessment Methods:**

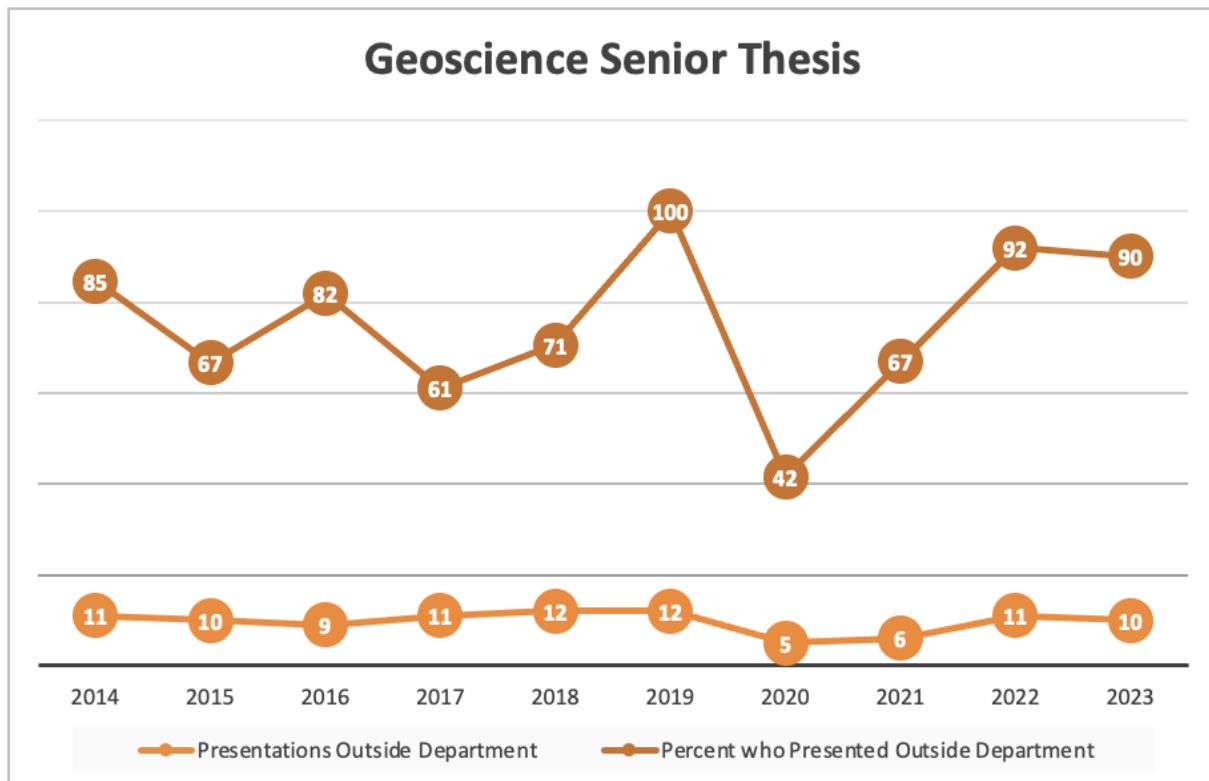
*Senior Thesis:* The Department tracks the number of students presenting thesis research outside the department.

**Criteria for Success (Thresholds for Assessment Methods):**

*Senior Thesis:* The percentage of geoscience graduates presenting research outside the department should be >70%.

**Results and Analysis:**

*Senior Thesis:* For academic year 2022-2023, 10 out of 11 graduates presented their research outside the department. This is above the threshold of 70%. Graduates presented research at TTU Student Research Day, the TTU Physics Undergraduate Colloquium, the Tennessee GIS Conference, and the Tennessee Academy of Sciences Conference.





**Use of Results to Improve Outcomes:**

Faculty continue to encourage all graduating students to present senior thesis research outside of the department. A decrease in external presentations from 2019 to 2021 is due to Covid-19 impacts such as cancelled conferences and limited travel opportunities. However, the number of presentations rebounded in 2022 and 93% of students presented research outside of the department. This is comparable to pre-pandemic levels and is expected to continue. Faculty and students are encouraged to participate in virtual research conferences as well as traditional in-person venues.

**Summative Evaluation:**

PG 1: The department continues aggressive recruitment and retention of geoscience majors. Some general education courses are now cross-listed to offer online and in-person options (GEOL 1040, GEOL 1045, GEOG 1120, GEOG 1130). Each class includes at least one lecture showcasing geoscience careers and highlighting the curriculum pathways for geology, environmental geology, GIS and geography. The Department anticipates that these actions will help recruit geoscience majors and thus, increase the number of graduates.

SLO 1: We added two new courses (Mineralogy and Economic Geology) to improve student understanding of these fundamental fields, and we expect an increase in ACAT scores to meet our targeted threshold in the coming years.

SLO 2: We adopted a grading rubric to assess critical thinking and communication skills developed during Senior Thesis 1 and 2 (GEOL 4930 and GEOL 4931). This is now incorporated into the assessment of this outcome.

SLO 3: Faculty continue to encourage all graduating students to present senior thesis research outside of the department. We encourage participation in both virtual research conferences as well as traditional in-person venues.

**Assessment Plan Changes:**

We do not anticipate changing geoscience assessments for the next assessment cycle.

## Appendix 1: Curriculum Map, Geosciences BS

**Curriculum Map.** Alignment of required geoscience courses with student-learning outcomes. Core courses common to all concentrations are shaded in blue. Geology concentration courses (4/5 required) are shaded in red; GIS concentration in green; environmental geology in purple; and geography in orange. The courses at the bottom of the table (unshaded blocks) are regularly offered directive elective courses.

Course	Title	SLO 1: Communication and critical thinking	SLO 2: Geoscience knowledge	SLO 3: Undergraduate research
GEOL 1020	Field Experiences (freshmen only)		x	
GEOL 1040	Physical Geology		x	
GEOL 1045	Earth Environment, Resources and Society		x	
GEOL 2500	Geologic Fundamentals		x	
GEOG 4510	Theory of GIS I		x	
GEOL 4930	Senior Thesis I	x	x	x
GEOL 4931	Senior Thesis II	x	x	x
GEOL 2000	Earth Evolution and Life History		x	
GEOL 3110	Principles of Mineralogy and Petrology		x	
GEOL 3230	Structural Geology and Tectonics	x	x	
GEOL 3830	Field Geology	x	x	x
GEOL 4110	Sedimentation and Stratigraphy	x	x	
GEOG 4210	Cartography		x	
GEOG 4650	Environmental Applications of GIS		x	x
GEOG 4850	Advanced GIS		x	
GEOL 4410	Remote Sensing	x	x	x

Appendix 1: Curriculum Map, Geosciences BS, cont.

GEOL 3200	Water Resources	x	x	
GEOL 4150	Geomorphology	x	x	
GEOL 4200	Geological Exploration Techniques	x	x	
GEOL 4410	Remote Sensing	x	x	x
GEOL 4711	Hydrogeology	x	x	
GEOL 4650	Environmental Applications of GIS		x	x
GEOG 1012	Cultural Geography	x	x	
GEOG 1130	Geography of Natural Hazards		x	
GEOG 2100	Meteorology		x	
GEOG 3200	Water Resources	x	x	
GEOG 4210	Cartography		x	
GEOG 4650	Environmental Applications of GIS		x	x
GEOG 1100	Global Climate Change	x	x	
GEOG 4511	Theory of GIS II		x	x
GEOL 3310	Planetary Geoscience	x	x	x
GEOL 3350*	Paleobiology	x	x	x
GEOL 3410*	Paleontology		x	
GEOL 3550	Paleoclimates	x	x	
GEOL 3750	Stable Isotope Geochemistry	x	x	
GEOL 4300	Environmental Aqueous Geochemistry	x	x	
GEOL 4810	Special Problems: Techniques in X-ray Diffraction	x	x	
GEOL 4820	Special Problems: Geobiology Field Trip	x	x	

\*offered until the spring 2017 semester.

Appendix 1: Curriculum Map, Geosciences BS, cont.

GEOL 3200	Water Resources	x	x	
GEOL 4150	Geomorphology	x	x	
GEOL 4200	Geological Exploration Techniques	x	x	
GEOL 4410	Remote Sensing	x	x	x
GEOL 4711	Hydrogeology	x	x	
GEOL 4650	Environmental Applications of GIS		x	x
GEOG 1012	Cultural Geography	x	x	
GEOG 1130	Geography of Natural Hazards		x	
GEOG 2100	Meteorology		x	
GEOG 3200	Water Resources	x	x	
GEOG 4210	Cartography		x	
GEOG 4650	Environmental Applications of GIS		x	x
GEOG 1100	Global Climate Change	x	x	
GEOG 4511	Theory of GIS II		x	x
GEOL 3310	Planetary Geoscience	x	x	x
GEOL 3350*	Paleobiology	x	x	x
GEOL 3410*	Paleontology		x	
GEOL 3550	Paleoclimates	x	x	
GEOL 3750	Stable Isotope Geochemistry	x	x	
GEOL 4300	Environmental Aqueous Geochemistry	x	x	
GEOL 4810	Special Problems: Techniques in X-ray Diffraction	x	x	
GEOL 4820	Special Problems: Geobiology Field Trip	x	x	

\*offered until the spring 2017 semester.