Institutional Effectiveness
2023-2024

Program: Geosciences BS
College and Department: College of Arts and 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):
Attached Files: 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.

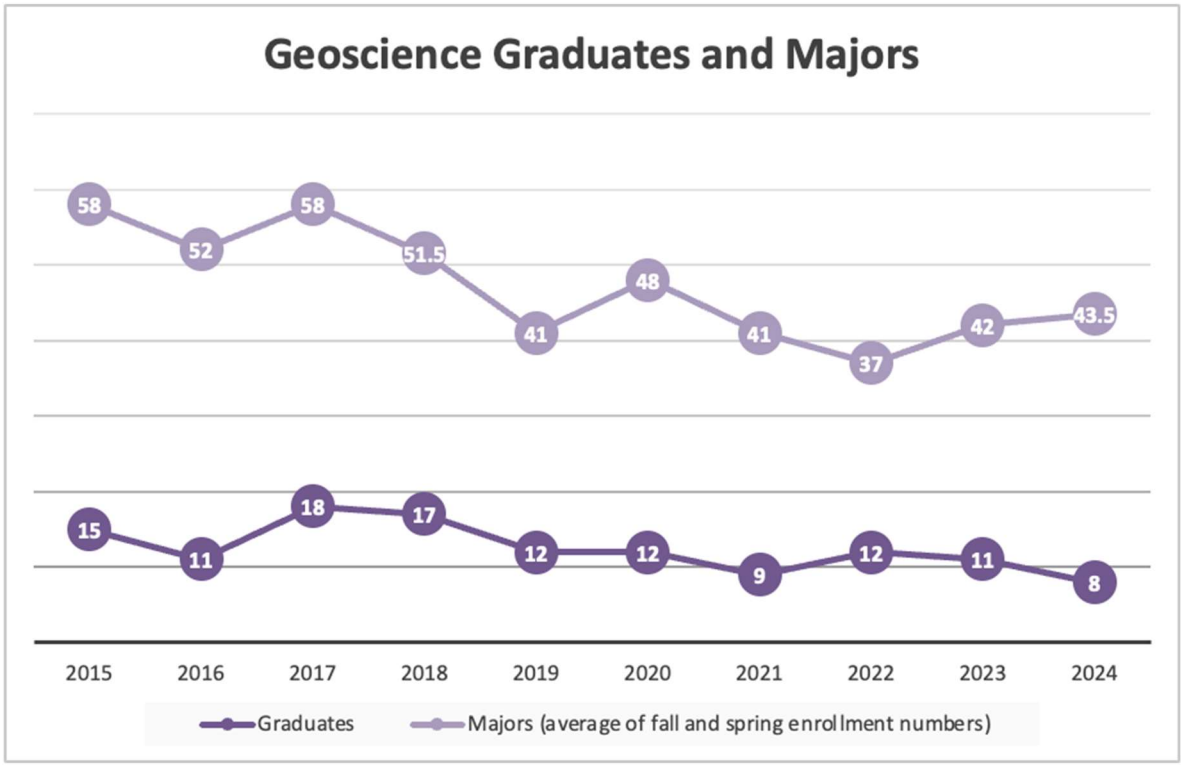
Graduates: The number of geoscience graduates will average more than 10 graduates per year for the preceding 5 year period.

Justification: The Earth Sciences faculty established these thresholds to: (1) ensure sufficient graduation rates to sustain and grow the geosciences major; (2) maintain low to moderate student-to-faculty ratios (5:1 to 30:1) in upper division courses; and (3) provide individual attention and support for undergraduate senior thesis research projects.

Link to 'Tech Tomorrow' Strategic Plan:
3.A Efficiency and Effectiveness,4.B Programs, Certificates, and Training

Results and Analysis:
Majors: The number of majors in the Fall 2023 semester was 39; it increased to 48 in spring 2024. The average number of majors over the preceding 5 year period is 43.5, above the targeted threshold of 40 majors.

Graduates: The number of geoscience graduates during the 2023-2024 academic year was 8. As of summer 2024, the average number of geoscience graduates over the preceding 5 year period is 10.4, above the targeted threshold of 10 graduates.



Use of Results to Improve Outcomes:
Concentration Name Change: In a 2023-2024 curriculum proposal, the Earth Sciences department renamed the Geographic Information Systems (GIS) major to Geospatial Data Analysis (GDA). This change better aligns with job opportunities, such as geospatial analysis positions, and is expected to increase enrollment in the GDA concentration.

New Concentration: Additionally, the Earth Sciences department proposed a new concentration in 2023-2024, effective in the fall of 2024. The Planetary Geology concentration combines courses in earth sciences and astronomy to meet the growing demand for space science careers. Enrollment in the first year of the program is expected to attract 5-10 new geoscience majors.

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 asses 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: All graduates will meet or exceed expectations (>70%) on the common departmental exit exam. The departmental exit exam evaluates core knowledge for all students in geoscience concentrations.

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.

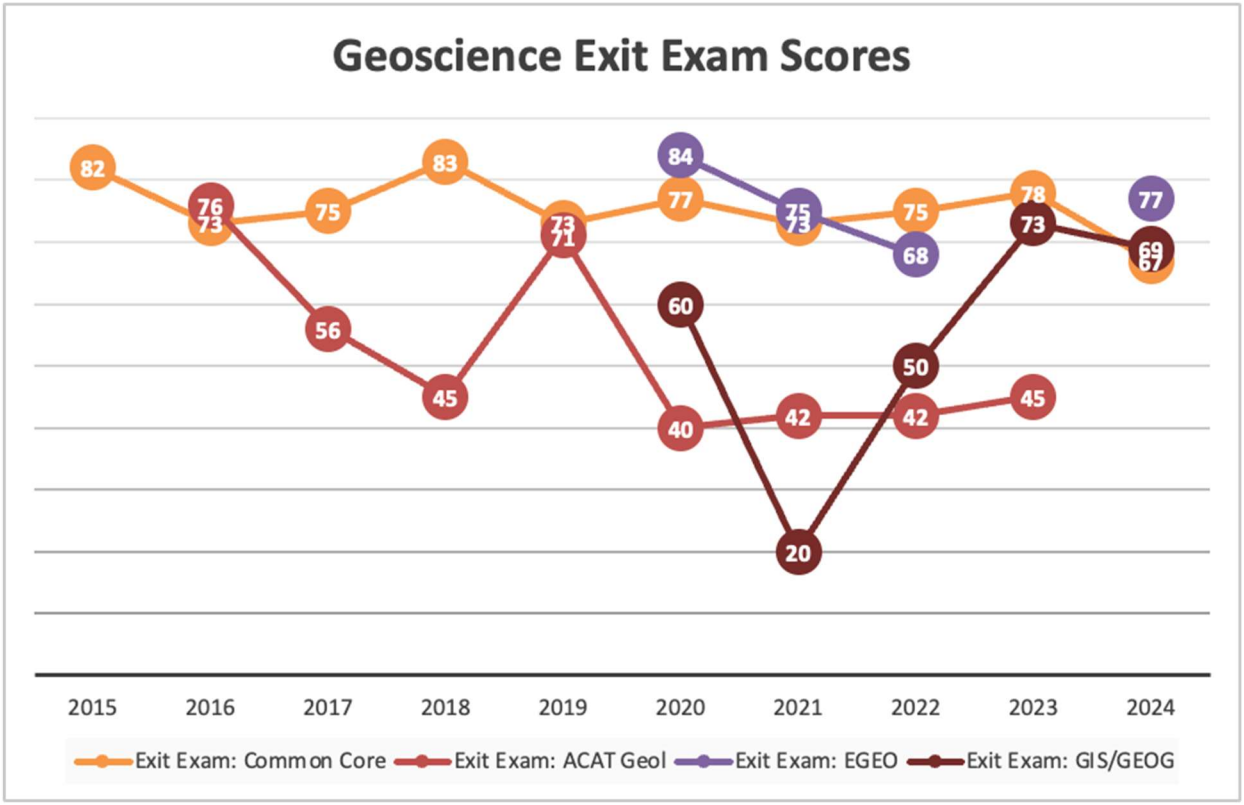
Justification: The Earth Sciences faculty established these scoring thresholds to: (1) ensure that graduates are well-versed in core areas of geology, environmental science, and geography; (2) identify and improve curriculum gaps in concentration subjects; and (3) allow flexibility as data is collected for EGEO and GDA/GEOG concentrations.

Link to 'Tech Tomorrow' Strategic Plan:
1.D High Impact Practices,4.B Programs, Certificates, and Training

Results and Analysis:
Department Exit Exam: All graduating seniors took the department exit exam in academic year 2023-2024. The exam average decreased from the previous academic year, from 78% to 67%. This is below the targeted threshold of 70%.

ACAT Exam: There were no GEOL concentration graduates in the 2023-2024 academic year.

Environmental Geology and GIS/Geography Exams: For the 2023-2024 academic year, the EGEO mean exit exam score was 77 (N=3), an increase from an average of 68% (N=2 in 2021-2022). The GIS/GEOG mean exit exam score was 69% (N=2), a decrease from an average of 75% (N=2 in 2022-2023). This is our fifth year of data for the EGEO and GIS/GEOG exams.



Use of Results to Improve Outcomes:

Improving Department Exit Exams: Administering exams for each concentration is cumbersome and may not provide sufficient information to identify curriculum gaps or areas for improvement. Faculty note that student course performance is not always reflected in exam performance, and this undercuts confidence that exit exams are a valuable assessment tool. As 2024-2025 marks the Earth Sciences department's 5-year review, this is a topic worth exploring with an external reviewer.

SLO 2: Proficiency in communication and critical thinking

Define Outcome:

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

Assessment Methods:
The California Critical Thinking Skills Test (CCTST) is used to evaluate critical thinking. The test is administered to all graduating students at TTU.

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 at or above the TTU mean for the current academic year.

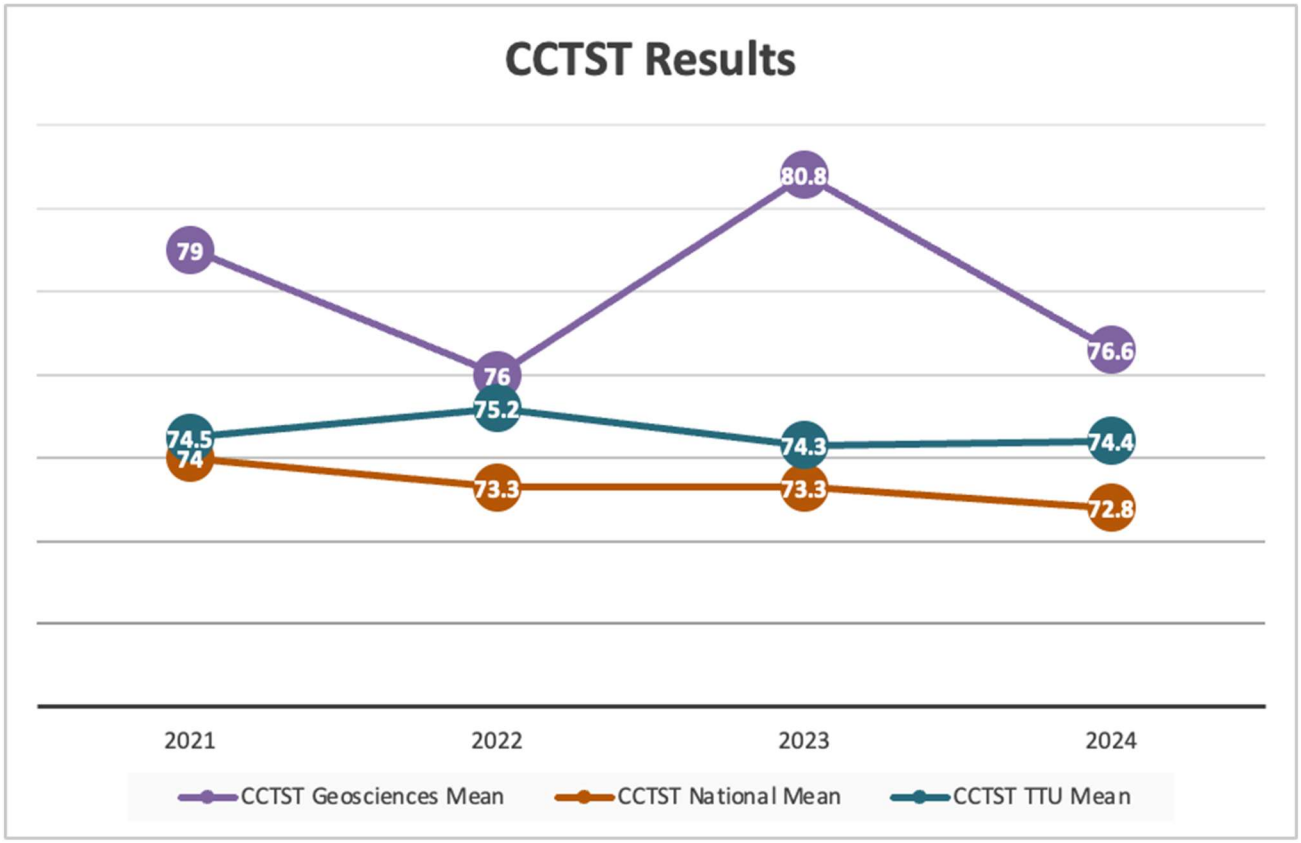
Communication Skills: Geoscience graduates should score at or above 70% for the current academic year.

Critical Thinking Skills: Geoscience graduates should score at or above 70% for the current academic year.

Justification: The Earth Sciences faculty set these scoring thresholds to ensure that graduates are: (1) equipped with critical thinking skills necessary for success in geoscience careers; and (2) proficient in scientific communication, including both oral and written skills.

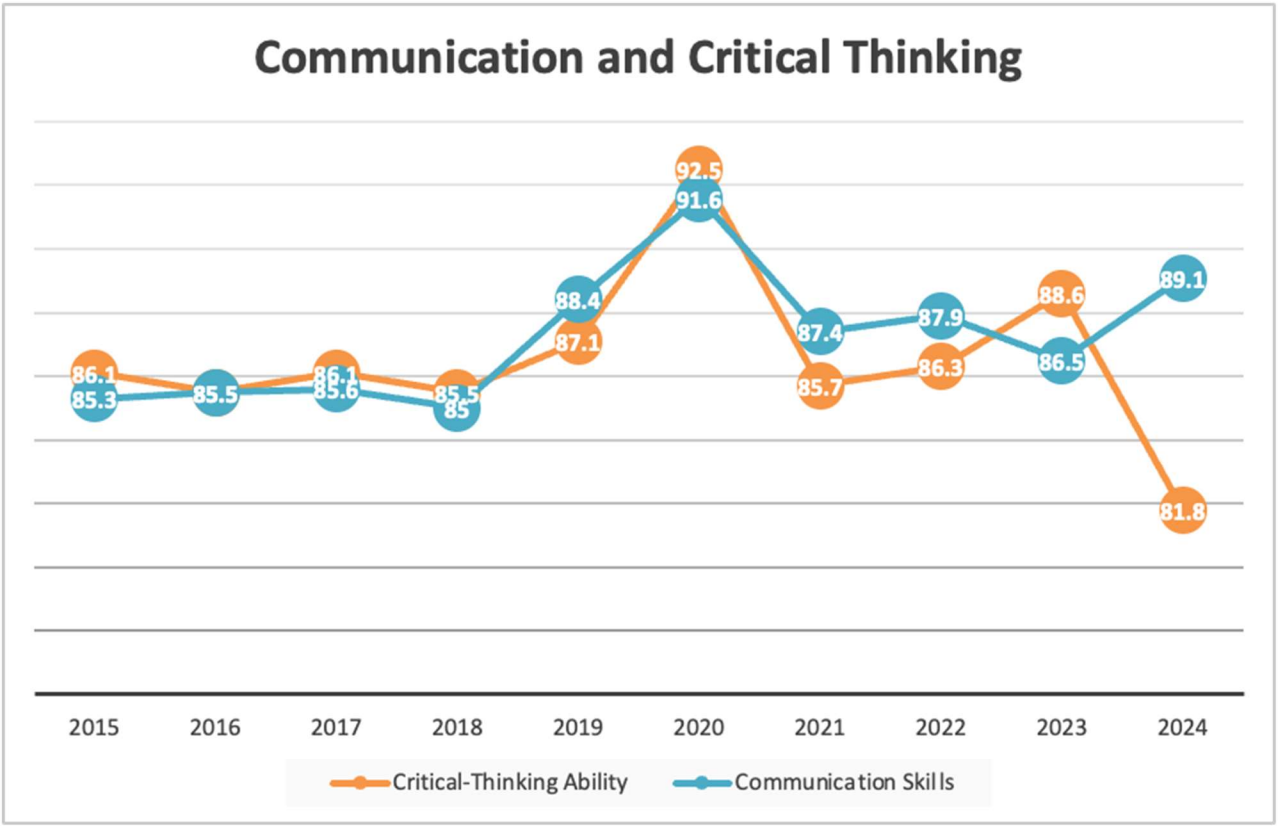
Link to 'Tech Tomorrow' Strategic Plan:
1.D High Impact Practices,2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:
CCTST Results: For the 2023-2024 academic year, geoscience graduates (N=8) scored an average of 76.6% on the CCTST. This is higher than the national mean score of 72.8% and exceeds the threshold TTU mean score of 74.4%. Note that the scoring system was changed to a 100-point system in 2021 so only four years of data are shown below.



Communication Skills: For the 2023-2024 academic year, geoscience graduates achieved a mean communication score of 89.1%, higher than the threshold of 70%.

Critical Thinking Skills: For the 2023-2024 academic year, geoscience graduates achieved a mean critical thinking score of 81.8%, higher than the threshold of 70%.



Faculty use 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 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.

Use of Results to Improve Outcomes:

Senior Thesis Common Syllabus: In discussing this outcome, Earth Sciences faculty noted the absence of a common syllabus for senior thesis, which may result in varying grading standards

among instructors. Developing a standardized syllabus that emphasizes critical thinking skills and professional communication could enhance this outcome.

SLO 3: Undergraduate research

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

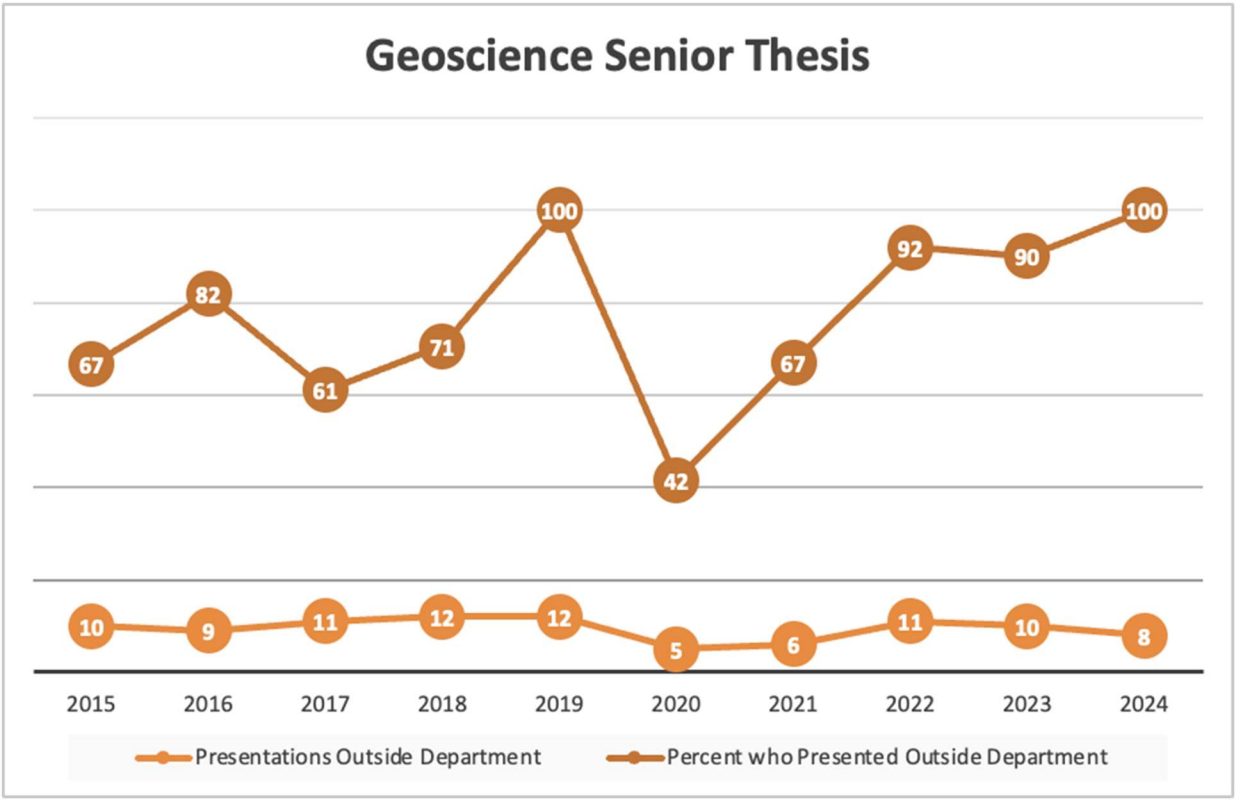
Assessment Methods:
Senior Thesis: The Department tracks the number of students presenting thesis research outside the department.

Criteria for Success (Thresholds for Assessment Methods):
Senior Thesis: The percentage of geoscience graduates presenting research outside the department should be >70%.

Justification: The Earth Sciences faculty set this threshold to ensure that students actively engage with the professional community, which helps build communication skills, fosters networking, and ultimately supports their success in geoscience careers.

Link to 'Tech Tomorrow' Strategic Plan:
2.B Research, Scholar, Intellect, and Creativity,4.C Network of Scholars

Results and Analysis:
Senior Thesis: For academic year 2023-2024, 8 out of 8 graduates presented their research outside the department. This is above the threshold of 70%. Graduates presented research at TTU Student Research Day, Cookeville GIS Day, the Tennessee GIS Conference, the Tennessee Water Resources Symposium, and the Geological Society of America National Conference.



Use of Results to Improve Outcomes:

Covid-19 Impacts: 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 was due to Covid-19 impacts such as cancelled conferences and limited travel opportunities. However, the number of presentations rebounded and 100% of students presented research outside of the department in 2024. 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.

Challenges: Earth sciences faculty note that students often want to attend regional or national conferences, but funding for this travel is limited. Sources such as the TTU Undergraduate Research and Creative Activity (URECA) travel fund are capped at $1,000, and although this amount used to be sufficient, it sometimes does not cover the full travel request. Earth sciences faculty are therefore exploring options for a travel fund, possibly through endowments and/or annual donations.

Summative Evaluation:
PG 1: With the update of the Geospatial Data Analysis concentration (formerly Geospatial Information Systems) and the introduction of the new Planetary Geology concentration in 2024, the department expects enrollment growth in 2024-2025. Additionally, geoscience classes will highlight career opportunities and curriculum pathways in geology, environmental geology, geographic data analysis, geography, and planetary geology.

SLO 1: Administering both a core exam and concentration exams is cumbersome and may not adequately capture curriculum gaps and areas for improvement. This should be addressed during the 5-year review in 2024-2025.

SLO 2: Earth sciences faculty will explore creating a standardized syllabus for the senior thesis course to emphasize critical thinking and professional communication skills, and to ensure consistent grading across different instructors.

SLO 3: Faculty continue to encourage graduating students to present their senior thesis research outside of the department. To support this, they are considering options to develop a travel fund to assist with conference and travel expenses.

Assessment Plan Changes:
We do not anticipate changing geoscience assessments for the next assessment cycle.

List of Appendices:
Appendix 1: Geosciences BS Curriculum Map

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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

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