Institutional Effectiveness Report

2021-2022

Program: Earth Sciences BS

Unit: Geosciences

Contact: Jeannette Luna

Mission

1. To provide a robust undergraduate learning and research experience for geoscience students.
2. To demonstrate the importance of the geosciences to society.
3. To promote faculty research, scholarly activity and interdisciplinary collaboration.

Program Goals

PG 1: The Department will maintain an average of 10 graduates/year.

PG 2: Increase the department's Alumni Endowment to offer more scholarships, experiences, and student research.

Student Learning Outcomes

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

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

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

Assessment Methods

PG 1: Number of majors and graduates, reviewed annually.

Programs graduating <10 students/year can be classified as low producing by the Tennessee Higher Education Commission. Low producing programs have been eliminated.

PG 2: Donations and endowment growth

The Department tracks the size of the endowment as well as the number of scholarships, experiences and student research funded.

SLO 1: Competency

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

ACAT Exam: 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.

Departmental Exam: 90% of graduates will meet or exceed expectations on the departmental exams. The departmental exams evaluate core knowledge for all students and concentration knowledge.

SLO 2: Communication and Critical-thinking skills

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 required to complete a thesis project: Senior Thesis 1 and 2 (GEOL 4930 and GEOL 4931). The course grade issued by the adviser 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, the faculty adopted a separate grading rubric (Appendix 1).

SLO 3: Undergraduate research

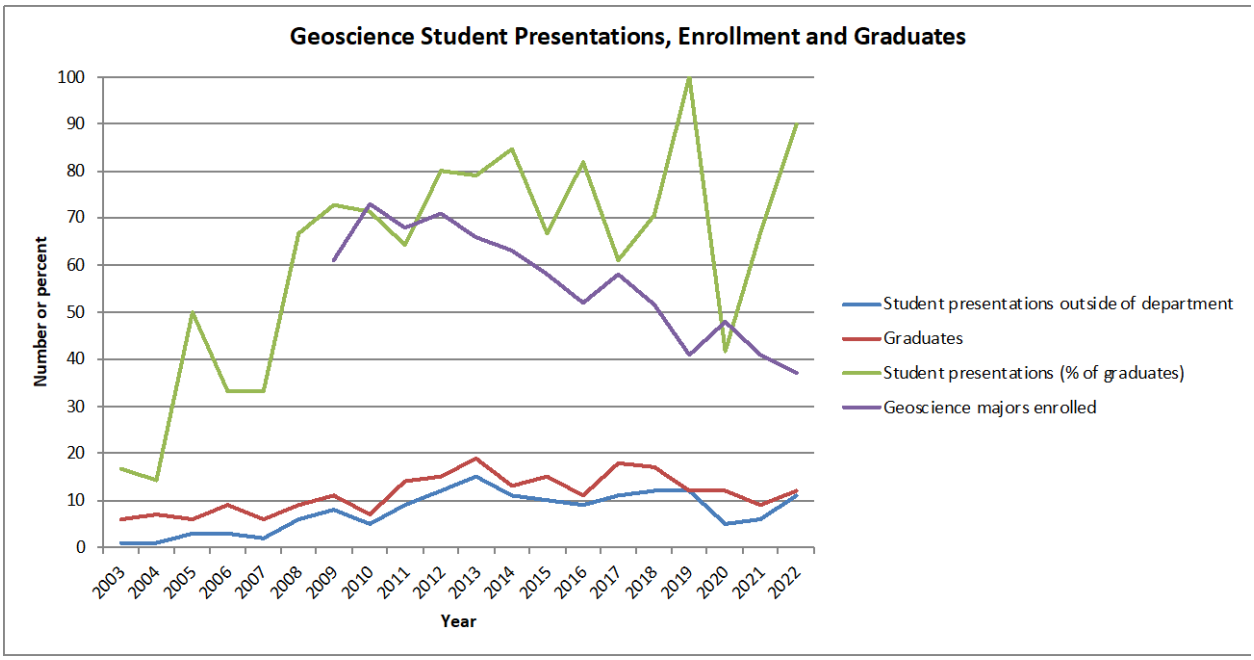
The Department tracks the number of students presenting thesis research outside the department.

Results

PG 1: Number of majors and graduates, reviewed annually.

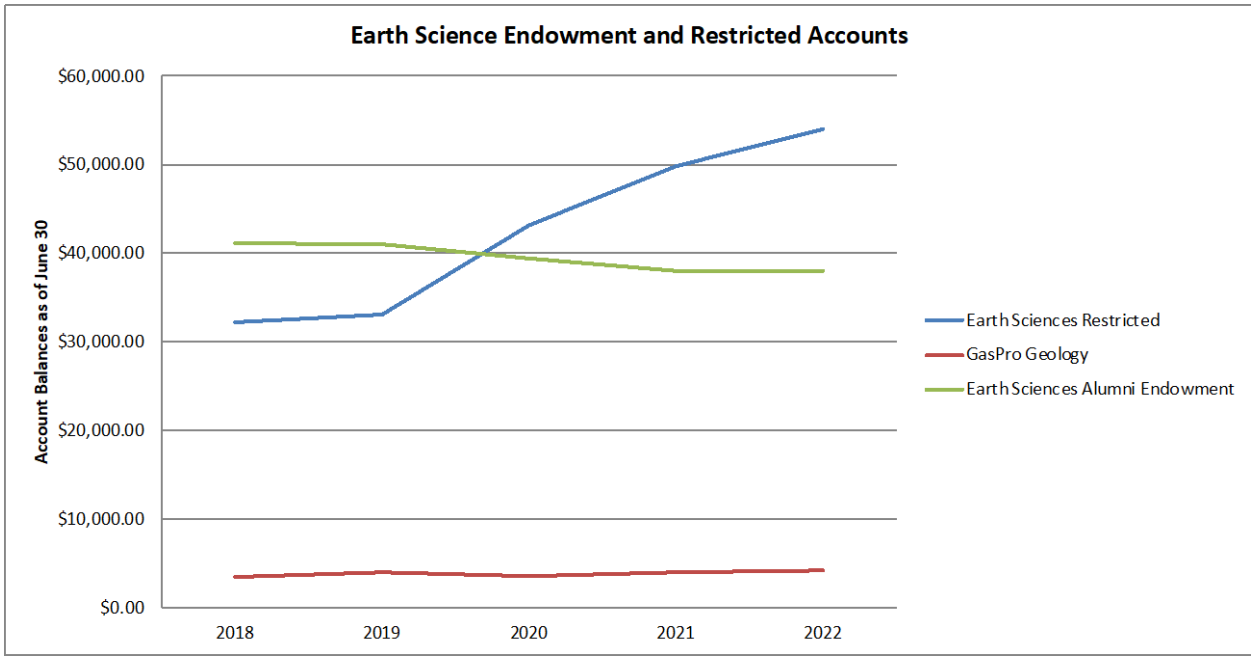
The number of majors in the Fall 2021 semester was 38; it decreased to 36 in spring 2022. For F2021-S2022, we graduated 12 students. As of summer 2021, our 5-year graduation average is 12.6 students/year, a decrease from last year's 5-year average of 13.6.

Figure 1. Geoscience student presentations, enrollment and graduates from 2003-2022.



PG 2: Donations and endowment growth

As of August of 2022, our Earth Sciences Restricted account has a balance of $54,021.54 (increase of 7%), our GasPro Geology Endowment has a balance of $4,269.90 (increase of 7%), and our Earth Science Alumni Endowment has a balance of $38,032.62 (increase of <1%). Donations from department alumni may go to any of these accounts. In calendar year 2021, we received $6,460.00 in donations. As of August 2022, we have received $1,600.00. The Earth Sciences Restricted account is the most flexible and can be used for scholarships, travel, supplies, and equipment. The GasPro Geology Endowment supports student field trips. The Earth Sciences Alumni Endowment supports student scholarships.



SLO 1: Competency

Department Exam for all Majors: From spring 2006-spring 2022, 177 students completed the department exit exam. During this time, 136 students scored ≥70 on the exam (12/12 for the F2021-S2022 cohort). The 2021-2022 exam average increased slightly, from 75% compared to 73% for 2020-21.

ACAT Exam for GEO Concentration: For the 2021-2022 AY, geoscience students (N=10) scored in the 42nd percentile on the national ACAT Geology exam, the same as last year. This is our seventh year of data for this exam. The percentile range on this exam for 2021-2022 students was from 1 to 75, indicating a disparity that may not reflect student aptitude.

EGEO and GIS/GEOG Concentration Exams: For the 2021-2022 AY, the EGEO exam score was 67.5% (N=2), a decrease from an average of 75% (N=1) the previous year. The GIS/GEOG exam score was 50% (N=1), an increase from an average of 20% (N=1) in 2020-2021. This is our third year of data for the EGEO and GIS/GEOG exams.

SLO 2: Communication and Critical-thinking skills

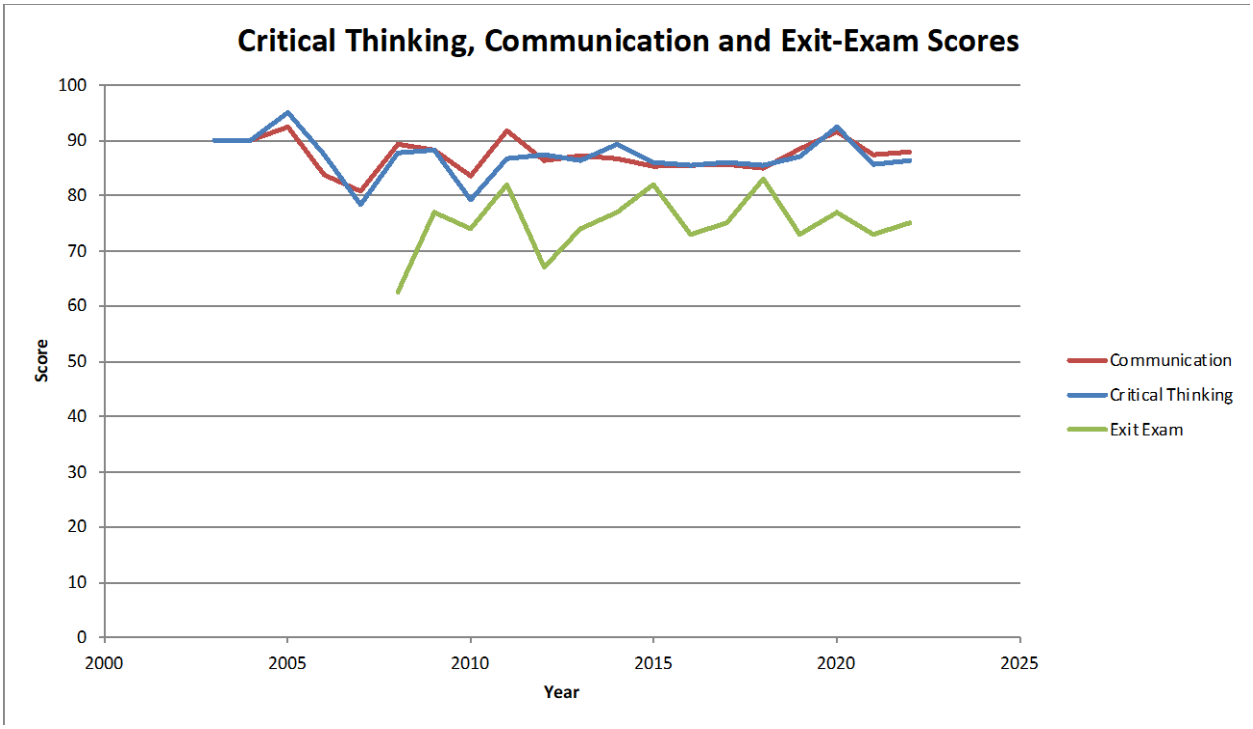
Senior Thesis: Between spring 2003 and spring 2022, 220 geoscience students have completed senior theses. The average course grade for that time is 91.6. For F2021-S2022, the average is 92.5 (N=12)—an increase from the F2020-S2021 average of 91.6 (N=9). Critical thinking and communication scores averaged 86.3 and 87.9, respectively, for F2021-S2022. Critical thinking and communication scores increased, respectively, from last year (85.7 and 87.4).

Results of the CCTST exam (Table 1) show that geoscience majors scored above the TTU mean for the 2021-2022 academic year.

Table 1. Comparison of CCTST scores of geoscience majors to the University mean.

	2017-2018		2018-2019		2019-2020		2020-2021		2021-2022	
MAJOR	Mean	N*	Mean	N*	Mean	N*	Mean** 34 point /100 point	N*	Mean** 100 point	N*
GEOS	20.2	13	20.6/83	8	18.7/79	6	79	2	76	8
TTU Total	17.2	1767	16.8/76	1295	16.2/75	1515	74.5	1365	75.2	1445
CCTST	≈16.2		≈15.4/74		≈15.4/74		≈74.0		≈73.3	

Figure 2. Critical thinking, communication, and exit exam scores for geoscience majors from 2003-2022.



SLO 3: Undergraduate research

Between spring 2003 and spring 2022, 155 out of 220 (70%) geoscience graduates who completed a senior thesis have presented senior-thesis research outside the department. For F2021-S2022, 11/12 (92%) students presented their thesis research outside the department, an increase from last year (67%). Although year-to-year percentages fluctuate, the overall trend is positive since 2003-2004, when the percentage was <20%. The anomalous decrease in research presentations in 2019-2021 is attributed to Covid-19 impacts, e.g., conference cancellations.

Modifications for Improvement

PG 1: Number of majors and graduates, reviewed annually

Enrollment declines in 2020, 2021, and 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.

PG 2: Donations and endowment growth

We continue to work with alumni to increase contributions to the Alumni Endowment. This ongoing work resulted in two new geoscience scholarships and the acquisition of an XRD instrument to assist with faculty and undergraduate research. A successful Alumni Open House in fall 2019 boosted donations; a similar event is planned for the fall of 2022 pending low local Covid-19 transmission rates. Faculty continue to seek more funding for senior thesis research on and off campus (e.g. NASA, NSF, TDOT, TTU URECA and CISE grants).

SLO 1: Competency

A decrease in department exit exam scores during AY 2019-2020, AY 2020-2021, and AY 2021-2022 may be due to additional demands on students during the Covid-19 pandemic. Historically, students who complete GEOL 2500 do better on the department exit exam; thus, we continue to require this course for all geoscience majors. Additionally, we now have seven years of data for GEOL majors taking the ACAT exam and three 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.

SLO3: Undergraduate research

We 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.

Appendices

1. Curriculum Map
2. New Grading Rubric

Appendix 1: 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 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	

Appendix 2: Grading Rubric

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).

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.