

## Comprehensive Program Review - GEOSCIENCE

### General and Overview

1. Describe your program's most significant opportunities and significant challenges.

(Narrative)

During the review period, there were 4 faculty in Geoscience at the Green Bay campus. Two of these faculty were geologists, along with a climatologist and a soil scientist. Geoscience faculty teach many courses that serve general education and other majors, especially Environmental Science and the ES&P Graduate Program.

Opportunities include continued development of two new faculty and one lecturer, growth of the number of majors, and continued contributions toward other majors, the ES&P graduate program, and extensive community outreach. Challenges have included faculty turnover, service reassignments, and overloads.

### **Opportunities**

- Grow the number of majors from the 16-20 range into at least the 25-30 range.
- Provide more travel and funded research opportunities for Geoscience majors.
- Provide more graduate school opportunities for Geoscience graduates.
- Continue to provide high quality outreach programs to the greater community.
- ASBOG Exam (Fundamentals of Geology) integration into the curriculum.
- As new Wisconsin Teacher Licensure requirements come online soon, working with Education to ensure Geoscience majors can fill the role of the new license.
- Future success of two new tenure-track faculty members and one lecturer.

### **Challenges**

- Geoscience major counts are smaller than desired for some course enrollment targets. Better recruiting of students from high schools and additional locations could help.
- Prior to the review period, many students were inspired to major in Geoscience while taking the introductory course in Physical Geology. The retooling of the General Education Program near the beginning of the review period resulted in a significant decrease in undecided students taking that course because it has a laboratory.
- We have had significant turnover and reassignments of Geoscience faculty during the 2013-2020 period, which has resulted in additional workload, course preparation, and uncertainties in student engagement. Coupled with significant support for other programs, additional service assignments (see below) and other commitments have made this a challenging period. This is especially challenging during sabbaticals.
- Overloads are common because of our commitment to administrative support or teaching in other disciplines.
- Unlike other parts of Wisconsin, Earth Science courses in high school are rare in northeastern Wisconsin. Along with decreased enrollment in science education following Act 10, interest in Geoscience teaching has been limited.
- Transportation for field trips; student cost burden and faculty time commitment for some trips. Bureaucratic red tape has made long-distance domestic trips impossible.
- Storage for drill cores has been limited.

2. What are some things that would help make your program and its students more successful? (Narrative)

Several initiatives could make the Geoscience program and its students more successful. First, because Geoscience is a smaller program, even a modest increase in the number of declared majors would lead to a greater sense of community among students and would reach course enrollment targets more frequently. Second, unlike other majors in NAS, none of the departmental scholarships is directed at Geoscience majors, so even one or two scholarships directed at Geoscience students could be very effective at drawing students into the program. UW-Oshkosh, our main regional competitor has abundant geology scholarships available to undergraduate students. Additional assistance recruiting from high schools would also help. Few internships are directed at Geoscience majors specifically, and this might be improved through partnerships with local companies. Additional research funds should be made available for undergraduate research throughout CSET, like that available at some other UW campuses, which would help students conduct high quality high-impact practices. For many projects, \$1000 to \$2000 is needed to conduct the research because of requirements for travel, outside chemical or isotopic analysis, or consumables such as liquid nitrogen. Finally, some internal analytical instrument upgrades or access to tools we presently do not have would greatly enhance the ability of students to conduct research on campus.

3. What are some program accomplishments worth highlighting? (Narrative)

Geoscience has many program accomplishments for which it should be proud. Our faculty contributions are diverse, and, we provide strong contributions in teaching, service, and scholarship. Some of the many highlights include:

- Students regularly present their research at Academic Excellence Symposium, Posters in the Rotunda, and various scientific conferences.
- Students are coauthors on peer-reviewed articles and presentations
- Kevin Fermanich was selected by the Green Bay Water Utility and NEW Water for their Watershed Champion award (March 2020).
- Melvin Johnson and Keith West served as SAGE 2yc Change Agents as part of a four-year NSF funded national grant with researchers from other institutions.
- John Luczaj: 2015 University Award for Excellence in Community Outreach
- Steve Meyer: 2016 University Award for Excellence in Institutional Research
- Kevin Fermanich: Barbara Cofrin Hauxhurst Professor of Natural Sciences
- Chancellor Harden's letters of commendation for both Currier and Luczaj (outreach)
- Extensive external grant funding and publications.
- Success of our students on the Fundamentals of Geology Exam (state administered)
- Extensive outreach that includes media interviews, summer camps, and presentations to dozens of organizations including Lifelong Learning Institute (LIR), Neville Public Museum, Lambeau Lectures, schools, etc.

4. Have there been any significant changes that have affected your program? (Narrative)

Several significant internal and external changes have affected our program during the 2013-2020 period include staffing changes, curriculum changes, changing interest in science teaching majors, etc. These include:

- Significant faculty turnover or reassignments at 3 of the 4 campuses has proved challenging. (see discussion below)
- The retooling of the General Education Program near the beginning of the review period resulted in significant decrease in students taking the intro course (Physical Geology) because of its laboratory requirement. As a result, few students with undeclared majors take this course, thereby reducing our ability to recruit students into Geoscience.
- Dissolution of the UWGB vehicle fleet was a huge challenge because of the reliance on vans for many field trips. Luckily, the fleet was partially moved to CSET, so we were able to continue most trips until Covid-19.
- About 10-15 years ago, about 1/3 to half of the Geoscience majors were in the science teaching track. However, 2011 Wisconsin Act 10 appeared to negatively impact the number of students in the Geoscience Teaching track that paralleled science teaching declines in other parts of camps.
- Going forward there is new uncertainty with new “All-Sciences” state teaching licensure for science teachers that should be completed in 2021. There is the potential for renewed interest, depending upon the final requirements and recommendations made by advisors in Education at UWGB.

Despite these challenges, Geoscience has remained stable and has slightly increased enrollment overall during the review period. We believe this is a positive sign that what we’re doing is working well and that our reputation is growing and improving.

5. Where do you want your program to be 5 to 7 years from now? (Narrative)

We desire to continue to grow the Geoscience program. An ideal number of majors would be in the 25-30 range, to support upper-level course enrollment targets. Two ways in which this might be accomplished is by working to increase the number of student internships and by working with Advancement to create 2 scholarships (one entry level and one advanced level) targeted at Geoscience majors.

At present, the program provides a solid experience for Geoscience majors and minors, and our graduates are much better prepared for graduate school than they were a decade ago. Continued vigilance in offering field, lab, and independent research opportunities is required to prepare students for graduate school or to enter the workforce.

We would like to offer some field opportunities that are farther away from the western Great Lakes region. Our ability to do this is uncertain, but will be based upon how domestic travel opportunities are going to be administered in the future.

**Demand**

*All data in this area is provided with the materials. (Graduates, majors, minors, etc.) This space is for any commentary you would like to apply to that material. (Narrative)*

Despite increasing the rigor of our program and the post-Act 10 challenges mentioned above, the number of Geoscience majors has grown slightly since the beginning of the review period, and the number of minors has increased significantly.

**Internal****1. Program goals (Mission, vision, learning outcomes; present as narrative/lists)**

The Geoscience program contributes to the UW-Green Bay Select Mission through high quality teaching, extensive community-based partnerships, and collaborative faculty scholarship. It also plays a key role in environmental sustainability, especially as it relates to soil health and agriculture, surface water quality, and groundwater resources. For the Core Mission, Geoscience is a core science which has been prolific in scientific research, external granting, and community outreach. Our graduates promote the economic development of the state by working in private industry, government, and education. Our faculty also assist these three sectors by providing scientific expertise, training, educational presentations, and other resources. Inter-institutional relationships exist with USGS, DNR, Green Bay Water Utility, NEW Water, and many other organizations.

**GEOSCIENCE LEARNING OUTCOMES:**

- 1. Students will develop a knowledge base in the principles of physical and historical geology with special emphasis on the unifying theory of plate tectonics and the linkage between geological processes and global biogeochemical cycles.*
  - 2. Students will be trained to apply the scientific method to investigations of geological processes, Earth systems, and interactions among the various physical and biological realms utilizing standard scientific field and laboratory methods.*
  - 3. Students will be able to apply their knowledge base and research skills to current Earth-system based issues such as mining and management of Earth resources with emphasis on related economic, social, and public policy dimensions.*
  - 4. Students will understand the concept of geologic time and major events in the evolution of Earth and its plant and animal life.*
  - 5. Students will understand the various landscape-forming processes that act on the Earth's surface (agents of weathering and erosion) and those that act from the planet's interior (mountain building, volcanism, earthquakes).*
  - 6. Students will understand how knowledge of Earth system science aids in land-use decisions and mitigation of natural hazards such as flooding, earthquakes, and landslides.*
  - 7. Students will understand the functioning of hydrologic systems and the challenge of maintaining surface and ground water quality.*
  - 8. Students will understand the genesis of Earth resources including fossil fuels, metals, and non-metallic minerals and in this way they will appreciate their finite nature.*
  - 9. Students will be able to analyze, interpret, and report on laboratory and field findings using appropriate statistical techniques and computer applications.*
- Additional student learning outcomes specific to the earth science education subplan:*
- Students will demonstrate knowledge in theories of the structure, origin, and evolution of the universe and solar system.*
  - Students will understand the fundamental processes of the atmosphere, the resulting weather and climate, and the effects of the atmosphere on other aspects of the earth's environments and on humans.*

## 2. Curriculum development (Lists, brief narrative if appropriate)

There have been significant developments in the curriculum. At the very start of the review period, a major change in requirements was made to increase the rigor of the program to better prepare our students for graduate school and the ASBOG “Fundamentals of Geology” exam, which is needed if students pursue a pathway as a licensed professional geologist. Changes included:

- Dropping the Environmental Geology requirement
- Requiring an expanded Mineralogy & Petrology course (Geoscience 340)
- Requiring 1 semester of calculus-based Physics

Other changes include:

- A first-year seminar (Geoscience 198) was developed by Ryan Currier (Nature and American History)
- In addition, at least 4 courses that were regularly taught as “Special Topics” courses were converted to specific course numbers, such as Structural Geology, Ore Deposits, Field Methods, and Stable Isotopes.
- Recently, a new “Accelerated Emphasis” was added (similar to several other NAS majors). Admitted accelerated students are eligible to enroll in up to 12 graduate credits prior to obtaining their Bachelor’s degree, and those credits can count toward the Environmental Science & Policy M.S. degree.

## 3. Connections to other programs (Lists, brief narrative if appropriate)

Geoscience is intrinsically connected to several other programs. Faculty teach Geoscience courses that are required for other majors, and faculty teach extensive course loads that have other discipline prefixes. This includes both undergraduate and graduate courses, as well as independent studies and internship supervision.

- Out of the total ~15 Geoscience prefixed courses, at least 4 are required by other programs, including Physical Geology, Ocean of Air, and Hydrogeology. For students seeking broadfield science certification for Earth Science teaching must take Earth System History.
- Not including internships and independent study, Geoscience faculty also taught several courses in Environmental Science (15), Water Science (2), Chemistry (1), and Math (1) during the review period. Two of these are also cross listed with Engineering Technology.
- Contributions to the Environmental Science & Policy Graduate Program
  - Geoscience faculty taught at least 11 unique courses taken by graduate students during the review period, including 4 Environmental Science and Policy graduate courses (700 level), and 7 undergraduate courses dual-listed as graduate courses (500 and 600 level). A few other courses have selected enrollment by graduate students (1-2 per course/semester)
  - Geoscience faculty served as M.S. thesis advisors to at least 23 graduate students in the ES&P program during the review period.

4. Number of courses offered (Overall number provided in materials. Chairs: short commentary if appropriate. Provide a sub-grouping of various modalities by percentage. For example, what percentage of your program is available online, hybrid, etc.?)

In addition to independent study and internship courses, Geoscience faculty teach 15 unique courses with the Geosci prefix. As mentioned above, our faculty also teach an extensive array of courses with other prefixes, some of which are taken by Geoscience majors, but many of which are not. During the review period Geoscience faculty supervised 25 independent studies and 3 internships in Geoscience, Env. Sci., ES&P, and Water Sci.). Faculty served as thesis advisors for at least 23 graduate students, and these students enrolled as ES&P 799.

Aside from Covid-19, the Geoscience program is 100% face-to-face. One distinction, however, is the substantial number of field experiences (at least 2-3 courses per semester) that allow students to learn in a setting beyond the classroom or laboratory setting. One of these courses is a 3 or 4-day camping based field course (1 credit) that is different each semester (can be repeated).

5. Diversity of students, faculty, and curriculum (Overall number provided in materials. Chairs: short commentary if appropriate; provide examples from curriculum if appropriate.)

The proportion of female graduates is 35%. The spreadsheet provided to chairs did not seem to accurately reflect racial diversity. Minorities are estimated to make up about 10-20% of the students in the major.

6. Gen Ed, FYS/GPS, CCIHS (Lists)

- FYS: Two courses regularly taught by Ryan Currier and Steve Meyer - Geoscience 198 and Environmental Science 198, respectively.
- Several courses in Geoscience satisfy general education requirements, including:
  - Physical Geology (Natural Science)
  - Earth System History (Biological Science)
  - Natural Hazards (Natural Science)
  - Ocean of Air (Natural Science)
- Geoscience faculty also teach the following Environmental Science courses that satisfy the **Sustainability requirement**:
  - Radioactivity: Past, Present, and Future
  - Introduction to Water Science
- CCIHS – One course: Geology of Wisconsin taught by Mr. Brack Gillespie at Ashwaubenon High School – counts for Physical Geology (Geoscience 202) at UWGB.

7. Program support and staffing (Chairs: History, trends, and future needs. Depending on program, could be connected to accreditation.)

Program support has been adequate, as shared resources for NAS/CSET have worked well. However, there was significant turnover and reassignments for Geoscience faculty

during the 2013-2020 period, which has resulted in additional workload, course preparation, and uncertainties in student engagement. Staffing challenges included:

- The departure of Ryan Currier in June 2019 and the transition of Kevin Fermanich from teaching faculty to a Wisconsin Extension Green Bay Research and Outreach specialist, which began in Fall 2017. This required the multi-year hiring of temporary teaching faculty which has brought its own challenges.
- The merger of the three additional locations has brought added complexity. Keith West (Marinette), Mel Johnson (Manitowoc), and Will Sharkey (Sheboygan) were all Geography profs or instructors, with a primary teaching load in CAHSS. Each joined CSET and Geoscience with the intention of preparing and teaching at least 1 course in Geoscience (Geoscience 202, and possibly 222/223). The transition *did not* go as planned. Mr. Sharkey left UW-Green Bay in May 2020, and Mel Johnson voluntarily moved to CAHSS after not desiring to teach Physical Geology (Geoscience 202). William Jacobson (1-year lecturer) has taken on the Geoscience 202 responsibility for those 2 campuses during Fall 2020, except for the laboratory section taught by Keith West at Marinette.
- Many of these challenges were largely resolved when Dr. Shawn Malone and Dr. Kelly Deuerling were hired in the summer of 2020 to join Geoscience (and Water Science), so most of their historic course loads can continue to be covered, along with the expansion of 2 new courses supporting Water Science.

Coupled with significant support for other programs, teaching overloads, service reassignments and other commitments made this a challenging period.

- Meyer's service as the SOFAS commitment and UC Chair & Faculty Rep, Lead of scholarship for NAS, FOCUS/R&R/Orientation, and chair of Environmental Science
- Fermanich's primary role as Wisconsin Extension Specialist since 2017
- Luczaj's service as Geoscience Chair and Water Science chair (uncompensated)

Going forward, we believe the two new hires will bring much needed stability to the program at the Green Bay campus. Dr. Shawn Malone and Dr. Kelly Deuerling were hired in the summer of 2020 to join Geoscience (and Water Science), so most of their historic course loads can continue to be covered, along with the expansion of 2 new courses supporting Water Science.

Staffing is less certain at the additional campus locations for Physical Geology, Ocean of Air, and possibly for other courses associated with the new rollout of Environmental Science major at Manitowoc. So far, Dr. William Jacobson has partially filled that role as a lecturer.

8. Cost per credit hour (TBD)  
Uncertain what to put here.

**External**

## 1. Outreach: student/faculty partnerships, collaborations, participation with organizations or individually (Lists)

The list of outreach activities related to Geoscience faculty is extensive and includes hundreds of examples of interactions with the community and with industry, governmental, and educational organizations. Some examples include:

- Dozens of interviews with media organizations (print, TV, radio).
- Summer camps such as Grandparents' University, Environmental Science (for Oneida Nation), GBAPS.
- Training and expert assistance to the Wisconsin DNR and other organizations.
- Invited presentations to various scouting groups, Lifelong Learning Institute (LLI/LIR), Niagara Escarpment Resource Network, Baird Creek Preservation Foundation, neighborhood associations, companies, and industry partners.
- Service to organizations such as Neville Public Museum Geology Club, American Water Resources Association, Lower Fox River Watershed Monitoring Program, Technical Advisory Committee, Brown County, Lower Fox Demo Farms Network Advisory Committee and Soil Health subcommittee, Save the Bay initiative, Great Lakes Climate Adaptation and Resilience Workshop, and others.
- Weekly or biweekly contact with community members seeking assistance with rock and fossil identification, sinkholes, water flooding problems, well water quality questions, and other general inquiries.
- Particularly noteworthy outreach field trips include an all-day bus field trip to Door County for 16 teachers, sponsored by WSST (Wisconsin Society of Science Teachers) and WESTA (Wisconsin Earth Science Teachers Association), and a trip to the Garden Peninsula (Michigan) for about 50 members of the Lifelong Learning Institute.

## 2. Contributions to regional infrastructure (Lists)

- Geoscience **graduates employed** by Wisconsin DNR and DOT. Geoscience faculty also work extensively with DNR on funded and unfunded research projects relating to groundwater quality and quantity.
- Geoscience faculty are **regional experts** in many areas, and as such are sought out by farmers, engineers, regulators, educators, NGOs, media, and others. Geoscience faculty are routinely interviewed by media, including television, newspapers, and radio.
- Geoscience faculty **provide training** for organizations such as the Wisconsin DNR, Wisconsin Water Well Association, UW-Extension, and Engineering societies for training and continuing education.
- Green Bay National Estuarine Research Reserve (NERR) Organizing Team
- Hosted meetings of multi-agency Lower Fox River watershed monitoring work group.
- Lower Fox River Planning Steering Committee service
- Co-chair of Shared Measurements workgroup
- **Partnerships** with local water utilities (Green Bay Water Utility, Village of Bellevue) to assist with well rehabilitation, water leaks, etc.
- Neville Public Museum – assisted in development of new exhibits.



3. Scholarly activity of faculty (Lists that are not all-inclusive; maybe seek to highlight the different areas/types of activity)

Geoscience faculty have been very productive in terms of peer-reviewed journal articles, internal and externally funded grants, scholarly presentations, books, and edited volumes. The research spans many subdisciplines, including soil and water quality, igneous petrology, regional geology, groundwater systems, etc.

- During the review period, Geoscience faculty have been associated with \$12,000 of internal grants and over \$3 million in externally funded grants from a wide variety of organizations.
- Over 80 oral and poster presentations at scientific conferences
- 13 peer-reviewed scientific articles
- 8 non-peer reviewed articles or reports (including a county-wide map)
- Coauthor of leading textbook in Earth System History
- Multiple journal volumes edited
- Faculty served as thesis advisors for at least 23 graduate students.

### **Student Success**

1. High-impact practices and individualized-learning opportunities (Some data provided; lists and/or brief narrative)

Many student experiences are HIPs in Geoscience, and faculty contribute to a wide variety of individualized learning opportunities within and outside Geoscience.

- Laboratories in about 2/3 of the courses required in the Geoscience major.
- Required field trips in about half of the courses required for the major, some of which are day-long trips on Saturdays.
- Geoscience Field Trip, which takes students on a 3-4 day trip each semester to regional localities in parts of Wisconsin, Michigan, and Minnesota.
- Independent research opportunities in laboratory and field settings occur across a broad array of topics in the Geosciences. Many have led to conference presentations or peer-reviewed articles.
- Geology Club Student Organization runs trips to museums, geology core repository, kayak trips, quarry trips, etc.

2. Retention (TBD. Note: if program-level data is not provided, maybe list some things your program does that you believe aid in retention.)

Not provided? Although not formally tracked, retention of declared Geoscience majors is relatively high and is estimated to be above 80%, based upon experience with advisees.

We keep retention rates high through several practices:

- High flexibility in the program by limiting the number of required introductory courses needed before upper-level courses.
- We provide extensive opportunities for high-impact practices, such as field trips, independent research projects, and internships.

**Mission Relevant**

## 1. Relevance to mission (Narrative or lists as appropriate)

Geoscience is the study of Earth materials (e.g., rocks, minerals, soil, water, and air), the processes that shape and alter those components, and the interplay between the biosphere and the Earth. The program strongly emphasizes the fundamentals of geoscience, but it also focuses on groundwater management, soils, and other Earth system processes.

The Geoscience program relates to the select mission of the University primarily through its emphasis on teaching excellence. The program takes an application-focused, interdisciplinary approach, known as Earth system science, in which the physical environment is investigated as many interacting systems. The Geoscience curriculum addresses pressing environmental issues and encourages critical thinking, both in and outside the classroom. The program provides fundamental knowledge about Earth systems in a historical context that is vital to understanding the processes that limit natural resources and impact world climate. This understanding is essential to effective promotion and teaching of the environmental sustainability goals of the UWGB select mission.

The Geoscience program also contributes to the UW-Green Bay Select Mission through extensive community-based partnerships and collaborative faculty scholarship. It also plays a key role in environmental sustainability, especially as it relates to soil health and agriculture, surface water quality, and groundwater resources. For the Core mission, Geoscience is a core science which has been prolific in scientific research, external granting, and community outreach. Our graduates promote the economic development of the state by working in private industry, government, and education. Our faculty assist these three sectors by providing scientific expertise, training, educational presentations, and other resources to organizations such as USGS, DNR, Green Bay Water Utility, NEW Water, and others.

## 2. Cultural enrichment (Narrative or lists as appropriate)

Although the Geoscience discipline is in the sciences, it still provides valuable elements of cultural enrichment. For many people, the landscape upon which we live defines a strong sense of place, especially features such as the bay of Green Bay, the Niagara Escarpment and Door Peninsula, and many other geographic characteristics. This was illustrated during a faculty interview in a documentary on “The Great Ledge”, which appeared on Wisconsin Public Television. Another movie on the Fox River Lock and Dam system features interviews from two geoscience faculty members (currently in production).

## 3. Access (Does the program have any agreements with other institutions? For example, a transfer agreement with a technical college.)

None.