The Manual for Augustana Geology Major Advising (The MAGMA)

Departmental Mission Statement

The Geology Department of Augustana College aims to provide a comprehensive undergraduate education that emphasizes critical and creative thinking, problem solving, reading, and communication, all in the context of the earth sciences. Upon graduation, geology majors should be well prepared for entry-level jobs in the earth sciences and other professions, and they should have the necessary knowledge and skills to succeed in graduate programs in the earth sciences.

The Geology Curriculum

The ideal order and timing of geology courses taken by majors *not* participating in foreign term programs is as follows; however, much flexibility is allowed. Ten geology courses required (30 credits) plus five additional supporting science courses required (15 credits) – 45 total credits required:

Physical Geology (GEOL101)	(first-year: fall, winter or spring)	3 credits (with lab)
or		
Physical Geology in the Rocky Mountains (GEOL105)	(first-year: summer)	3 credits (with lab)
Historical Stratigraphy (GEOL201)	(first-year or soph.: spring)	3 credits (with lab)
Structural/Tectonics (GEOL340)	(sophomore: fall)	3 credits (with lab)
Mineralogy (GEOL301)	(sophomore: winter)	3 credits (with lab)
Historical Stratigraphy (GEOL201)	(sophomore or 1st yr: spring)	3 credits (with lab)
Geomorphology (GEOL309)	(sophomore or junior: spring)	3 credits (with lab)
Paleontology (GEOL325)	(junior or sophomore: fall)	3 credits (with lab)
Petrology (GEOL403)	(junior: winter)	3 credits (with lab)
Geomorphology (GEOL309)	(sophomore or junior: spring)	3 credits (with lab)
Research Methods (GEOL450)	(junior: spring)	3 credits (with lab)
Senior Research (GEOL451)	(senior: fall)	3 credits; credits should be accrued in fall term (strongly suggested) but may need to be taken winter (e.g., with a fall foreign term…)
Any course(s) with GEOL prefix	(any year: any term)	totaling 3 credits
or		
Soil Science (GEOG306)	(any year: any term)	totaling 3 credits

Requirements and Electives

There are nine specifically required geology courses, for 27 out of the 30 geology credits: Physical Geology (GEOL101) *or* Physical Geology in the Rocky Mountains (GEOL105); Historical Stratigraphy (GEOL201); Mineralogy (GEOL301); Structural Geology & Tectonics (GEOL340); Geomorphology (GEOL309); Paleontology (GEOL325); Petrology (GEOL403); Research Methods (GEOL450); Senior Research (GEOL451). The last 3 elective credits can be from any course(s) with a GEOL designation – a single 3-credit course or a few 1-credit courses – or Soil Science (GEOG306).

Required supporting courses (15 credits): Chemistry 121+122, Mathematics 219, and either (a) two from Physics 101-102-103-105 or 201-202-203 or (b) one from either Physics sequence and Geography 373 (GIS).

The chemistry courses ideally should be taken during the first year (CHEM121 fall term, CHEM122 winter term) but can be delayed until the second year if necessary, without affecting the timely completion of the major. The other three required supporting courses may be taken at any time.

Suggestions for other *optional* courses are made in an accompanying document for those majors wishing to gain additional expertise by pursuing a specific sub-disciplinary track (e.g., paleontology, volcanology-geochemistry, environmental). The geology faculty encourages students to participate in foreign term programs. Most students elect a fall-term experience (to Asia, Latin America, or Europe); the missed fall-term geology course would be taken in the subsequent year. Students wishing to participate in winter- or spring-term foreign programs should consult with the department chair. Missing GEOL450 during the spring of junior year is possible but requires much careful, early preparation.

In addition to the 27 specifically prescribed credits (9 courses) listed above, three more GEOL elective credits must be taken for the major (e.g., GEOL100 GeoMyths, GEOL104 Gemology, GEOL106 Earthquakes, Tsunamis & Eruptions in Asia, GEOL112 Dinosaurs and Extinction, GEOL 115 Environmental Geology, GEOL116 Energy Resources and the Environment, GEOL330 Hydrogeology, GEOL370 Special Topics) – or Soil Science (GEOG306).

Different subjects are taught in different courses subsumed under the "Special Topics" general title, GEOL370, 1-3+ credits. Students are allowed to take GEOL370 multiple times as long as the covered topics are different each time (same number but different subtitles will appear in student's transcript). Most 1-credit GEOL370 courses are tied to the spring break fieldtrips; for example, a 1-credit winter-term seminar may be taught on the geology of the region to which we'll travel over spring break (e.g., to Death Valley, CA; Grand Canyon, AZ; the Big Island, HI; Big Bend, TX; the Keys, FL).

On rare occasions students may need to make a substitution in place of one of the prescribed courses. Petitions for these substitutions must be made in writing to the department Chair well in advance.

Geology Senior Inquiry

The geology faculty believes that doing geologic research is one of the best ways to learn geology. We feel that in order to make this a meaningful, true scientific research experience, a minimum of two courses (and most of a year of thinking) is required.

Overall Format: As an integral, culminating part of the geology program, this two-course (6-credit) Senior Inquiry (SI) is required of all geology majors. For students attempting to complete double majors, it is conceivable that a single research project could satisfy the research requirements of certain combinations of departments, typically both with similar pedagogical methods of inquiry. Indeed, interdisciplinary scientific research in geophysics, geochemistry, geobiology, and geography, for instance, is encouraged (permission would need to be obtained from both departments). It is possible for geology – non-science double majors to complete a substantial portion of their geological research during the summer between their junior and senior years (see below), thus enabling them to fulfill the research requirements of their other major during part of their senior academic year.

The first course of the SI sequence is offered every spring term to juniors; it is a preparatory Research Methods course. The second course, Senior Research, constitutes the time during which the actual research and write-up occurs. Majors are strongly encouraged to conduct a significant portion of the research during the summer between the junior and senior years, but GEOL451 credit will usually be officially taken in the fall term of the senior year. Students should take no more than two additional courses during that term, in order to focus an appropriate amount of effort on their research.

Research Methods course (GEOL450): The main goal of this course is to prepare the geology major to undertake real scientific research (with collection and interpretation of *new* data as a core component). Sub-goals of this course are four-fold; (1) Learn how to use the library's informational technology system to do literature searches and gather background material in order to become aware of potential research topics (important, answerable research questions, given their level of knowledge, time constraints, and access to necessary equipment). A concomitant part of these tasks will be to demonstrate mastery of the found material during seminar-style discussions. Certain assigned readings will focus on the historical development of the geologic sciences and on the scientific method. (2) Learn what type of data are generated by, and how to use, the department's and College's analytical instruments (POL-microscopes, XRD, XRF, SEM, air scribes, magnetic separators, water chemistry kits, GPS units,...) which students may need for data collection. (3) Reflect upon what aspects of geology have been of enough interest to consider as a research avenue and possible career path; create a resumé, an ePortfolio site, and a LinkedIn profile. (4) Develop an NSF-style research proposal that, ideally, students would investigate during the subsequent Senior Research course. The proposal (the final project for the course) will include: (a) a discussion of prior research on the subject, incorporating conclusions and uncertainties in our current state of knowledge; (b) the question that the student will attempt to answer; (c) the importance (relevance & significance) of why the question should be answered; (d) a detailed step-by-step description of how the student will attempt to answer the question – what equipment, techniques, lab- & field-work, supplies, funding will be needed, and a time-frame of research progress; (e) a discussion of the possible conclusions.

Senior Research course (GEOL451): Offering the Research Methods (GEOL450) course during the spring term of the junior year will allow students the opportunity to use the summer between their junior and senior years to further develop their ideas or even conduct some or much of the research (especially field studies). In addition, the department encourages its majors to seek geology-related summer experiences, such as NSF-funded RUI (Research at Undergraduate Institutions), REU (Research Experiences for Undergraduates), field camps, or any number of geology internships. We envision that many of these summer experiences may be the foundation of a Senior Research project. Senior Research credit (GEOL451) would be given toward these experiences if the summer research produces results that can be used as the Senior Research project *and* the student continues to further the work during the academic year (e.g., additional background reading, production of a written thesis...). The actual research, as described in the students' Research Methods proposals, typically will be carried out during the summer and fall. Multiple drafts of the research paper are required. Faculty review and student revisions of the thesis will occur throughout the year.

Four public presentations are required of each geology senior: an oral PowerPoint presentation at the beginning of fall term showing preliminary work (e.g., at weekly Udden Geology Club meetings), an oral PowerPoint presentation during spring term with final data and conclusions (e.g., at weekly Udden Geology Club meetings), a poster presentation at the Geological Society of America's annual north-central regional spring meeting (abstract deadline in winter), and (the same) poster presentation as part of the College's late spring Celebration of Learning. In addition, a written thesis is required, produced in a standard GSA format (first drafts due during winter term, final drafts due during spring term of senior year). Thesis drafts, research materials, resumés, and reflections should be archived on each student's ePortfolio.

Letter grades will be assigned for each course of this effort (both Research Methods and Senior Research). The grade for the Senior Research (GEOL451) initially will be given an "In Progress" (IP) designation. A final letter grade will be assigned at the end of spring term; the written thesis, oral presentations, poster, and reflective essay will comprise parts of the final grade for GEOL451. All components must be completed in a timely fashion:

Components of the Geology SI grade (GEOL451)

50% Written thesis (quality & substance)
20% Oral & PowerPoint presentations (final one at spring term Udden Club)
10% Poster (quality & substance)
5% Presentations of poster (at GSA & Augustana Celebration of Learning)
5% Personal initiative on research
10% Reflection (graded based on effort, length & thoughtfulness)

Electronic Portfolio: Each student is required to assemble and maintain an ***ePortfolio*** using the departmental template on Google Sites. This portfolio will archive research papers, SI work, videos of presentations, resumé versions, and reflection. Faculty members will use the portfolios to monitor student progress and to advise effectively. Students will retain this ePortfolio after graduating, ensuring easy access to important documents and files as they move into graduate studies and/or careers. Students should also create a professional-looking ***LinkedIn*** profile and keep it updated.

Reflection: As you prepare to graduate from Augustana College with a major in geology, it is a good time to reflect on how your experiences over the past several years have influenced your intellectual and professional growth. Students should reflect upon each significant experience within the geology major: field trips, departmental courses, summer research experiences, Senior Inquiry, etc. All reflection is completed within the ePortfolio (see above). For the final reflection, near the end of your senior year, you should reflect upon, integrate, and write an essay about your experiences and responsibilities as a maturing citizen, senior liberal arts college student, young scientist, and geology major. Part of this reflection should touch on your developing understanding of the nature of knowledge and modes of human inquiry and how the totality of your Augustana experiences has influenced your self-awareness and connection with others.

Why do we ask you to reflect?

Many of you will be seeking jobs or graduate school training in the geosciences, while some of you will pursue other paths. It is our goal to provide you with the knowledge and the skills and dispositions to choose your path and succeed in it. Your success in gaining employment in any field or acceptance to a graduate program will depend in large part on your ability to articulate to others what makes you worthy for the position. For your final reflection, we ask you to respond thoughtfully to the following questions (general questions first followed by more specific questions):

1. How have your experiences in our department and at Augustana made you a better scientist, one who is able to work independently or in a team, identify a problem, conduct appropriate background research, collect and analyze information critically, and communicate the results effectively? As you respond to this question, please refer to specific courses, assignments, requirements, or other departmental experiences (e.g. Udden Club, field trips, Senior Inquiry, etc.) which helped you mature as a scientist.

2. One could argue that geoscientists' ability to identify and solve complex problems and deal with scientific uncertainty is different from other scientists. Elaborate on how you acquired such skills and dispositions and how they have helped shaped you as a scientist.

3. How have your experiences in our department and at Augustana made you a better citizen, one who is able to understand the challenges of society, consider the various ethical implications of human activities on earth, and affect positive change in the world?

4. What are some of your personal and/or professional goals, either immediate or long-term? How have your experiences in our department and at Augustana helped you develop these goals?

- Why did I choose this major and this particular sub-discipline of study?
- What did I do for my project (i.e., class, directed study, summer, but *especially* SI projects)?
- Why did I do this project? What difference does it make? Who should care about it?
- What did I learn from this project? What do I know now that I didn't know before? What questions did my project fail to answer? What additional questions should I have asked?
- What are the implications of my work for those in my field?
- How did my Senior Inquiry research experience change my view of the discipline?
- Did my education at Augustana prepare me to do this SI project properly?
- How has my overall Augustana education and this project in particular prepared me for the future? How will this work relate to future goals? What will the meaning of this work be to me in the years to come?
- To which communities does my project contribute, and why/how?
- How does this project fit into my evolving life story? Why do I care about it? Who was I when I came to Augustana, and who am I now?
- Were the courses and field trips of value in my geologic education? How?
- How did my work as a teaching assistant help me grow? What problems did I face/overcome?
- How have my experiences in the Geology Department helped me achieve any of the nine college-wide learning outcomes (see table below)? Can I provide specific examples?

Department Honors

"Geology with Distinction" departmental honors ("Summit" cum laude): Students can earn the highest departmental honor upon successful completion of ***both*** a superior senior research thesis, GEOL451, ***and*** the geology degree with a G.P.A. ≥ 3.5 for all geology courses and the supporting courses that are required for the major. In addition, students seeking this honor must complete their thesis by the end of week five of spring term, so the faculty has time to evaluate its quality before the various honors ceremonies (final draft finished and turned in and oral presentation given at Udden Geology Club.)

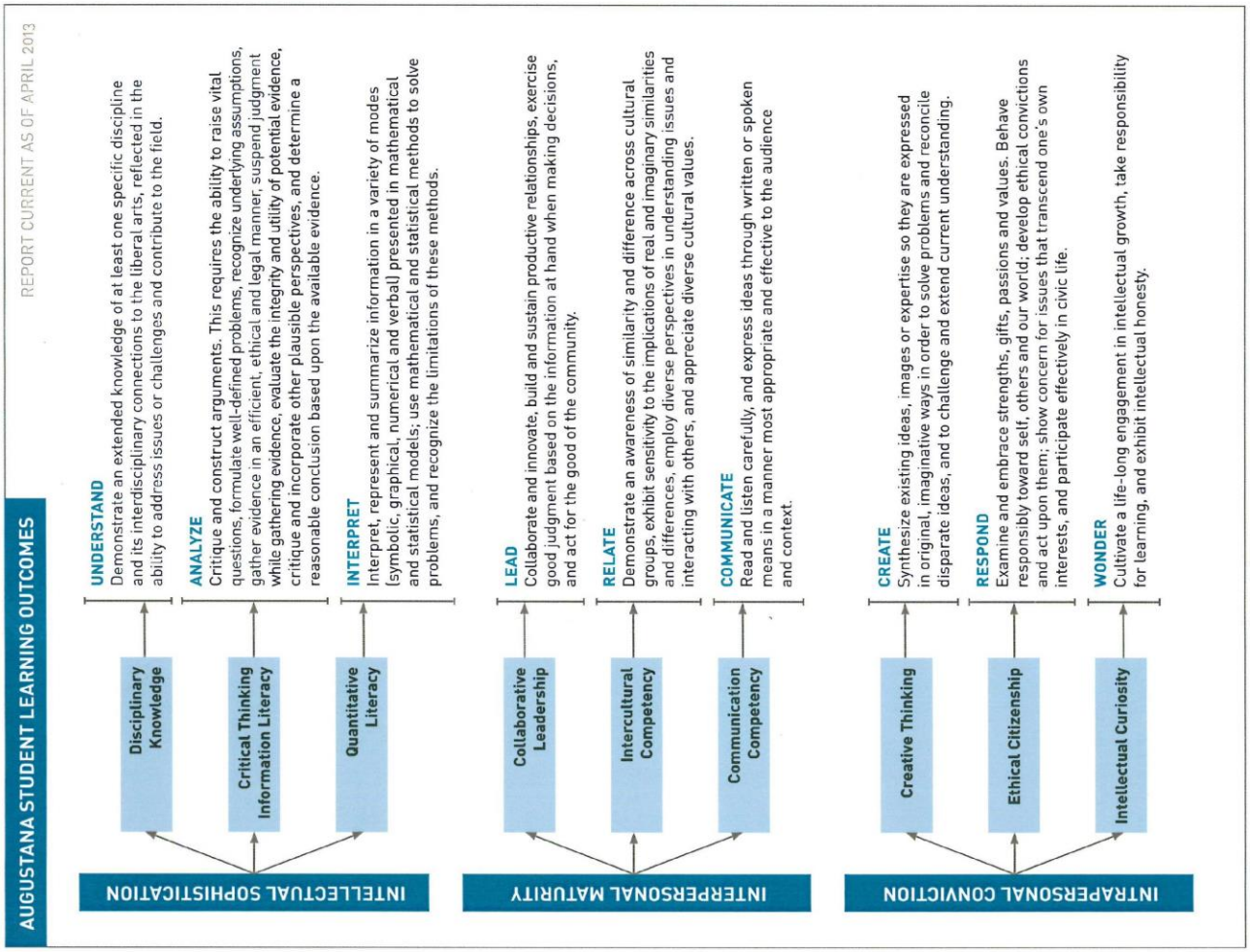
"Geology with Merit" departmental honors ("Magma" cum laude): Students can earn the this departmental honor upon successful completion of ***either*** a superior senior research thesis, GEOL451, ***or*** the geology degree with a G.P.A. ≥ 3.5 for all geology courses and the supporting courses that are required for the major. In addition, students seeking this honor must complete their thesis by the end of week five of spring term, so the faculty has time to evaluate its quality before the various honors ceremonies (final draft finished and turned in and oral presentation given at Udden Geology Club.)

National Honor Society for the Earth Sciences
(SGE: Sigma Gamma Epsilon, Alpha Iota Chapter)

Any person in any branch of the Earth Sciences who has completed at least 10 semester hours (3.3 Augustana 3-credit courses) in Earth Science courses and has maintained a minimum 3.0 G.P.A. in those courses, together with an overall G.P.A. of 2.67 in all college courses is qualified for membership. If you qualify and wish to join, please inform any student SGE officer or faculty advisor of your department's chapter and they can propose you for membership.

Learning Outcomes: As a result of successfully completing the major in geology, which includes the Senior Inquiry project as an integral capstone experience, geology majors should be able to:

- Demonstrably master and retain an understanding of the fundamental knowledge base and skill sets of the various scientific and mathematical subjects to which they are exposed in their coursework, and, more importantly, make connections between these subjects to realize the interdisciplinary nature of geologic investigations of the complex Earth systems.
- Eagerly take responsibility for their learning in that they design, carry out and finish a substantial research effort (based on literature review, original data collection, critical analysis and synthesis) which demonstrates an appropriate level of engagement and mastery of the tools, techniques, methodology, and modes of inquiry of the geological sciences.
- Effectively convey the meaning, significance and complexity of their SI research in a scientific research paper.
- Effectively convey the meaning, significance and complexity of their SI research in an oral presentation, and defend their ideas, in front of a critical audience of peers.
- Honestly reflect upon their Augustana College experiences in a meaningful way which will enhance their progress towards discerning their vocation, their participation in society, and their understanding of our environment.



Fieldtrips, Research and Reflections

Successful completion is required for graduation (optional portions marked)*

- **Fall Term, Sophomore Year:** Reflect upon last year's geology course(s) and develop career and life interests in written and oral assignments (in GEOL340).

- **Winter Term Fieldtrip, Sophomore Year:** Departmental fieldtrip to the Tucson Gem and Mineral Show, as part of GEOL301 (Mineralogy); a required component will be a daily journal of observations and thoughts.

- **Spring Break Fieldtrip, Sophomore Year*:** For those students participating in this optional departmental fieldtrip, a required component will be a daily journal of observations and thoughts.

- **Fall Term, Junior Year:** Reflect upon last year's geology courses and develop career and life interests in written and oral assignments (in GEOL325). Create a resumé and add it to your ePortfolio.

- **Early Winter Term, Junior Year*:** Explore the possibility of up-coming summer research opportunities through various National Science Foundation programs (e.g., Research Experiences for Undergraduates, REUs; Research at Undergraduate Institutions, RUIs; Keck Consortium projects).

- **Spring Break Fieldtrip, Junior Year*:** For those students participating in this optional departmental fieldtrip, a required component will be a daily journal of observations and thoughts.

- **End of Spring Term, Junior Year:** Complete GEOL450 (Research Methods). The final project for this 3-credit course is a written research proposal and oral presentation which typically will become the student's senior research project. Some written assignments during the course will focus on reflection – what aspects of geology does the major find interesting enough to study independently in more detail, and possibly as a career choice. A revision of the student's resumé and ePortfolio site will constitute some of the assignments.

- **Summer between Junior and Senior Years*:** Take advantage of NSF (or other) research opportunities. These experiences fulfill part of the requirements for GEOL451, Senior Research. Additional on-campus synthesis, analysis, and writing during the senior year will be necessary.

- **Beginning of Fall Term, Senior Year:** Give an Udden Club talk on your preliminary research.

- **End of Fall Term, Senior Year:** Complete the bulk of the research (GEOL451), with the first rough draft given to the faculty research advisor no later than the beginning of winter term. Part of the requirement will be daily entries into a research journal (this journal will become a record not only of research findings but of research ideas, personal thoughts, frustrations, elations of doing the work itself).

- **Middle of Winter Term, Senior Year:** Submit abstract to Geological Society of America (GSA) for annual spring-time north-central regional meeting.

- **End of Winter Term, Senior Year:** Copies of the second draft, in GSA format, given to faculty advisor.

- **Spring Break Fieldtrip, Senior Year*:** For those students participating in this optional departmental fieldtrip, a required component will be a daily journal of observations and thoughts.

- **Spring Term, Senior Year:** Oral presentation of research given at Udden Geology Club meeting. Poster presentation at the GSA north-central regional meeting. Poster presentation at the Augustana College Celebration of Learning (using the same GSA poster).

- **End of Spring Term, Senior Year:** Completion of the thesis, reflective essay and resumé. Grade for GEOL451 assigned by geology faculty (written research paper will comprise the major portion of the grade).