

Advising Guide to Programs in Geosciences

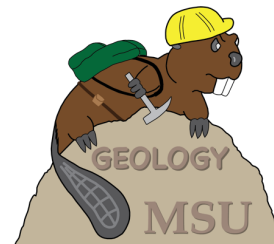
Bachelor of Science (BS)
or
Bachelor of Arts (BA)
with a major in
Geology



Minor in
Environmental Geology



Bachelor of Science
in Education (BSEd)
with a major in
Earth Science



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Introduction

The purpose of this advising guide is to provide you with information that will help you complete one or more of the programs offered by Geosciences as smoothly as possible – to minimize bumps in the road or surprises. While it is important to learn about geologic time, we don't want the pursuit of Geosciences programs to be measured in geologic time.

While getting good advice from your advisor in Geosciences is important – and yes you should be meeting with your advisor regularly – this guide will help you be your own best advisor. It is very important that YOU understand general graduation requirements and the requirements of the specific program(s) you are pursuing.

Other Sources of Information

Besides your advisor, you might find information available on handouts kept in the hallway (where faculty offices are located) to be very useful. There are checklists for both General Education requirements and for Geosciences programs. You will also find the most up-to-date long-range schedule for Geosciences courses, which will be very important for mapping out your academic plan. Checking your progress can be done using the Academic Requirements tool in Campus Connection. You should learn how to use this, and make use of it regularly—especially as you get closer to graduation.

Overview: All Majors/Minors

Graduation Requirements

Regardless of your major, to graduate you will need to meet the following requirements:

Please Verify & Check the Following

- | | |
|--|--|
| <input type="checkbox"/> Earned a minimum of 120/128 Credits | <input type="checkbox"/> General Education Requirement met. |
| <input type="checkbox"/> Earned 60 CR from a four-year institution | <input type="checkbox"/> No more than 12 CR of 200 & 400 Special Topics applied to Degree |
| OR <input type="checkbox"/> Earned 42 CR for Bachelor of Applied Science | <input type="checkbox"/> No More than 15 CR of Sat/Unsat applied to degree (as student's option) |
| <input type="checkbox"/> Earned 30 CR from MSU | NDSU SWK ONLY: |
| <input type="checkbox"/> Met a cumulative GPA of 2.00 or above | <input type="checkbox"/> NDSU HDFS Degree Completion Date: _____ |
| <input type="checkbox"/> At least 12 CR in each major have been completed at MSU | BSE ONLY: |
| <input type="checkbox"/> At least 6 CR in each minor have been completed at MSU | <input type="checkbox"/> Praxis II licensure test and PLT scores |
| <input type="checkbox"/> Earned 3 CR General Ed and 3 CR Grad diversity courses | Date: _____ |
| OR <input type="checkbox"/> Developmental Content | |

These requirements are listed on the Application for Graduation form completed prior to graduation. Some of these don't seem to show up clearly in the MiSU Catalog, so it is important that you are familiar with these requirements. A change is in the works to replace paper Application for Graduation forms with an online system, but the requirements should remain the same.

Governing Catalog

The general graduation requirements and the specific requirements for your major(s), minor(s), and concentration(s) are based on your “governing catalog,” which is the catalog that was current when you started at MiSU. That catalog remains as your governing catalog as long as you are enrolled each semester. If you are not enrolled for one or more semesters, the catalog in place when you resume enrollment will become the governing catalog.

You can change your governing catalog to a newer one if you so choose. If you do not know which catalog is your governing catalog, you can find this in Campus Connection under Academic Requirements. It should be listed at the very top, where there is a statement that reads “You are currently under the 20XX-20XY catalog.”

General Education Requirements

General Education (Gen Ed) requirements changed in recent years. If you started at MiSU in fall of 2014 or later, you are subject to the new Gen Ed requirements (unless you transfer here after completing Gen Ed at another NDUS campus, in which case your Gen Ed is considered to be completed). Below are the Gen Ed requirements, along with required courses that fulfill select Gen Ed categories.

MiSU General Education Requirements

Required Core (14-16 cr)

UNIV 110; ENGL 110 and 120; COMM 110; MATH

Foundational Content (23 cr)

FC1: Humanities (6 cr)

FC2: Lab Science (8 cr)

CHEM 121, GEOL 105

FC3: History (3 cr) and Social Sciences (6 cr)

Developmental Content

Critical Capacities and Skills

CCS1–Problem Solving

CHEM 121, GEOL 105

CCS2–Information Literacy

SCI 240

CCS3–Critical Reading

CCS4–Quantitative Literacy

CHEM 121, GEOL 105

CCS5–Oral/Written Communications

SCI 480

CCS6–Collaboration

CHEM 122*, GEOL 300

Personal and Social Responsibility

PSR1–Relationships and Value Systems

PSR2–Responding to Community Needs

UNIV 110

PSR3–Individual Well-Being

GEOL 290**

Interconnecting Perspectives

IP1–Knowledge

IP2–Experience

GEOL 290

* required for Geology BS major and Environmental Geology minor

** not yet approved; we will be applying for PSR3 approval for GEOL 290

These requirements total to a minimum of 37–39 cr of coursework. The Developmental Content requirements do not (in general) require taking additional courses. You must take some course that meets the requirement, but that course may also fulfill some other requirement such as the Required Core or Foundational Content, or perhaps a course required in a major, minor, or concentration (i.e., courses can count toward more than one requirement). The one exception, at least in the case of Geosciences programs, is the PSR3 requirement; this will require taking an additional 1–3 cr course.

In total, meeting Gen Ed requirements involves 38–42 cr of coursework. However, one thing to keep in mind is that courses used to meet Gen Ed requirements can also be used to fulfill requirements for majors, minors, and concentrations. For example, the Geology BA and Earth Science BSEd majors require courses that meet the Math and Lab Science Gen Ed requirements, reducing the Gen Ed requirements by 11–12 cr (i.e., you need 26–30 cr of additional coursework to complete Gen Ed).

When to Take Gen Ed Courses

It seems to be common that students receive advice along these lines: *Get all of your Gen Ed done in the first couple of years, then work on your major.* This might be appropriate advice for students who have not decided on a major. Completing Gen Ed requirements can provide for a breadth of experiences that can help students identify a major that interests them. However, if you have decided on a major, this is likely to be bad advice. If the first two years are spent only completing Gen Ed requirements, you’ve only left yourself two years to complete the major (and perhaps other) requirements. In the case of Geosciences, you will need more than two years to complete your major requirements.

Geosciences: The Prerequisite Courses

With one exception, no matter which major or minor you are pursuing you will need to take GEOL 105 (Physical Geology), GEOL 106 (Historical Geology), and GEOL 210 (Minerals and Rocks). The one exception is the Environmental Geology Minor if you are **not** also pursuing a Geosciences major.

Historical Geology and Minerals and Rocks are offered each spring semester. It is important that you take both courses during the first spring semester following completion of Physical Geology. Historical Geology is a prerequisite for GEOL 300 (Geologic Field Methods), GEOL 311 (Paleontology), and GEOL 471 (Sedimentation and Stratigraphy). Minerals and Rocks is a prerequisite for all 300–400 level courses (except for GEOL 323 Global Climate Change).

Completing the “core” prerequisite courses (GEOL 105–106–210) in a timely manner is important because then you are prepared to take upper-level courses when they are available. Upper-level courses are taught on an alternate-year basis (once every two years). We are not a large enough program to be able to teach them each year. Thus, you can count on needing a minimum of full two years to complete your required Geology courses beyond the GEOL 105–106–210 “core.”

Bachelor of Arts (BA) with a Major in Geology

General BA Requirements

One very important thing to understand is that there are some requirements that must be met for any Bachelor of Arts (BA) degree beyond the specific major requirements. Along with your major(s), you must also complete the requirements for minor(s) and/or concentration(s). In short, you must complete one of the following combinations.

- one major and three concentrations
- one major, one minor, and one concentration
- one major and two minors
- two majors and one concentration or minor
- three majors

It is important that you plan your coursework so that you are progressing toward meeting one of these combinations by working to complete your minor(s) and concentration(s) while also working on your major(s).

Geology BA Requirements

The current Geology BA requirements (starting with 2018-19 catalog) are shown below. If you started at MiSU prior to fall 2018 (and you have been continuously enrolled), the requirements listed in your “governing catalog” are slightly different.

General Education (not covered by courses below)	27–30 cr
Required Geology Courses	46 cr
GEOL 105 Physical Geology (4)	
GEOL 106 Historical Geology (4)	
GEOL 210 Minerals and Rocks (3)	
GEOL 300 Geologic Field Methods (3)	
GEOL 305 Methods in Mineralogy - Petrology (2)	
GEOL 310 Igneous and Metamorphic Petrology (3)	
GEOL 311 Paleontology (4)	
GEOL 321 Hydrogeology (3)	
GEOL 322 Geomorphology (4)	
GEOL 361 Structural Geology (4)	
GEOL 471 Sedimentation and Stratigraphy (4)	
GEOL 494 Directed Research in Geology (2)	
Elect 6 credits [†] from:	[[†] see section on “Field Experiences” for more information]
GEOL 290 Regional Geology (3)	
GEOL 390 Regional Field Geology (3)	
GEOL 411 Field Geology (6)	
Required Support Courses	14 cr
CHEM 121 General Chemistry (5)	
MATH 107 Pre-calculus (4)	
SCI 240 Research Methods (2)	
SCI 480 Seminar (3)	
Second Major/Minor/Concentration(s)/Electives	30–33cr
Total Credit Hours	120 cr

The Geosciences “Combo Pack”

Many students who pursue the Geology BA also pursue the Environmental Geology minor. Normally, students cannot complete a major and minor in the same discipline. The Environmental Geology minor has a version for students who are majoring in Geology, and it was approved because there is no overlap in required courses between the major and that version of the minor. If students choose to take GEOL 340 Chemistry of Natural Waters as part of the Environmental Geology minor (the version for Geology majors), they also receive credit for completing a Chemistry concentration; the Chemistry program allows GEOL 340 to count toward the Chemistry concentration.

Bachelor of Science (BS) with a Major in Geology

Geology BS Requirements

The Geology BS is a new degree program that will first appear in the 2019-20 catalog. There are two major differences between the Geology BS and BA degree. First, a BS degree does not require the concentrations/minor that BA degree students must complete. Second, there are additional mathematics and science courses required for the Geology BS. The Geology BS requirements are shown below.

General Education (not covered by courses below)	23 cr
Required Geology Courses	49 cr
GEOL 105 Physical Geology (4)	
GEOL 106 Historical Geology (4)	
GEOL 210 Minerals and Rocks (3)	
GEOL 220 or GEOG 289 Introduction to GIS (3)	
GEOL 300 Geologic Field Methods (3)	
GEOL 305 Methods in Mineralogy - Petrology (2)	
GEOL 310 Igneous and Metamorphic Petrology (3)	
GEOL 311 Paleontology (4)	
GEOL 321 Hydrogeology (3)	
GEOL 322 Geomorphology (4)	
GEOL 361 Structural Geology (4)	
GEOL 471 Sedimentation and Stratigraphy (4)	
GEOL 494 Directed Research in Geology (2)	
Elect 6 credits [†] from:	[[†] see section on “Field Experiences” for more information]
GEOL 290 Regional Geology (3)	
GEOL 390 Regional Field Geology (3)	
GEOL 411 Field Geology (6)	
Required Support Courses	35–37 cr
CHEM 121 General Chemistry I (5)	
CHEM 122 General Chemistry II (5)	
MATH 165 Calculus I (4)	
MATH 166 Calculus II (4)	
MATH 210 Elementary Statistics (4)	
PHYS 211 College Physics I (4) or PHYS 251 University Physics I (5)	
PHYS 212 College Physics II (4) or PHYS 252 University Physics II (5)	
SCI 240 Research Methods (2)	
SCI 480 Seminar (3)	
Electives	11–13cr
Total Credit Hours	120 cr

Geology BA and BS Programs: Field Experiences and Research

Field Experiences

For a long time, GEOL 411 Field Geology has been an important capstone course, as it is for many if not most geology programs. The 6-cr Field Camp (as it typically called) is a five- to six-week course taken during the summer. It is most often taken the summer after completing all other requirements for graduation, although it doesn't have to be the last thing you take. The most important factor is the geology coursework you've had. Typical prerequisites are structural geology, sedimentation/stratigraphy, and petrology, although they do vary among field camp courses. Field Geology is not taken through MiSU; we don't have the resources to offer a Field Camp. An approved 6-credit course is taken through another college or university and then transferred to MiSU to meet the GEOL 411 requirement. Be aware that you should start looking for an appropriate Field Camp course early, during the later part of the previous fall semester or very early part of the previous spring semester.

While most students have completed a "standard" Field Geology course to meet the GEOL 411 requirement, there have been a small number of students who completed a 6-credit hydrogeology Field Camp course. If environmental geology is your primary interest, this might be appropriate for you.

Recently, the Geosciences program approved an alternative to the 6-credit Field Geology requirement. It involves taking GEOL 290 Regional Geology (3 cr) and GEOL 390 Regional Field Geology (3 cr). The GEOL 390 course was designed as a kind of "mini field camp." Unfortunately, as currently staffed (and for other reasons) we are not likely to be able to offer GEOL 390. However, this alternative could still be an option if you complete GEOL 290 and take an appropriate field course for at least 3 credits from another school. There are some field courses available that are less than 5-6 credits. If you take one for 3 credits or more, it can be transferred to MiSU as a substitution for GEOL 390 in the same way that 6-credit field geology courses are transferred to MiSU as a substitute for GEOL 411.

If you are a Geology major under an older catalog (prior to the 2018-19 catalog), you could still pursue the alternative to GEOL 411. A GEOL 290 course combined with a field course of at least 3 credits could be approved as a substitute for GEOL 411.

Research

Another aspect of your academic program that should be well thought out is the requirement to complete some original research. One requirement for the Geology BA is completion of 2 credits of GEOL 494 Directed Research. However, the research process really begins with SCI 240 Research Methods, and ultimately ends with SCI 480 Seminar, which is the course in which you present your research. The research process is described in more detail in the "Guide to Research in Geosciences" section of this guide.

Bachelor of Science in Education (BSEd) in Earth Science

The Earth Science BSEd degree program prepares students to teach earth science at the secondary level. With some additional coursework, you could also be prepared to teach other science disciplines as well.

Earth Science BSEd Requirements

The Bachelor of Science in Education (BSEd) with a major in Earth Science involves fewer geology courses than the Geology BA, but more support courses and a Professional Education Sequence. It is somewhat like a double major, but it has no requirement for minor/concentrations like the BA degree. The Earth Science BSEd requirements are listed on the next page.

There are many courses in the Professional Education Sequence that can be taken prior to formal admission to the Education Program, but there are some that are restricted to admitted students. You should make sure you are familiar with the application procedures and admission requirements so you know when you should be applying for admission.

Juggling coursework in Geology, support areas, and Education can be a challenge. It is important that you work with your advisor in Geosciences and advisors in Education (including the Science Education faculty member, currently Dr. Dane Schaeffer) to plan out your program carefully. Even with careful planning, you might find that you have to work around conflicting course schedules by modifying your plan.

Research for Earth Science Majors

Earth Science BSEd majors have to complete both SCI 240 Research Methods and SCI 480 Seminar. Although there is no requirement to take GEOL 494 Directed Research in Geology, there is a requirement to complete an original research project (presented in Seminar). Even though it is not required, it is a good idea to take GEOL 494 while working on your research. Regardless, you will have to meet the same requirements for getting into SCI 480 Seminar. You must have your research completed, and you must have a draft of a paper that includes Introduction, Background, Methods, Results, and References Cited. See the Guide to Research in Geosciences section for more information.

One aspect of SCI 480 Seminar that is unique to BSEd majors is an expectation to address applicability of your research project to your teaching. Typically it is not difficult to make some connections to teaching, regardless of the nature of the research, so don't design your whole research project around this expectation. It doesn't have to be a major focus of your Seminar presentation and paper.

General Education (not covered by courses below)	27–30 cr
Required Geology Courses	26 cr
GEOL 105 Physical Geology (4)	
GEOL 106 Historical Geology (4)	
GEOL 210 Minerals and Rocks (3)	
Internal Geology (4 cr minimum)	
GEOL 305 Methods in Mineralogy - Petrology (2)	
GEOL 310 Igneous and Metamorphic Petrology (3)	
GEOL 361 Structural Geology (4)	
Surficial Geology (11 cr minimum)	
GEOL 311 Paleontology (4)	
GEOL 321 Hydrogeology (3)	
GEOL 322 Geomorphology (4)	
GEOL 331 Soils (4)	
GEOL 471 Sedimentation and Stratigraphy (4)	
Required Support Courses	41 cr
CHEM 121 General Chemistry (5)	
CHEM 122 General Chemistry (5)	
CSCI 101 Introduction to Computer Science (3)	
GEOG 330 Geography of Weather & Climate (3)	
MATH 107 Pre-calculus (4)	
MATH 210 Elementary Statistics (4)	
PHYS 110 Astronomy (4)	
SCI 240 Research Methods (2)	
SCI 480 Seminar (3)	
One BIOL course (4)	
One PHYS course (4) (may not be PHYS 110)	
Professional Education Sequence	38 cr
ED 260 Educational Psychology (2)	
ED 260L Clinical I (0)	
ED 282 Managing the Learning Environment (2)	
ED 282L Clinical II (0.5)	
ED 284 Teaching Diverse Learners (2)	
ED 284L Clinical III (0.5)	
ED 320 Curriculum, Planning & Assessment I (2)	
ED 321L Clinical IV (0.5)	
ED 322 Curriculum, Planning & Assessment II (2)	
ED 323L Clinical V (0.5)	
ED 324L Fall Experience (0)	
ED 380 Technology in Teaching (2) *	
ED 493 Student Teaching, Secondary (and ED 483) (12) *	
SCI 391 Teaching Science in Secondary Schools (3) *	
SPED 110 Introduction to Exceptional Children (3)	
SS 283 Ethnic and Cultural Diversity in America (3)	
Take one:	
PSY 255 Child & Adolescent Psychology (3)	
PSY 352 Adolescent Psychology (3)	
* Requires admittance to Teacher Education.	
Total Credit Hours	132–135 cr

What About Teaching in Other Disciplines?

Your employability as a secondary teacher can be enhanced by being qualified to teach science disciplines beyond Earth Science. It used to be that a teaching minor was required to teach a particular discipline. With No Child Left Behind, secondary science teachers were required to have a BSEd with a major in the science, but then could teach other science disciplines if they had at least 12 credits of coursework in the discipline(s). Successful completion of a discipline-specific Praxis exam was also required. The current requirements may be somewhat different. If this is of interest to you, make sure you ask about current requirements – it seems to be a bit of a moving target.

Environmental Geology Minor

The Environmental Geology minor has two options – one for non-majors (i.e., not pursuing a Geology major) and one for Geology majors (those pursuing a Geology BA – see note below). Only the latter is discussed here; the requirements are shown below. For Geology BA majors, there are two advantages to completing the Environmental Geology minor. The first is that it expands your background in geology. The second is that because it consists primarily of Geology courses, you won't have to worry about schedule conflicts with courses required for your major. The Geology courses are scheduled such that courses beyond GEOL 105 do not conflict with one another. A third potential advantage is completion of a Chemistry concentration in the process. If you choose GEOL 340 as part of the minor, when combined with two semesters of General Chemistry you have met the requirements for a Chemistry concentration.

Environmental Geology Minor (with geology major) 20–21 cr

GEOL 220 Introduction to GIS (3)

GEOL 260 Energy Resources (3)

GEOL 331 Soils (3)

GEOL 323 Global Climate Change (3)

CHEM 122/122L General Chemistry II (5)

Take one:

GEOL 340 Chem. of Natural Waters (4)

CHEM 380 Environmental Chemistry (4)

GEOL 421 Applied Hydrogeology (3)

Note: The Environmental Geology Minor (with geology major) is only available to students pursuing the Geology BA degree. Because of the overlap in required courses (GEOL 220 and CHEM 122), this minor is not available to students completing the Geology BS degree program – BS students can take the courses, but cannot earn the minor. It is possible that in the future we will create a version of the Environmental Geology minor that can be completed by Geology BS majors.

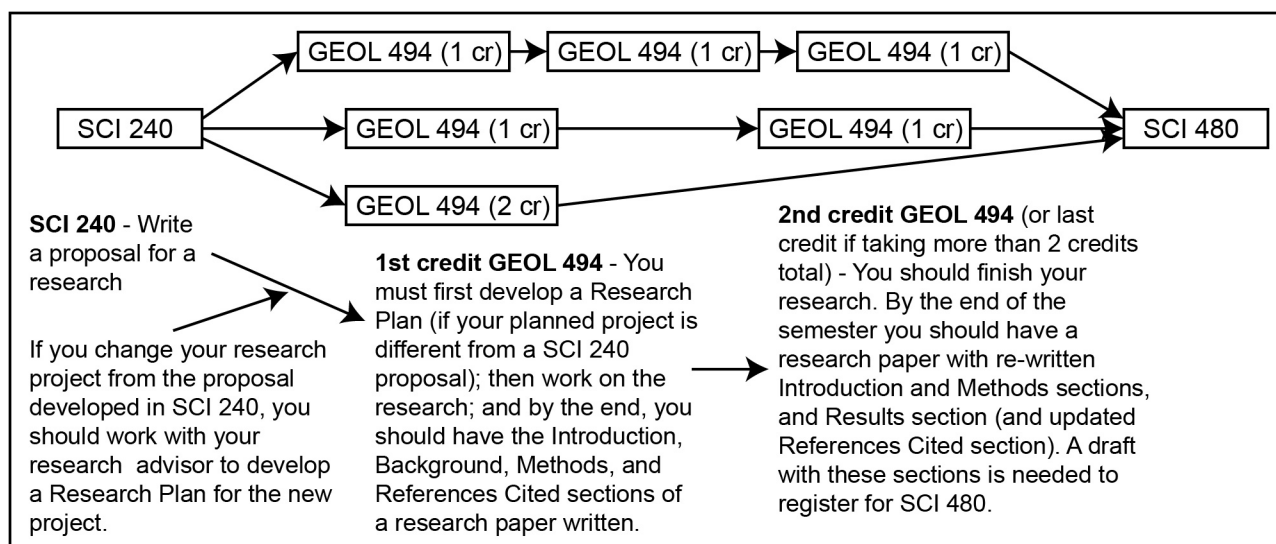
Guide to Student Research in Geosciences

Introduction

As a Geology or Earth Science major, you will be expected to conduct a research project. You will present the results of your research in SCI 480 Seminar, typically in your final semester of course work. The research itself is not carried out in SCI 480, but rather is planned and carried out prior to SCI 480 in a sequence of SCI 240 Research Methods and GEOL 494 Directed Research in Geology. In SCI 240 Research Methods, you learn some basics about carrying out research, but the focus is on development of a research project. The primary product of SCI 240 is a formal research proposal. After developing a research proposal in SCI 240, the research is carried out in GEOL 494 Directed Research in Geology. Starting with students entering MiSU fall 2015 or later, the Geology BA requires two credits of GEOL 494. While GEOL 494 is not required for the Earth Science BSEd program, the research still needs to be completed between SCI 240 and SCI 480.

Plan Ahead!

The SCI 240 – GEOL 494 – SCI 480 sequence used to plan, carry out, and then present results of a research project takes time, and so it requires planning ahead. The nature of the research project will dictate the amount of time required for GEOL 494 (or for simply carrying out the research if GEOL 494 is not required). The two credits of GEOL 494 may be taken in one semester, or one credit at a time over two semesters. It is also possible to take GEOL 494 more than twice if you are engaged in a longer project. The flow chart below shows possible options. The best option depends on how long the research will take to complete. This is something that should be considered carefully, and realistically, with your research advisor. Regardless of how you take the GEOL 494 credits, there are certain requirements that go along with the first credit. There are other requirements that go along with the second credit (or final credit if taking more than two credits of GEOL 494); these ensure that you will reach a point in your research and writing that allows you to enroll in SCI 480.



SCI 240 Research Methods (2 cr)

This course will introduce students to library skills, computer skills and communication skills used to plan and carry out research projects. Students will search for, read, and discuss journal articles; write and edit project proposals; and learn basic data management and analysis skills. Prerequisite: sophomore, junior, or senior status.

Early in SCI 240 you will be introduced to the kinds of research that faculty members in the Division of Science are doing and/or are interested in doing. If there are possible research projects that interest you, you should investigate these further by discussing them with the faculty member(s). If you have your own idea for a research project, you should discuss it with the faculty member best suited to help you with that type of research.

During SCI 240, as you develop and refine a research proposal, you should work closely with the faculty member who would serve as your research advisor. He or she can provide you with background material and help you understand the methods necessary to carry out such research. You should also have the research advisor read your project descriptions and proposal drafts throughout SCI 240. This will help ensure that you develop a feasible plan for completing your research.

GEOL 494 Directed Research

Students conduct research under direction of a faculty mentor. The topic and goals are agreed to by student and mentor in writing at the beginning of the research. A requirement for successful completion of a second credit of GEOL 494 on a project is that the student will submit an acceptable draft of a research paper that includes introduction/background, methods, and results. Repeatable for credit.

GEOL 494 is a required course for the Geology BA under the revised curriculum (2 credits required). It is in GEOL 494 that you carry out your research. If you are still under “old catalog” requirements for the Geology BA, you are not required to take GEOL 494. However, if you are going to be doing research, you should be enrolling in GEOL 494. You may not be held to the new requirements that go along with GEOL 494, but in the end (regardless of whether you take GEOL 494) you will have to have a paper written up through Results in order to get into SCI 480 (that is not a new requirement).

Certain expectations go along with the GEOL 494 credits; certain things should be done during the first credit, and additional things during the second credit (or last credit if taking more than two credits total). This is all to prepare students for SCI 480 Seminar. To get into SCI 480, the expectation is that students have a majority of their research paper written; they must have the Introduction, Background, Methods, Results, and References Cited sections. The Discussion and Abstract can be written during SCI 480. In some cases, students may get permission to enroll in SCI 480 if there are a few more results to gather, and if the timeline for getting those results is short. The reason for the expectations for getting into SCI 480 is so students can be successful. In the past, students who have tried to carry out their research, do all their writing, and prepare a presentation all in one semester have not been successful.

Each time you enroll in GEOL 494 you and your research advisor should complete the Research Plan and Objectives form. Two things should be attached to the form:

- SCI 240 proposal, or a Research Plan (if the research is not based on a SCI 240 proposal); and
- Specific Research Objectives form describing specific research objectives and target dates for the semester.

On the Research Plan and Objectives form you will also indicate whether this is your first, interim, or final enrollment in GEOL 494. The expectations for the semester (beyond completing your specific research objectives) depend on whether this is your first enrollment in GEOL 494 (and you will take it again later), an interim enrollment (not your first, but not your last), or your final enrollment. Regardless of your specific situation, one expectation is that you keep a Research Journal detailing the work you do. Your specific situation does, however, determine expectations in terms of what you must have written by the end of the semester.

If you will enroll in GEOL 494 more than once prior to SCI 480:

During your first enrollment in GEOL 494, you should complete (by the end of the semester) a draft of a research paper that includes Introduction, Background, Methods, and References Cited sections. During your final enrollment in GEOL 494, you are expected to complete a research paper (revised if you completed an earlier draft) that also includes your Results section.

If you are enrolled in GEOL 494 and it is not your first time nor your last time, you are not required to complete an updated draft of your research paper unless that is a specific research objective agreed upon by you and your research advisor.

If you will enroll in GEOL 494 only once prior to SCI 480:

If your research is such that it can be completed in one semester, and you are going to enroll in the required two credits of GEOL 494 in one semester, the expectations are the same as described above for final enrollment. You are expected to complete a research paper that also includes Introduction, Background, Methods, Results, and References Cited sections.

The forms that should be used when taking GEOL 494 are shown on the following two pages. These forms are available from your research advisor or the Geosciences program coordinator.

GEOL 494 Directed Research in Geology

Research Plan and Objectives

Semester _____ GEOL 494 credits _____

Student _____ (print name) Research Advisor _____ (print name)

Title of Research Project: _____

- Research Plan:**
- ☐ This project was the subject of my SCI 240 proposal. A copy of the proposal is attached to this form.
 - ☐ This project was the subject of my SCI 240 proposal, but the project has been modified from what I originally proposed. A copy of a modified proposal is attached to this form.
 - ☐ This project was not the subject of my SCI 240 proposal. A research plan consisting of Introduction, Background, Methods, and References Cited sections is attached to this form.

Research Objectives: Specific research objectives should be described using a Specific Research Objectives page (or pages) that should be attached to this form. You should describe specific objectives to be met in carrying out your research, and each should have a target date for completion. If you are developing a new project that was not the subject of your SCI 240 proposal, or if you are getting involved in research early (before taking SCI 240), development of a Research Plan can be one of your objectives – but this should be done early in the semester.

Course Requirements:

- ☒ You are expected to keep a record of your work in a Research Journal. The type of notebook you use for this is up to you, but a hard-bound notebook is best. Entries should be dated, and they should be written **legibly in ink**. The journal should be submitted for review at the end of the semester.

Check one:

- ☐ **First semester of enrollment in GEOL 494.** Check this if you are enrolling in your first credit(s) of GEOL 494, and you intend to enroll in GEOL 494 again in a subsequent semester to complete your research. You are expected to complete a draft of your research paper that includes your Introduction, Background, Methods, and References Cited sections. It should be a revision of your SCI 240 proposal or Research Plan that expands your background material and updates your methods (e.g., changing from future tense to past tense). It is also recommended that you include a Results section that presents the results obtained thus far.
- ☐ **Interim semester of enrollment in GEOL 494.** Check this if you are enrolling in GEOL 494 for the second time (or more), and you intend to enroll in GEOL 494 again in a subsequent semester to complete your research. Although it is not a requirement in this case, it is recommended that you complete a revision of your research paper by the end of the semester.
- ☐ **Final semester of enrollment in GEOL 494.** Check this if you are enrolling in your final credit(s) of GEOL 494 prior to enrolling in SCI 480; also check this if you are enrolling in your first and only credits of GEOL 494. You are expected to complete a draft of your research paper that includes your Introduction, Background, Methods, Results, and References Cited sections. A draft that includes Results is required for enrollment in SCI 480.

Student _____ (signature) Research Advisor _____ (signature) Date _____

GEOL 494 Directed Research in Geology

Specific Research Objectives

page ____ of ____

Specific research objectives should be listed (and briefly described) chronologically as much as possible.
A target date should be given for each objective.

Student _____ Semester _____

Research Objective	Target Date

Student _____ (signature) Research Advisor _____ (signature) Date _____

SCI 480 Seminar (3 cr)

Students present and discuss original student research project. Time in this course is also dedicated to a review of fundamental aspects of the discipline of their major and successful completion of a comprehensive exam. Prerequisites: 2 credits of GEOL 494, senior status, permission of instructors.

During SCI 480, you will work through multiple drafts of your research paper, improving it based on editorial comments from your research advisor and the SCI 480 instructors. The better the shape of your research paper coming into SCI 480, the easier this will be. At a minimum, to enroll in SCI 480 you must have a draft of your paper that includes the Introduction, Background, Methods, Results, and References Cited sections. You can also include the Discussion section and an Abstract if you are far enough along in your writing. Normally, you will be adding the Discussion section and an Abstract during SCI 480.

In addition to working on your research paper, you will spend time preparing for your oral presentation. This will be a 30-35 minute presentation scheduled for the latter part of the semester. One day a week in SCI 480 is also dedicated to review sessions designed to help you prepare for a required exit exam to be taken at the end of the semester.

Geology (GEOL) Courses

Long-Range Schedule

The Geosciences program has maintained a regular rotation to its course offerings. The current long-range schedule is shown below. This can be used to plan out your academic program.

		Semester	Fall	Spr	Fall	Spr	Fall	Spr	Fall	Spr	Fall	Spr	Fall	Spr
		Year	18	19	19	20	20	21	21	22	22	23	23	24
GEOL 101	Environmental Geology		X	X	X	X	X	X	X	X	X	X	X	X
GEOL 105	Physical Geology		X	X	X	X	X	X	X	X	X	X	X	X
GEOL 106	Historical Geology			X		X		X		X		X		X
GEOL 108	Earth and Planetary Science		X	X	X	X	X	X	X	X	X	X	X	X
GEOL 210	Minerals and Rocks			X		X		X		X		X		X
GEOL 220	Introduction to GIS			X		X		X		X		X		X
GEOL 260	Energy Resources		X		X				X				X	
GEOL 290	Regional Geology					X				X				X
GEOL 300	Geologic Field Methods		X				X				X			
GEOL 305	Methods in Mineralogy & Petrology		X				X				X			
GEOL 310	Igneous & Metamorphic Petrology			X				X				X		
GEOL 311	Paleontology		X				X				X			
GEOL 321	Hydrogeology					X				X				X
GEOL 322	Geomorphology				X				X				X	
GEOL 323	Global Climate Change			X				X				X		
GEOL 331	Soils						X				X			
GEOL 340	Chemistry of Natural Waters				X				X				X	
GEOL 361	Structural Geology					X				X				X
GEOL 471	Sedimentation & Stratigraphy				X				X				X	
GEOL 494	Directed Research in Geology		X	X	X	X	X	X	X	X	X	X	X	X
SCI 240	Research Methods		X	X	X	X	X	X	X	X	X	X	X	X
SCI 480	Seminar		X	X	X	X	X	X	X	X	X	X	X	X

Geology listed in the catalog (see following section) that are not shown in the long-range schedule are not going to be offered, at least based on current plans. Planned offerings could change if staffing in Geosciences changes. Courses not on the planned schedule could perhaps be taken as an Independent Study.

Course Descriptions

GEOL 101 Environmental Geology with Lab (4 cr)

Mankind's interaction with the earth. Major environmental problems facing citizens today including: water resources, energy and mineral resources, and geologic hazards. Local field trips. Lecture, 3 hours; laboratory, 2 hours.

GEOL 105 Physical Geology with Lab (4 cr)

Earth as a physical body, its structure, composition, and the geologic processes acting on and within the earth. Designed especially for students with a specific interest in geology and for those students contemplating a major in sciences. Field trips. Lecture, 3 hours; laboratory, 2 hours.

GEOL 106 Historical Geology with Lab (4 cr)

Earth through time, its origin, history, and the history and evolution of animal and plant life. Laboratory study of fossils, sedimentary rocks, and stratigraphic problems. Field trips. Lecture, 3 hours; laboratory, 2 hours. Prerequisite: GEOL 105.

GEOL 108 Earth and Planetary Science (4 cr)

An introduction to the physical geology of Earth and astronomy, focusing on our solar system. Earth's materials and structure; internal and surficial processes that work to shape Earth; the history of Earth. Introduction to astronomy, including Earth's Moon, the planets and minor bodies of our solar system, the Sun, and the universe beyond our solar system. Lecture, 3 hours; laboratory, 2 hours.

GEOL 127 Environmental Earth Systems (4 cr)

This course is an introduction to Earth Science with an emphasis on people's connections to environmental issues. Earth science is covered within an Earth systems framework with an emphasis on interactions, now the various Earth systems interact with one another. It also deals with how Earth interacts with people, including how Earth affects people (resources, hazards), and how people affect Earth in both positive and negative ways. An underlying concept in this course is stewardship: how people can live with Earth responsibly, working toward a sustainable future.

GEOL 210 Minerals & Rocks (3 cr)

Physical, chemical, structural, and optical properties of minerals; description and identification of common rock-forming and ore minerals; mineral associations and introduction to classification of common rock types. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: GEOL 105.

GEOL 220 Introduction to GIS (3 cr)

Introduces students to theory and techniques of geographic information systems (GIS), which includes the discovery, management, analysis, and display of spatial data. GIS is a valuable tool in disciplines that deal with spatial data, including geography, history, field or environmental sciences, epidemiology, economics, and business. This course is equivalent to GEOG 289. Lecture, 2 hours; laboratory, 2 hours.

GEOL 240 Geology of North Dakota (3 cr)

Geology of North Dakota for including historical geology of North Dakota and surrounding areas; Precambrian basement rocks; Phanerozoic sedimentary rocks; glacial geology; relationships between geology and physical geography (landforms); and existing and potential economic resources of North Dakota. Weekend field trip(s) required. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: GEOL 105.

GEOL 260 Energy Resources (3 cr)

A survey of energy resources including fossil fuels, renewable, nuclear and unconventional sources. Includes origins, extraction, geography (major reserves, producers, and consumers), uses, and environmental implications. Field trips. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: GEOL 105.

GEOL 290 Regional Geology (3 cr)

A study of the geology of a particular region in the United States or abroad. Class time involves introduction to the geology and preparation for a field trip to the region. Field trip is typically 10-14 days long and involves hiking and camping. Special fees required. May be repeated for credit. Lecture, 2 hours; field trip required. Prerequisite: GEOL 101 or GEOL 105 or consent of instructor.

GEOL 300 Geologic Field Methods (3 cr)

Geologic mapping and sampling techniques. Students use basic mapping instruments, gather data and record it while in the field, and construct complete and accurate geologic maps, cross sections, and stratigraphic columns. Field trip(s) required. Lecture, 1 hour; laboratory, 4 hours. Prerequisites: GEOL 106 and GEOL 210, or consent of instructor.

GEOL 305 Methods in Mineralogy and Petrology (2 cr)

Application of modern laboratory methods to the study of minerals and rocks. Methods include optical and scanning electron microscopy (SEM), analysis of bulk materials by ICP-AES and/or XRD, and SEM-EDS microanalysis of minerals. Students apply these methods while working on a research-based petrologic project. Laboratory, 6 hours. Prerequisite: GEOL 210.

GEOL 310 Igneous & Metamorphic Petrology (3 cr)

Description and classification of igneous and metamorphic rocks based on mineralogy, textures, and chemical compositions; study of the origins of rocks through laboratory investigation of suites of related rocks. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: GEOL 305.

GEOL 311 Paleontology (4 cr)

Fossilization, classification, evolution, and paleoecology. Geologic history and identification of major invertebrate phyla. Laboratory emphasizes fossils identification. Offered alternate falls. Field trip. Lecture, 2 hours; laboratory, 4 hours. Prerequisites: GEOL 106 or BIOL 151.

GEOL 320 Oceanography (3 cr)

Nature, origin, and evolution of ocean basins and sea water. Sea water chemistry, movement, and ability to support life. Life forms. Lecture, 2 hours; laboratory, 2 hours. Prerequisite: GEOL 105.

GEOL 321 Hydrogeology (3 cr)

Surface water hydrology; runoff and stream flow; groundwater hydrogeology: distribution of groundwater, aquifer properties, local and regional groundwater flow, geology of groundwater occurrence; groundwater resource development and management; water law. Lecture, 2 hours; laboratory, 3 hours. Prerequisite: GEOL 210.

GEOL 322 Geomorphology (4 cr)

Processes that shape Earth's surface. Effects of rock type, geologic structures, and climate on the formation and evolution of landforms. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: GEOL 210.

GEOL 323 Global Climate Change (3 cr)

Examination of physical, chemical and biological processes that cause environments to change naturally or under the influence of human activities. Consideration of small watersheds, large lake systems and global atmospheric-ocean systems including meteorological processes. Emphasis on positive and negative feedback in controlling environments and their susceptibility to change. Prerequisite: GEOL 101 or GEOL 105 or GEOL 108.

GEOL 331 Soils (4 cr)

Principles of soils including formation, properties, and classification. This course includes the use of soils information in environmental applications. Lecture, 3 hours; laboratory, 3 hours. Prerequisite: GEOL 210.

GEOL 340 Chemistry of Natural Waters (4 cr)

Principles of aqueous chemistry, interactions between water and geologic materials, and the chemical nature of various natural waters; includes both fresh and saline waters found in both surface water environments (streams, lakes, oceans) and subsurface environments (vadose zone and saturated zones). Lecture, 3 hours; laboratory, 2 hours. Prerequisite: GEOL 210. Prerequisite or Co-requisite: CHEM 121.

GEOL 361 Structural Geology (4 cr)

Stress, strain, mechanical behavior of rocks; description and interpretation of folds, faults, joints, and foliation; tectonic processes; interpretation of geologic maps and field data. Lecture, 2 hours; laboratory, 4 hours. Prerequisite: GEOL 210.

GEOL 390 Regional Field Geology (3 cr)

Application of geologic field methods to a particular area or areas. Field work focuses on rock unit descriptions, stratigraphic section measurement, and geologic mapping in areas of moderately complex geology. One hour of lecture per week is used to prepare for field work. The field work requires a 15-day trip. Prerequisite: GEOL 300.

GEOL 411 Field Geology (6 cr)

The methods of geology, including the preparation of stratigraphic columns, cross sections and geologic maps integrated with paleoenvironmental interpretation and structural history. Students must write professional level reports. Offered in summer. Prerequisites: GEOL 361, GEOL 471, and consent of instructor.

GEOL 421 Applied Hydrogeology (3 cr)

Mass transport in vadose and saturated zones; origin and behavior of inorganic and organic contaminants; investigative techniques; groundwater models; site remediation. Lecture, 2 hours; laboratory, 3 hours. Prerequisite: GEOL 321.

GEOL 471 Sedimentation and Stratigraphy (4 cr)

Origins, characteristics, and classification of sedimentary rocks. Techniques of study, interpretation of data, lithostratigraphy, biostratigraphy, chronostratigraphy, and correlation. Field trip required. Lecture, 3 hours; laboratory, 2 hours. Prerequisites: GEOL 106 and GEOL 210.

GEOL 494 Directed Research in Geology (1-2 cr)

Students conduct research under direction of a faculty mentor. The topic and goals are agreed to by student and mentor in writing at the beginning of the research. A requirement for successful completion of a second credit of GEOL 494 on a project is that the student will submit an acceptable draft of a research paper that includes introduction/background, methods, and results. Repeatable for credit.