

Research in Geology: A Primer

Geology majors have the possibility of doing independent research work throughout their college careers, and the Department encourages all of our majors to get involved in one or more research projects. Research involving both literature review and original work introduces a student to a dynamic community of Earth scientists who act as colleagues, collaborators, peer reviews, and intellectual resources. Original research also provides an opportunity for students to demonstrate their creativity and self-motivation and can thus provide an advantage when applying for jobs, internships, and graduate school.

OPTIONS

A number of sophomore and junior majors undertake research projects in conjunction with faculty members and may receive GY207 or GY307 credit for that work, depending on the coursework background they have coming into the project. Most senior majors undertake an independent research project. They can receive GY405 credit and use the project to fulfill their major “capstone” requirement *if* the project involves a significant amount of original work. Most seniors do this. If the project involves literature review only it can receive GY307 credit, but not GY405 credit, and will not satisfy the capstone requirement.

Consent of instructor is required for all of these block research options. More details are below.

1. GY207; GY307: Independent Study in Geology

Independent research projects based on laboratory, field or library investigations. May be taught in extended or regular format.

With the consent of a faculty advisor, students may take GY207 after they have completed GY130, GY135, or GY140. Students who have also completed GY211, GY212 may take GY307. NOTE: registration for GY207/GY307 must take place at least one month before the block begins.

This type of research project involves working with a faculty advisor who will help develop, monitor, and evaluate the work. The nature and outcome of a project can be quite varied (e.g. a review of literature and summary paper, independent research and a poster or oral summary, possible presentation of results at Geology Day). Note that while it may be possible to complete a project during a single block, it is not necessary to do so. Work may take place over summer, winter and block breaks or as an ‘overload’ while taking other classes. It is not possible to receive more than one block of GY207 or 307 credit for a single project.

2. GY405: Research Topics in Geology

Student participation in original research. The particular topic, chosen in conjunction with a faculty member, to be included in the course title whenever offered.

As noted in the course description, this type of research project also involves working with a faculty advisor who will help develop, monitor, and evaluate an *original* research project. Original research must include data collection, data compilation or data modeling followed by interpretation as part of the project. This type of project fulfills the “capstone” requirement of the major.

At a minimum, any student undertaking original research for GY405 credit must present a summary of their findings at Geology Day, as well as fulfill any other conditions agreed upon with their faculty advisor. Students also have the option of developing their research project into a *senior thesis*. A thesis is a written document that follows a prescribed scientific format and that is published in the library. The ‘thesis’ designation is not conferred on a project until this document is completed and approved by the faculty advisor (see section 2.4 for basic criteria that often lead to ‘thesis’ designation).

In general, it is *not* possible to complete original research during a single block, and work must take place over summer, winter and block breaks, **or** as an ‘overload’ while taking other

classes. As a reflection of the additional time that is often needed to complete original research, it is possible to enroll and receive credit for two blocks of GY405 instead of one. Many times, one of two GY405 is a data collection and analysis block (sometimes involving use of instrumentation at a university) and the second is devoted to writing and preparation of data-presentation diagrams and illustrative figures to support the written text.

2.1 *Research proposals*

Any senior who plans to undertake an independent research project as part of a GY405 block must write a research proposal. In this document the scientific background, research question(s) at hand, and planned work are summarized, and a bibliography of cited works and key literature is provided. These proposals are reviewed and evaluated by at least two faculty members. Please ask your faculty advisor for details on this process. *Guidelines for the senior research proposal are provided in the preceding pages.*

2.2 *Deadlines*

Deadlines for research proposals and for the completion of rough drafts and final drafts associated with GY405 projects vary slightly from year to year and are posted on the academic year calendar in the geology department office.

In general, the deadlines are:

- Research proposals – due the first day of block 3.
- First, complete drafts of papers – due at the end of block 6 to the advisor. Must include bibliography and figures.
- Revised, complete drafts of papers – due to the advisor and second reader at the end of block 7. Must include correctly formatted bibliography (see p. of this doc) and figures.
- Final drafts of the research papers – due at the end of the second week of block 8.

Additional deadlines may be set by the advisor.

Within research papers (including all drafts), a bibliography of cited works and relevant figures (with captions) are to be included. Figures and Tables should be numbered in the order that they are mentioned in the text (and ‘tables’ of data should not be referred to as figures).

As for any other block course, the failure to adhere to the stated deadlines for senior research papers and/or submission of incomplete work may result in a re-examination of credit or affect the grade that a student receives for the GY405 or GY307 block.

2.3 *Role of second readers*

When it comes to senior research as part of a GY405 block, it is ultimately up to the faculty advisor to (1) decide if a student has done all that is necessary to receive credit for completing a research project/GY405 block, and (2) to decide whether a written research paper will be approved as a thesis.

The second readers of research papers also plan an important role, which is to provide objective/outside feedback on the final draft of a potential thesis paper. This feedback can be used (1) by students to improve their papers, (2) by the advisor when considering whether the research paper should be designated as a ‘thesis’, and (3) by all faculty when seniors are being considered for the honor of distinction at graduation with Distinction in Geology. In a certain sense, the feedback provided by the second reader functions as a form of peer review, that is a vital element of the proposal-writing and publication process in the natural sciences.

In order for a second reader to be assigned, a student must have a thesis draft that is complete, has already undergone substantial revision, and is available for the second reader by the end of block 7. If this is not the case, a second reader will not be assigned to read the entire draft. In such situations, however, the advisor can request that a second reader provide feedback on a specific subsection of the paper that is complete.

The lack of a second reader does not preclude a paper from becoming approved as a thesis but will serve as a significant impediment because the document under consideration will not have been provided with any outside/objective feedback for the student and the advisor to consider.

2.4 Basic criteria associated with the 'thesis' designation

The following list is not meant to be all-inclusive, and a student must meet with their advisor to discuss any additional content requirements that are expected for a specific paper/project. For a paper to be considered as a thesis it should:

- Follow through on the work promised in the research proposal
- Include all sections as agreed upon with the faculty advisor
- Include an extensive bibliography* that demonstrates a student's willingness/ability to do literature review that (1) places their research in a broader scientific context, and (2) describes its significance. – **formatted according to the specified guidelines.*
- Include a comprehensive discussion section that (1) incorporates outside data or perspectives from published literature to help provide context for interpreting the student's data, and (2) place interpretations in a broader context and discusses their significance
- Incorporate feedback that is given by the advisor and second reader

Distinction in Geology

'Distinction in Geology' is a recognition by department faculty of extraordinary academic achievement on the part of a senior geology major, on that is noted on a student's academic transcript and diploma. Because there are no special requirements to be considered for distinction, *all* seniors are eligible. It should be realized, however, that 'distinction' implies unusually strong performance, and not all seniors will be awarded this honor. In fact, it may only be awarded to one or two students a year.

There is no checklist of achievements that guarantees a student will be awarded distinction; instead faculty consider the academic goals students have set for themselves, how well the goals have been met, and the individual initiative displayed in achieving the goals. Goals that have traditionally helped students in this regard include:

- Taking more than the required number of courses in the major and maintaining a high-grade point average (or showing a marked improvement in grades over time)
- Taking a number of courses in an important related field (e.g. math, computer science, chemistry, physics, biology, environmental science) and maintaining a high-grade point average (or showing a marked improvement in grades over time)
- Successfully undertaking a senior project, including a Geology Day presentation.
- Successfully completing a senior thesis

If you would like advice on how best to set, and achieve, your academic goals with distinction in mind, please contact your faculty advisor.

Preparing a Proposal for Senior Research in Geology at Colorado College

I. Overview

The senior research / senior thesis proposal is a concise written document that describes the proposed research and its scientific significance, together with a description of how the study will be carried out. In it you should: 1) present a brief review of previous work published in the literature, 2) summarize any work you have completed at the time of writing the proposal, for example, from a Buster summer research project; 3) describe the work you will do during the academic year, including field and laboratory studies; 4) provide a detailed timetable for completion of the research work; and 5) present a bibliography of works cited in the proposal plus other critical publications.

Students must stay informed about research-related deadlines to ensure that all are met. Specific dates for deadlines are posted on the Geology office door, including the research proposal deadline on the second Monday of Block 3 (ordinarily) and abstract deadline for Geology Day presentations (in Block 7), among others. Aspects of the research effort that students should plan for include:

- Students are required to work with their faculty advisor on a draft proposal in advance of the proposal deadline in Block 3. Proposals that have not been reviewed by the faculty advisor will not be accepted.
- Two department faculty read the proposals, and together they judge the quality of the proposal and feasibility of the proposed work, to determine whether the student may proceed with the research project.

II. Guidelines for Proposal Content and Organization

A. Introduction

Proposals should begin with **title, student name, and date**, followed by a well-crafted, concise **Introduction** that places the research into a larger context, making its significance clear. Proposals need to be spaced at 1.5 lines. The first paragraph of the Introduction should concisely describe the nature of your proposed research. What is the scientific project you are undertaking? What is the particular hypothesis you are testing? The second paragraph should discuss the significance of the research. What is the larger context for the problem you are addressing and why should we be interested in it as geologists? **Citations** of relevant literature are an inherent part of a strong Introduction.

B. Geological Background/Previous Work

Summarize aspects of the geological setting and/or develop the geological context, based on published literature and your own work completed to date. • What work has been accomplished by previous researchers and what is the current state of knowledge? • What is known about your project? • What questions must be answered in order to advance understanding on the topic? • What work have you already done on this project? Include a location map and/or diagrams that summarize key data from work completed. What methods and techniques did you use/are you using in your study?

C. Proposed Work

1. What are you proposing to do in order to complete the research?
2. What techniques (field, laboratory, literature search) are you planning to utilize? Have you met with faculty members and with Steve Weaver to discuss the computer lab, use of Dept instrumentation and policies? What information will be gained from these approaches that will help you address the research questions? Demonstrate that you understand what you must do to complete this research.

D. Timetable

Include a detailed timetable to show that you understand the amount of time required to complete the proposed work, stating when you are going to do the work (including writing and revision) and indicating how much time is needed for each step. For example, geochemistry students might include the number of samples they will prepare and analyze, noting that they will need at least 1-1/2 hours per sample, and allocate a specific two-week period of time to that work. Faculty will review the timetable with great care to determine whether adequate time is allotted to finish the project, including multiple drafts of the final product!

E. References Cited and selected Bibliography

Use the format in the journal *Geology*. See a recent issue of *Geology* for the appropriate format, or go to <http://www.geosociety.org/pubs/geoguid5.htm> to review the guidelines for paper preparation and citation style. See also below. Cite all the works mentioned in your proposal; plus a few key articles that are important for you to study as the project progresses.

III. Evaluation

Two members of the department faculty review and comment upon each of the proposals. We will assess the clarity of thought and the organization of your scientific writing, as well as the caliber of the research itself. Successful proposals describe original, high quality research and entail extensive rewriting. We will evaluate your timeline to judge whether the work can be accomplished in the time available. Most important, we will decide, on the basis of your proposal, whether the work is appropriate in scope and investigation methods.

Below is the rubric that faculty use for assessment of research proposals associated with student research (e.g. GY405) and student work in advanced courses (e.g. GY370, GY400, and GY445). The criteria are used to evaluate an individual student's written work/proposal within a larger context of content, quality of expression and thought, and feasibility.

<u>Content</u>	Poor	Basic	Accomplished	Excellent
Introduction/ Rationale	No clear rationale/ research question or a weak rationale for the project	Some rationale presented, begins to motivate the work, significance or the research question may be unclear	Provides and discusses a suitable and significant rationale, with appropriate research questions	Accomplished rationale that is <u>also</u> persuasive and creative
Background/ Scholarly Context	Author does not demonstrate awareness of the scholarly literature, may over-rely on too few sources	Author demonstrates a reasonable awareness of the literature and relates an applicable geologic setting for the work	Author demonstrates broad awareness and situates own work within the literature, geological setting is clearly related and appropriate to the subdiscipline	Author is accomplished <u>and</u> makes a contribution to the field or identifies a new direction for investigation
Methods/ Approach	Not clear what will be done or why, or method inappropriate	Approach is generally appropriate, synopsis of steps in research given	Clearly described and justified approach that is appropriate and fully described	Accomplished methods that are <u>also</u> creative and sophisticated

<u>Content</u>	Poor	Basic	Accomplished	Excellent
Argument	Weak, invalid, or no argument with simple assertions	Some arguments valid and well supported,	Main arguments valid, systematic, and	All arguments both well-supported and compared to

		some not	well-supported	conflicting explanations
Extra	Poor	Basic	Accomplished	Excellent
Scope/ Complexity	Frames complex questions as simple ones	Invests questions with some complexity, may over-simplify or over-extend	Reasonable balance between focus and complexity	Frames the topic with full appreciation of its complexity while retaining appropriate focus

Writing	Poor	Basic	Accomplished	Excellent
Grammar and Spelling	Significantly impairs readability	Frequent or serious errors	Some minor errors	Virtually no errors
Organization	Needs significant reorganization	Structure is of inconsistent quality, may have choppy transitions and/or redundancies or disconnections	Structure supports the argument, clearly ordered sections fit well together	Structure enhances the argument, strong sections and seamless flow
Clarity and Style Appropriate to Geologic Genre	Gets in the way of reading for content	Beginning to be comfortable with appropriate conventions, style is inconsistent or uneven	Effective prose style, follows relevant scholarly conventions, emergence of voice	Mastery of the genre, including elegant style, established voice
References	Few to no citations, inconsistent or inappropriate formatting of bibliographic information	Many citations, but may be incomplete, bibliographic information exists but may not match all citations	Citations generally included where appropriate in text, complete bibliographic information with few errors	Rich diversity of citations included in all places necessary, bibliographic information complete and appropriate to the genre

Guidelines for Citation of literature and internet sources

Written papers and proposals should cite (author, year) within the text, with full reference list provided at end of paper.

The **guidelines** for paper preparation and citation style can be found at:

<http://www.geosociety.org/pubs/geoqid5.htm>

Note that the table at the bottom of that webpage has clickable links to "Samples of different reference styles." You do not need to write an abstract for the Block 3 research proposal (but you will need to for your major research paper!).

Citation of **on-line resources** should be in the format stated by the American Chemical Society:

1. Uniform Resource Locators (URLs) for Web Pages

Format: Author, if available. Title of page as listed on the site. Address of page (date accessed).

Example: Lichtman, J.. American Chemical Society (ACS) Citation Style for Internet Sources.

www.cofc.edu/~chem/seminar/492/citing.htm (accessed Sept. 2008).

2. Online Periodical Article

Format: Author(s), Year, Title of article. *Journal name*, volume (number), Digital Object Identifier. URL.

Example: Luyendyk B. P., Wilson D. & Siddoway C.S., 2003. The eastern margin of the Ross Sea Rift in western Marie Byrd Land: Crustal structure and tectonic development. *Geochemistry, Geophysics, Geosystems (G3)*, 4 (10), 1090, doi:10.1029/2002GC000462.