Student Manual
Department of Geology
Whitman College

Welcome to the Department of Geology. We are delighted that you have chosen to major or minor in our department. We have created this manual to inform you of our requirements and provide you with the information that will help you get the most of your time with us and plan your course toward graduation. The faculty has a variety of backgrounds, styles, and areas of expertise. The curriculum is designed to acquaint students with a broad range of content and theoretical areas, and at the same time provide rigorous training in empirical research. Many of our students go on to graduate school and report their appreciation for the rigorous training our program provided, particularly the senior thesis research experience. There are several appendices at the end of this manual, each addressing a specific topic. For more information see the department web page and those of individual professors.

Courses.

The following courses are *required* for graduation in Geology. It is strongly *recommended* that geology majors also complete English 210 (Expository Writing) and Rhetoric 110 (Fundamentals of Public Address) no later than their junior year. Good writing is a hallmark of a good education. For those planning to pursue graduate programs in the earth sciences, Mathematics 126 and Physics 156, plus additional courses in computer science, mathematics, statistics, physical chemistry, and biology are strongly recommended. It is impossible to have too many math courses or be too quantitatively skilled.

The requirements for graduation in Geology, as specified in the College Catalog, are:

The Geology major: A minimum of thirty-six credits to include either:

either {
Geology 110 The Physical Earth
Geology 120 Geologic History of the Pacific Northwest
Geology 210 Environmental Geology
}

Geology 220 History of the Earth
Geology 320 Sedimentology and Stratigraphy
Geology 345 Mineralogy
Geology 346 Igneous and Metamorphic Petrology
Geology 350 Geomorphology
Geology 360 Paleontology
Geology 420 Structural Geology
Geology 470 Senior Seminar
Geology 358 Field Geology of the Northwest (at least 1 credit)
Geology 480 Field Mapping (at least 3 credits)

Chemistry 125, 126, 135
Mathematics 125
Physics 155.

> We strongly recommend:
> English 210
> Rhetoric 110
> If you plan to pursue graduate studies:
> Mathematics 126
> Physics 156

The Geology minor: A minimum of sixteen credits to include:

either {
Geology 110 The Physical Earth
Geology 120 Geologic History of the Pacific Northwest
Geology 210 Environmental Geology
}

Geology 358 Field Geology of the Northwest (at least 1 credit)

Please see the special requirements for **Combined Geology** programs in the College Catalog.

Field Trips. Field experience is the basis for all geologic research and is the final proving-ground for any geologic theory. We strongly encourage our majors to get into the field. We offer field trips in most courses, and invite majors and prospective majors to take advantage of Geology 158 and 358 trips as many times as they possibly can. 158 and 358 trips are perhaps best place for you to get field experience. **Geology 358, Field Geology of the Northwest**, is typically offered as a 1-credit course each semester, consisting of a Th-Su extended field trip to some interesting part of the West (generally the Pacific Northwest). Every Geo major and minor is required to take 358 once for credit, which requires that she or he write a paper summarizing the trip, including any exercises done in the field. Majors, however, can go on the 358 trip as many times as they like, without writing the paper, by signing up for 1 credit of Geology 158. Many majors go on every trip. One strategy is to go on 1-2 trips as 158 before taking it for 358 credit. The experience improves your field abilities, and may well improve your paper when you do finally take Geol 358 for credit. Geol 358 costs are heavily subsidized by the Department, and a trip typically costs the student about $30 (charged to your Whitman account). All attendees must sign up on the geotech's door prior to the trip and attend the pre-trip organizational meeting.

Occasionally one of the faculty will lead a special trip to some more exotic place during Spring Break, Semester Break, or the summer. These trips earn **Geology 158 Regional Geology** credit and are typically more involved that joining the 358 trip (hence the variable credit in the catalog). In the past, for example, Bob Carson has led trips to Africa, Ecuador, Yellowstone, Greenland, Tibet, the Caribbean, etc. These cost quite a bit more than the local trips, of course, but give majors an much broader geologic perspective.

The Department of Geology requires each major to take at least three credits of study in which independent geological investigation is pursued, preferably in the field. **Geology 480, Field Mapping**, is not regularly offered by Whitman College. We prefer that each student attend an approved summer field course offered by another college or university. There are only 3.5 geology professors at Whitman, and our regular field trips are typically limited to the Pacific Northwest. Taking a summer field course from another college or university allows our students to study under geologists with other specialties, and to learn about the geology of a different part of North America. At these field courses, generally in western United States, students learn how to make bedrock geologic maps and write geologic reports based on field work. Such field courses generally transfer as 6 Whitman credits (remember this when you plan your total credits for graduation) and cost in excess of $1,000. Whether the field course is after the sophomore, junior, or senior year, it is considered the capstone of an undergraduate geologic education.

Geology 490, Senior Research, or **Geology 498, Honors Thesis**, may, under certain circumstances, be allowed as a substitute for Geology 480. These circumstances include the following:

1. The research project must be approved early in the second semester of the junior year.
2. The research project must include geologic mapping of an area with a variety of lithologies and structures.

We urge students to carry out additional independent research in the junior and/or senior year. Such research generally, but not necessarily, involves field work as well as follow-up laboratory work. This research is often begun in the summer, and may become a senior or honors thesis.

Seniors in geology-environmental studies are required to complete a four-credit interdisciplinary senior project (**EnvS 488**) or honors project (**Geology 490**). This project should be an aspect of geology relevant to environmental science and/or environmental management.

Geology 470, Senior Seminar, is a capstone course covering various topics in the earth sciences. We attempt to address some broad topics that draw from and relate many of the sub-disciplines that you have experienced in classes. We also address such topics as academic honesty and ethics. Students are expected to complete assigned readings and make an oral presentation.

General Information

Geology Equipment

Geologists require some specific equipment, most of which is optional, but useful, for undergraduates, and essential if you plan to go on in geology. Group equipment orders are placed by the Geotech each September. There will be descriptions and a sign-up on the Geotech office door. Rock hammers ($20-30) are nice for obtaining a fresh sample at an outcrop. The Department also owns several rock hammers, so students aren't required to get one for field trips, but may be required for field camp or any other work. A hand lens is necessary for identifying small minerals and textures. Mineralogy and Petrology requires that you own one, and they are very useful in the field. Good ones cost about $30. Put yours on a cord so you can wear it around your neck and not lose it in the field. Waterproof bound field notebooks are needed for good notes in the field. A new field book is required for Geomorphology field trips, and you might need other ones for field camp, Regional, summer research, etc. They cost about $8, and are available from the Geotech. Everything is charged to your Whitman account.

The Blackboard

Much of the communication within the Department is placed on the blackboard outside room 124. Announcements, messages, and requests for students to see faculty appear often. ***Please check the blackboard daily to see if some matter concerns you.***

Geology Computer Lab

Most sciences require some specific computer programs, in addition to the typical support software (Word, Excel, etc.). The Department therefore maintains its own small computer lab. The first priority for work in the geology computer lab is for geology classroom work, then geology thesis work. E-mail and web surfing are low priority when others need to use the computers for scholastic purposes. If you are checking your e-mail in a filled lab and another student comes in, please offer your computer spot. Likewise, feel free to ask other students for a computer if necessary. Useful programs in the computer lab include: Adobe Illustrator, Photoshop, PowerPoint, and Arcview, in addition to some class-specific programs for Mineralogy, Petrology, and Structural Geology. There are also two scanners, one for PC and one for Mac. ***No food or drink is allowed in the computer lab*****.**

Science Building Keys

Any geology major can have keys to the science building if they so desire. These keys include the main entrance to the science building, the geology computer lab, and whatever lab prep room the student may be using as an office. Keys are very nice to have when finishing labs late at night. Some responsibilities come with having keys and late-night access. Do not let anyone else into the building or labs after hours. Tell them to call Campus Security if they have a good reason. Ask the department chair for a request form.

Bicycles

For fire code reasons, no bikes can be in the hallway during the day or in classrooms at any time.

Lights

In order to save energy, please remember to turn off the lights in a room if you see an empty lit room, or you leave a room empty for more than fifteen minutes.

Lab Teaching Assistants

Lab TAs are needed for assisting both Geo 110 and 210 labs. If interested, talk to the professor teaching the class. The commitment is usually 2 to 3 hours a week, and pays minimum wage. TAs not only get some teaching experience, they learn the material by reviewing it and explaining it to others.

Leeds Prize

The Leeds Prize was created to honor Dr. Albert Ripley Leeds, a geochemist (and Bob's grandfather). The display case in the hall has more information about his work. This prize honors excellence in geology and is usually presented to 1 - 5 juniors or seniors each year.

Summer Projects

Keck Geology Consortium

The Keck Geology Consortium is made up of twelve liberal arts colleges across the United States. Funding from The Keck Foundation, NSF, and the individual colleges provides geology students the chance to be involved in a large, team-based research project; an opportunity rarely available to students at smaller schools. **For the 2002 summer, there will be four projects that junior geology majors can apply for, three domestic and one international.** For more information go to the Keck Geology website at *keck.carleton.edu*.

Applications for Keck programs are due to the faculty in December, and we nominate 1-2 applicants for each project to a selection board in January. Selection announcements are made in late February. The commitment to the Keck program means that participants will be able to do research during the scheduled time in the summer. Back at Whitman, participants will finish their lab or research work and write a four-page abstract of their research project by February. This abstract will be published in the Keck Geology Journal. In April participants will attend the Keck Geology Symposium, which is held in a different place each year, where they will present their research either through a poster or an oral presentation.

Keck pays for students' room and board at the research site, and will pay up to about $400 for their transportation to the site. Keck also flies all participants to the meeting in April and provides room and board. Participants are awarded a stipend, typically between $1000 to $1200. Keck programs are a great experience and a fun way to learn about the geology of another part of the world.

Field Camps

The best way to satisfy the Geol 480 requirement is to attend a field camp. Field camp permits students to gain more experience in the field, mapping and studying geology in an area that isn't dominated by basalt. Field camps are put on by many colleges and universities around the country with summer sessions that range from 3 to 6 weeks long. Students must apply to the school/field camp, and deadlines vary greatly. Some good camps fill up early as applications are received. You should start looking in December, and be secure a place by spring break. Information about field camps may be found in the file cabinet in the geology computer lab. There is an internet service for late applications.

Summer Internships

Check the geology bulletin boards or talk to professors about possible summer internships. Some may involve research in the area, and others might be working for another college or university or a consulting firm.

Research and Professional Societies

Becoming a Professional Society Member

The Geological Society of America (GSA) offers student memberships for $20 a year. Joining entitles members to the monthly magazine, *GSA Today*, a free CD-ROM, and reduced registration fees for professional meetings. Registration can be done on-line at http://www.geosociety.org. The American Geophysical Union (AGU, www.agu.org) has student memberships for $7.

Attending Professional Meetings

Geology majors can gain some valuable experience by going to a professional meeting sometime during their undergraduate career. GSA sponsors a national meeting and several regional ones each year. Our region is the Cordilleran Section, which is meeting at Oregon State University in Corvallis mid-May this year. The 2001 national meeting is in Boston from November 5-8. Professional meetings, especially national GSA meetings, are a great time to network with graduate school contacts and geology employers from around the country. Graduate schools set up information booths at meetings; so prospective students can learn more about the geology programs at specific schools. The AGU national meeting is each December in San Francisco, a nice place to visit, but the meeting is typically during our finals week.

Presenting Research

Student research is typically presented at the Whitman Undergraduate Conference in April, in Senior Seminar, at the Keck Geology Consortium in April, or at a professional meeting. There are two different ways to present research. An **oral presentation** is usually accompanied with visuals, such as PowerPoint, overheads, or slides. A **poster** can be made using Adobe Illustrator in the geology computer lab, or in the Multimedia Lab at Hunter.

Oral presentations usually last about 15 to 20 minutes and have time for questions at the end. Posters are presented in a multiple-poster session, usually about 3 hours long, in which people come up to discuss the research with the presenters.

Specific Information for Seniors

Major Examinations

All geology majors and geology combined majors are required to pass written and oral examinations. The written test for geology majors occurs in late February. It consists of four hours of material (one hour of material written by each professor). Majors must pass both writtens and orals in order to graduate. Students attempting to get honors (see below) must pass both with “distinction,” a higher level of performance.

The oral examination for geology seniors is generally in the field. Students are individually asked questions about rocks, structures, landforms, and geologic processes. This examination usually occurs in early April.

The oral examination for geology environmental studies seniors is generally a one-hour session with two or three professors from Geology and Environmental Studies. There are similar oral examinations for other geology combined majors.

“Grades” for senior examinations are: 1) pass with distinction, 2) pass, or 3) fail. Students who fail either writtens or orals must re-take the exam. The entire senior examination is considered, however, and a weak performance on a written exam may be balanced with a strong showing in an oral exam, or vice versa.

The senior seminar (470) is attended by all senior geology majors, all geology combined majors, and all geology faculty. Each senior makes a presentation (usually the senior or honors thesis) which we discuss. We also discuss articles that we have all read, and presentations by the faculty and visiting geologists. Field trips may follow some of the presentations. Subjects discussed are likely to include: the geology of the Pacific Northwest, the history of geology, great geological controversies (e.g., the extinction of the dinosaurs), and professional ethics.

Senior Projects

Senior projects are optional. Non-Keck projects must be organized by the student. Contact a professor with whom you would like to work, and discuss some options. It helps if you have a project in mind, but a professor may offer something. Students interested in geophysics can apply for projects through the IRIS consortium (www.iris.edu). This program works similarly to Keck in that students are given financial help to go on a project in another part of the world. The bulletin boards in the geology computer lab and out in the hallway are also useful sources of information about internships or projects around the country that can be used as a senior project, such as work in the National Parks or with the National Forest Service.

Offices for Seniors

Senior geology majors working on their theses can have offices within the geology department to store material or have a private place to work. These offices usually are the small rooms off the mineralogy/petrology and sed-strat/geomorph labs. Seniors should talk to their advisors about getting an office in one of these rooms.

Honors Requirements

Students must have at least a 3.3 cumulative GPA and 3.5 GPA in their major to be eligible for honors in their major. They then must submit a proposal describing their thesis to the registrar within the first six weeks of the semester before their thesis is due (so before mid-October for Spring honor theses). Theses must be turned in to the library two weeks before Spring semester finals. Geology seniors must earn at least an A- on their thesis and pass their writtens and orals with distinction in order to graduate with honors in geology.

Graduate Schools

Students interested in attending graduate school after Whitman may get more information about graduate school programs in several ways. First, the file cabinet in the geology computer lab contains information from different grad schools around the country. Any geology professor would also be able to make recommendations about different programs or contacts that they know. Also look at specific university web pages. Lastly, professional meetings are a great place for students to go and make connections with representatives from different grad schools.

Careers in Geoscience (from AGI)

Geoscientists follow paths of exploration and discovery in quest of solutions to some of society's most challenging problems.

- Predicting the behavior of Earth systems and the universe.
- Finding adequate supplies of natural resources, such as ground water, petroleum, and metals.
- Conserving soils and maintaining agricultural productivity.
- Developing natural resources in ways that safeguard the environment.
- Maintaining quality of water supplies.
- Reducing human suffering and property loss from natural hazards, such as volcanic eruptions, earthquakes, floods, landslides, hurricanes, and tsunamis.
- Determining geological controls on natural environments and habitats and predicting the impact of human activities on them.
- Defining the balance between society's demand for natural resources and the need to sustain healthy ecosystems.
- Understanding global climate patterns.

Geoscientists gather and interpret data about the Earth and other planets. They use their knowledge to increase our understanding of Earth processes and to improve the quality of human life. Their work and career paths vary widely because the geosciences are so broad and diverse. The National Science Foundation considers geology, geophysics, hydrology, oceanography, marine science, atmospheric science, planetary science, meteorology, environmental science, and soil science as the major geoscience disciplines. The following list gives a glimpse of what geoscientists do in these disciplines and a variety of subdisciplines.

Atmospheric scientists study weather processes; the global dynamics of climate; solar radiation and its effects; and the role of atmospheric chemistry in ozone depletion, climate change, and pollution.

Economic geologists explore for and develop metallic and nonmetallic resources; they study mineral deposits and find environmentally safe ways to dispose of waste materials from mining activities.

Engineering geologists apply geological data, techniques, and principles to the study of rock and soil surficial materials and ground water; they investigate geologic factors that affect structures such as bridges, buildings, airports, and dams.

Environmental geologists study the interaction between the geosphere, hydrosphere, atmosphere, biosphere, and human activities. They work to solve problems associated with pollution, waste management, urbanization, and natural hazards, such as flooding and erosion.

Geochemists use physical and inorganic chemistry to investigate the nature and distribution of major and trace elements in ground water and Earth materials; they use organic chemistry to study the composition of fossil fuel (coal, oil, and gas) deposits.

Geochronologists use the rates of decay of certain radioactive elements in rocks to determine their age and the time sequence of events in the history of the Earth.

Geologists study the materials, processes, products, physical nature, and history of the Earth.

Geomorphologists study Earth's landforms and landscapes in relation to the geologic and climatic processes and human activities, which form them.

Geophysicists apply the principles of physics to studies of the Earth's interior and investigate Earth's magnetic, electric, and gravitational fields.

Glacial geologists study the physical properties and movement of glaciers and ice sheets.

Hydrogeologists study the occurrence, movement, abundance, distribution, and quality of subsurface waters and related geologic aspects of surface waters.

Hydrologists are concerned with water from the moment of precipitation until it evaporates into the atmosphere or is discharged into the ocean; for example, they study river systems to predict the impacts of flooding.

Marine geologists investigate the ocean-floor and ocean-continent boundaries; they study ocean basins, continental shelves, and the coastal environments on continental borders.

Meteorologists study the atmosphere and atmospheric phenomena, including the weather.

Mineralogists study mineral formation, composition, and properties.

Oceanographers investigate the physical, chemical, biological, and geologic dynamics of oceans.

Paleoecologists study the function and distribution of ancient organisms and their relationships to their environment.

Paleontologists study fossils to understand past life forms and their changes through time and to reconstruct past environments.

Petroleum geologists are involved in exploration for and production of oil and natural gas resources.

Petrologists determine the origin and natural history of rocks by analyzing mineral composition and grain relationships.

Planetary geologists study planets and their moons in order to understand the evolution of the solar system.

Sedimentologists study the nature, origin, distribution, and alteration of sediments, such as sand, silt, and mud. Oil, gas, coal and many mineral deposits occur in such sediments.

Seismologists study earthquakes and analyze the behavior of earthquake waves to interpret the structure of the Earth.

Soil scientists study soils and their properties to determine how to sustain agricultural productivity and to detect and remediate contaiminated soils.

Stratigraphers investigate the time and space relationships of rocks, on a local, regional, and global scale throughout geologic time -- especially the fossil and mineral content of layered rocks.

Structural geologists analyze Earth's forces by studying deformation, fracturing, and folding of the Earth's crust.

Volcanologists investigate volcanoes and volcanic phenomena to understand these natural hazards and predict eruptions.

Where Do Geoscientists Work?

Geoscientists may be found sampling the deep ocean floor or examining rock specimens from the Moon or Mars. But the work of most geoscientists is more "down to earth." They work as explorers for new mineral and hydrocarbon resources, consultants on engineering and environmental problems, researchers, teachers, writers, editors, and museum curators as well as in many other challenging positions. They often divide their time among work in the field, the laboratory, and the office.

Field work usually consists of making observations, exploring the subsurface by drilling or using geophysical tools, collecting samples, and making measurements that will be analyzed in the laboratory. For example, rock samples may be X-rayed, studied under an electron microscope, and analyzed to determine physical and chemical properties. Geoscientists may also conduct experiments or design computer models to test theories about geologic phenomena and processes.

In the office, they integrate field and laboratory data and prepare reports and presentations that include maps and diagrams that illustrate the results of their studies. Such maps may pinpoint the possible occurrence of ores, coal, oil, natural gas, water resources, or indicate subsurface conditions or hazards that might affect construction sites or land use.

Job and Salary Outlook

The employment outlook in the geosciences -- as in any profession -- varies with the economic climate of the country. The long-range outlook is good at this time. Dwindling energy, mineral, and water resources along with increasing concerns about the environment and natural hazards present new challenges to geoscientists.

According to the National Science Foundation, about 125,000 geoscientists work in the United States. Most geoscientists are employed by industries related to oil and gas, mining and minerals and water resources.

Many geoscientists are self-employed as geological consultants or work with consulting firms. Most consulting geologists have had extensive professional experience in industry, teaching, or research.

Also, many geoscientists work for the federal government or a state government agency. The U.S. Geological Survey (Department of the Interior), Department of Energy, Department of Agriculture, Forest Service, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, state geological surveys, and state departments of environment and resources all employ geoscientists.

Salary scales vary from employer to employer depending on the career path, location, qualifications of the geoscientist, and, of course, the economy.

Salaries for college graduates with bachelor's degrees start at about $29,000. Starting salaries for geoscientists with master's degrees are about $38,000 and about $42,000 for Ph.Ds.

Appendix 1: Scientific Writing

Writing is easy; all you do is sit staring in front of your keyboard or a blank sheet of paper until little drops of blood form on your forehead.

attributed to both Gene Fowler and Red Smith

Although your education within the discipline of geology is our main goal, and is the part of your education most likely to land you that first job, your ability to express yourself clearly and in an engaging fashion will control your movement up the promotional ladder. Whitman students are bright enough, but they do not necessarily write well. Writing styles vary from one discipline to another as well, and one must learn the style appropriate to a chosen field. We professors see many of the same errors occur over and over, year after year: misspelled words (despite "spell-check"), incomplete sentences, improper citations and referencing, and unintentional plagiarism. The following guidelines apply mostly to papers in the sciences, and some may not apply to the social sciences or humanities.

There is not enough room in our curriculum for each discipline to teach writing styles directly. Rather, Whitman asks that all professors take student writing seriously, correcting poor grammar, and including writing style in grading. The best way to familiarize yourself with the accepted standards for geologic papers is to read recent papers in the important journals in our field, such as *Geology* or *The Bulletin of the Geological Society of America*. Another possible source is *Suggestions to Authors of the Reports of the United States Geological Survey*. If you have questions during any stage of the writing of your paper, consult your professor and/or the English Writing Center.

General Principles

Good writing is inseparable from good thinking. Ideas are inseparable from the language used to express them. It is simply not true that your ideas are clear if your writing is not. As your thinking gets clearer, so will your writing.

Good writing is actually good re-writing. As John Updike said, "Writing and rewriting are a constant search for what it is one is saying." Very few people can put out a good first draft. Most of us have to get our ideas down and then cut, paste, restructure, elaborate, drop, reorganize, and rewrite several times before a draft is really strong.

Evaluation of your papers is typically based on:

- Clarity of thinking and writing
- Organization
- Completeness, in all respects (including figures)
- Breadth of sources, correct citations
- Grammar, spelling, punctuation, capitalization.
- Interest of subject (if the topic is chosen by the student)

Formatting

Papers must be "typed" with a word processor. Always number your pages at the bottom right corner, and make sure you staple them in correct order. The typical format is double-spaced lines. An exception is long quotations, which are indented and single-spaced. Papers must cite the literature and must include a list of references cited (see below). Print on both sides of the paper (duplex mode).

Always retain a copy of whatever you turn in. Remember, we have many papers coming in at many times during the semester. We have been known to lose one or two. If you turn in a paper of spreadsheet to an electronic "drop box" please remember to identify the file by including your name and a description in the file name itself (e.g. *Jim Smith Term Paper.doc*, *Smith Problem 3-5.xls*). Avoid unusual symbols ($, %, *), commas, or periods (other than the one separating the file name from the three-character extension), as these may confuse the server. Mac people: please humor the PC server and profs by putting a "*.doc*" or "*.xls*" extension on your files to identify the file type to PC programs.

Minimize the use of paper products. Do *not* use a folder or a title page (except for theses). The title and author go at the top of the first page. Start the *references cited* immediately after the summary/conclusions. Please use page numbers and print on both sides of the paper (instructions for duplex printing are posted in the lab), or use paper that has already had one side printed upon.

Your paper may or may not need a table of contents, an abstract, a bibliography (other than references cited), and/or appendices. Check with your professor as to what style he or she prefers.

If an **abstract** is requested, remember that *an abstract is a summary, not an introduction*. An abstract should be concise and complete. Make sure your abstract summarizes your paper: what, where, why, when, and what was determined. In other words, the reader should be able to read the abstract and get a good idea of what he/she will be reading about, including the results and the significance of those results. *Do not use phrases in an abstract that specifically state that something will be shown, demonstrated, or discussed in the paper itself.* Avoid the first-person in an abstract. Generally abstracts should not include references. To be perfectly honest, most of us read abstracts as a guide to determine if the rest of the article is going to be worth our time reading.

Illustrations (particularly maps) are important in most geology papers. **All figures should be put into the text, not bunched at the end of the paper.** For tips on how to do this see *Word Papers with Embedded Graphics* on the department or JDW web page. A figure should appear as soon as possible after it is first referenced in the text. Figures should be sequentially numbered (don't simply use the original figure number from the source) and have a clear and complete caption. A caption written by you is generally better than the original caption, because it puts the figure into the context of your paper. All maps, pictures, diagrams, figures, and tables must be mentioned in your paper, and important locations mentioned in the text should appear on the map. For example, if your paper is on Hood Canal and if you include a geologic map of western Washington, you might write, "Hood Canal is located at the eastern edge of the Olympic Peninsula (Fig. 2)." Be sure to cite the sources directly on all maps, pictures, diagram, figures, tables, etc. Include a complete reference of figure sources in your list of references cited. A brief manual on how to scan and insert figures in MS Word is available from the Department Web Page.

Most scientific papers have no footnotes. We tend to put relevant information directly in the text. References are cited as described below. Do not use terms like "*op. cit.*," "*ibid*," etc. Note the punctuation of "*et al.*" There is no comma before the term. "*Et*" is Latin for "and," and is not abbreviated; "*al.*" is an abbreviation for "*alii*" (others), hence the period. A definition of common Latin terms and abbreviations is supplied later in this manual.

Choose the right word! Do you mean a process, a landform, or an earth material? Do you need a noun or a verb? A *moraine* (landform) is composed of *till* (sediment) *deposited* (process) by a *glacier* (agent). A *pyroclastic flow* (event) *deposits* (process) an *ignimbrite* (landform), a sample of which is a *tuff* (material). *Dune sand* is a material, whereas a *sand dune* is a land form. The *outwash* (material) *crops out* (verb) along the *north* (lower case) bank of the Hamma Hamma River (upper case). The *outcrop* (noun) of *till* (material) is on the other side. *Pyroclastics* constitute a material. "The ridge was composed of *strong* (do you mean *resistant*?) rocks, whereas the valley was underlain by *soft* (do you mean <u>*erodible*</u>?) strata." **Use a dictionary and a geologic glossary for meaning and spelling.** (*Glossary of Geology*, published by American Geological Institute).

Most spelling errors can be eliminated by using spell check. Watch out for: Columbia vs. Colombia, principle vs. principal, coarse vs. course, loose vs. lose, columnar, consistent, dependent, dike, dissect, erodible, existence, fluorite, hornblende, intermittent, moraine, occur-occurrence-occurring, Pleistocene, precipitation, Quaternary, referred, resistant, separate, vegetation, vertical, vesicle, volcano (volcanoes). Although optional, we prefer that "Earth" (capitalized) be used when referring to the planet, and "earth" to refer to soil-like material. ***Don't let spell-checking be a substitute for careful proofing.*** We professors get tired of catching obvious mistakes that spell-checkers cannot detect (to-too, your-you're, etc.). These mistakes tell us that you relied on the spell-checker and didn't proof-read carefully.

Use proper numbers. It is common practice to spell out one through ten, but you may also write the numbers 1-10. For 11 and higher, however, use numbers (unless at the beginning of a sentence). In scientific writing it is customary to put a zero before any "orphan" decimals (e.g. "0.35"). The decimal is easily overlooked if reported as .35. *Try to keep track of significant figures*. Spreadsheets are notorious for calculating to 5 or 6 decimal places when only 1 or 2 are justified.

Use *METRIC* and SI measurements. The only exceptions are:

1. When quoting an English measurement.
2. When using an elevation from a non-metric map.

Notice that, although units of measurement are typically abbreviated, they are not followed by a period (except at the end of a sentence). Check each unit of measurement to be sure it is what you intended, e.g., mm for length, km^2 for area, m^3 for volume.

Unit Prefixes

factor	***prefix***	***symbol***	***example***
10^{12}	tera	T	1 TW = 10^{12} watts
10^{9}	giga	G	1 GPa = 10^{9} pascals
10^{6}	mega	M	1 Ma = 1 million years
10^{3}	kilo	k	1 kJ = 1000 joules
10^{-1}	deci	d	1 dL = 0.1 liter
10^{-2}	centi	c	1 cm = 0.01 meter
10^{-3}	milli	m	1 mm = 0.001 meter
10^{-6}	micro	μ	1 μm = 10^{-6} meter
10^{-12}	pico	p	1 pg = 10^{-12} gram

* 1 "billion" = 10^9 in the USA, but 10^{12} in the UK

Other useful units and abbreviations (SI units are in bold)

unit	***symbol***	***conversions***	
Length			
meter	**m**	39.37 inches (")	3.28 feet (')
angstrom	Å	10^{-10} m	10^{-8} cm
Mass			
gram	**g**	0.0353 ounces	
Volume			
liter	L	10^3 cm^3	
Temperature			
kelvin	**K**		
degree Celsius	^{o}C	K - 273.15	
Time			
second	**s**	1/60 minute	1/3600 hour
year (Latin: *annum*)	a (or y, yr)	365 days	

Force			
newton	**N**	$m \cdot kg \cdot s^{-2}$	10^5 dyne
Stress, Pressure			
Pascal	**Pa**	$m^{-1} \cdot kg \cdot s^{-2}$	0.00001 bar
bar		10^5 Pa	0.1 MPa
kilobar	kbar	0.1 GPa	100 MPa
atmosphere	atm	101,325 Pa	1.013 bar
Energy			
joule	**J**	$m^2 \cdot kg \cdot s^{-2}$ or $N \cdot m$	10^7 erg
calorie	cal	4.186 J	
Viscosity			
poise	P	1 g/cm · s	1 dyne · s/cm^2
Power			
watt	**W**	$m^2 \cdot kg \cdot s^{-3}$	
Heat flow			
heat flow unit	HFU	$1\ \mu cal \cdot cm^{-2} \cdot s^{-1}$	0.0418 W/m^2

Both “yr” and “a” are common abbreviations for “year,” but “a” is more convenient for large time spans (Ma = million years, Ga = billion years).

Most **capitalization errors** occur with geographic and stratigraphic names. Here are correct examples: West Virginia, but western Washington; Columbia River (not river); eastern United States, but the Midwest; Navajo Sandstone, but cross-bedded sandstone; glacial Lake Missoula; pluvial Lake Bonneville. While we're on directions, note that “northwest” and “southeastern” are each one word, not two (note that directions are generally not capitalized). Directions like south-southwest are hyphenated. Geologic time and stratigraphy: Early Devonian, Upper Silurian (not early, upper). Incidentally, “Early” and “Late” refer to *time*, whereas “Lower” and “Upper” refer to *strata*. “Middle” can refer to either.

Do not get behind in the writing of your paper. For a major term paper have a subject and a list of references at least two months before the due date. Make sure the subject is suitable, neither too narrow nor too broad. If in doubt as to the suitability of your subject, ask your professor. Order those articles and books not in the library through interlibrary loan. At least one month before the paper is due, finish the important reading and research, and have a complete outline. Late papers are typically penalized. Do not be robbed of a field trip or other worthwhile experience because you are behind on your paper.

More Tips on Producing Lucid prose:

1. Think about your introductory statements, particularly the first one(s) in your introduction. You probably learned these as “topic sentences.” Scientific writing is typically brief and to the point. Beginning scientific writers tend to overdo their introductory remarks. When proofing the first draft of your paper, ask yourself if the first one or two sentences are really necessary. Your prose will generally improve by simply dropping them.
2. Typographical errors, spelling mistakes, and poor grammar must be corrected by careful proofreading. **Proofread your paper *several times*** before submitting it and always have someone else (preferably in the class) do so as well. Trading papers is a good way to improve your effectiveness as a writer. As the writer you get help on your paper. As a reader you become sensitized to the role of the reader and the need for clarity and completeness.
3. Use as few words as possible. Achieve lucidity by dropping unnecessary words from subsequent drafts. Avoid extra words, especially with geologic terms. The italicized words in the following list are redundant: *glacial* till, *glacial* drift, outwash *deposit*, *till and* drift, tarn *lake*, white *in color*, Miocene *in age*, 3 mm *in size*.

4. Avoid repeating words and phrases, especially in the same paragraph.
5. Find transitional phrases and connecting thoughts between ideas. Your thinking ought to proceed logically from one idea to the next. Avoid lists. Avoid the phrases *another point*, and *also relevant* which make your thinking read like a grocery list, rather than a coherent discussion.
6. Don't tell the reader what you are going to do or say. "In this paper I will prove…" Just do it.
7. Don't use the word *feel* when you mean *think*, *believe*, or *assume.* Incorrect use of the word *feel* is very common, and promotes a confusion between thoughts and feelings.
8. In general, avoid paragraphs of less than two sentences and more than a page.

Citation

As you will see in current geologic literature, there is more than one standard way to cite references. The following are recommended:

Two authors	1. Hood Canal is a fiord (Bretz and Willis, 1913).
	2. Bretz and Willis (1913) demonstrated that Hood Canal is a fiord.
More than 2 authors	3. According to Crandell and others (1958) Hood Canal is not a fiord.
	4. Hood Canal is not a fiord (Crandell et al., 1958).
One author, 2 or more publications in one year	5. Carson (1973a, p. 123) stated, "There is a fault along Hood Canal."
	6. There is a fault along Hood Canal (Carson, 1973a).
Multiple sources	7. The origin of Hood Canal has been studied more than once (Bretz and Willis, 1913; Carson, 1973a, 1973b).
	8. Bretz and Willis (1913) and Carson (1973a, 1973b) have debated the origin of Hood Canal.
A reference you did not see	9. Pulaski (1872, in Reeve, 1977) found pingoes in Poland.
	10. There are pingoes in Poland (Pulaski, 1872, in Reeve, 1977).
An article in a collection	11. Crandell and others (1958) think still water runs deep.
	12. Still water runs deep (Crandell et al., 1958).

Examples 11 and 12, cite the author of an article, not the editor of a collection. See the fourth reference cited below. Note the use of punctuation. Citing the page number on which the information was found is optional except when quoting directly. For examples 9 and 10, Pulaski, 1872 would not be listed in your references cited, but Reeve, 1977 would be included. Although you may cite them, ***do not include books and articles you have not seen in your list of references cited***!

List of References Cited

There is also more than one standard ways to do "References Cited" at the end of your paper. In writing for a journal, use the format appropriate for that journal. This is our recommended format for papers turned in here:

References Cited

Bretz, J H., and Willis, B., 1913, The Origin of Hood Canal: Wash. Div. of Mines and Geology Bull. 9, 345 p. (yes, his first name is J)

Carson, R. J., 1973a, Quaternary faults in the southeastern Olympic Mountains, Washington: Geol. Soc. America Abstracts w. Program, v. 13, p. 65.

Carson, R. J., 1973b, Reinterpretation of the Skokomish Gravel, Mason County, Washington: U.S.G.S. Professional Paper 695, 77 p.

Crandell, D. R., Armstrong, C. B., and Easterbrook, C. D., 1958, Pleistocene history of the Puget Lowland: in H. E. Wright and D. L. Frey, eds., Quaternary of the United States. Princeton University Press, Princeton, NJ. p. 560-590.

Huntting, M. T., Bennett, W. A. G., Livingston, V. E., and Moen, W., 1961, Geologic Map of Washington: Wash. Div. of Mines and Geology.

Reeve, W. H., ed., 1977, Geology of the Green and Gold Mountains Area, Washington: John Wiley and Sons, New York. 752 p.

Zorro, Z., 1900, Folding in sandstone: Geology, v. 1, p. 30-35.

It is incorrect to write “et al.” in the references cited; name all authors. Note capitalization, punctuation, and order of the citation. Use only the last name and initials. Note that only the first word and proper names are capitalized in the titles of articles. In general, specific pages are used for articles, and total pages for books (the use of “pp.” for pages is obsolete). Articles must have the volume number of the journal. Books references should include the publisher.

Plagiarism

Next to fraud, plagiarism is the ultimate sin in the academic world and is grounds for failure. Except in cases where original investigations are done, your library research paper is a report on investigations done by others. In your paper be sure to give credit where it is due. When you use an investigator's data, state his ideas, paraphrase her conclusions, or quote him directly, cite a reference! (modified from “Senior Project” by Whitman College biology faculty). Figures also must be cited (see below). Distinguish between general knowledge (which does not need a reference) and the other material in your paper. Be sure the reader can distinguish between your ideas and the ideas of others. As a general guideline, there should be at least one citation per paragraph if the ideas are not your own.

It is dishonest to turn in the same or nearly the same paper for two or more courses during the same semester or in different semesters (see “Academic Dishonesty” in Student Handbook). Reworking an old paper is not permitted either. There are two exceptions, **each of which requires faculty permission**. One is using an old paper for a seminar presentation; in this case the old paper should be updated and expanded before presentation. The second exception is using an old paper as part of a substantial senior thesis.

Common Errors to Avoid

1. Our *minimum* expectation is that you write in *complete sentences* having a subject and a verb, and generally an object. We also expect that the case of the subject and object agree. **Watch for agreement problems.** For example, “Pat gave the book to me” has a subject (Pat), a verb (gave), and an object of a preposition (me). Note that the object is in the objective case, *me* and not *I*. *Adding another person does not change the case of a pronoun*, a curiously common error in American usage. “Pat gave the book to David and I,” is wrong. Just mentally remove the accompanying person(s) to determine the correct case (me, not I). Another common example: “one should argue their own ideas,” lacks agreement between *one* (singular) and *their* (plural). By the way, “data” is the *plural* form of “datum.” To say “the data is good” is an agreement problem. Data *are* good (or so we hope).

2. **Do not use sexist** (and other forms of discriminatory) **language**. Use "[sic]" to indicate this and any other problem when quoting, as in "Man [sic] and Nature." In general, avoid sexist referents by switching to plural forms. For example, avoid "A scientist should be aware of his assumptions." Although "A scientist should be aware of his or her assumptions" is technically correct, a more elegant phrasing is "Scientists should be aware of their assumptions."
3. Understand the distinction between *it's* (a contraction of it and is) vs. *its* (possessive) and don't use an apostrophe for the possessive. "*It's true that its dish is missing*."
4. Understand the distinction between *affect* and *effect*. When used as nouns, *affect* is a feeling, and *effect* is the result of a cause. When used as verbs, to *affect* is to partially influence and to *effect* is to create. In scientific prose, *effect* is typically used as a noun, and *affect* as a verb. The temperature may thus *affect* the humidity, whereas one might investigate the *effect* of weathering on granite.
5. Understand the difference between *that*, and *which*. *That* is used for identification, *which* is used for description. "Come to the door that is open." In this case, "that" identifies the proper door. "Come to the door, which is open." In this case there is only one door, a clause that could stand on its own. "Which" describes that the door happens to be open, and requires a comma before the dependent clause.
6. Understand the distinction between *less* (or *least*) and *fewe*r (or *fewest*). Less applies to a quantity, whereas fewer applies to a number (even if unspecified). For example: "Global warming would be mitigated if we produced *less* CO_2." "There are *fewer* of us that there used to be."
7. Understand the distinction between *compose* and *comprise.* The parts *compose* the whole, and the whole *comprises* the parts. *Comprise* is equivalent to *consist of*, compose is equivalent to *constitute*. "Tuff *comprises* (or *consists of*) ash, crystals, and lithic fragments." "Four professors *compose* (or *constitute*) the Department of Geology."
8. **Avoid passive language** such as "It is thought that. . . ." Who thinks it? Active constructions are much more accurate and powerful forms of phrasing. This may be more of a problem in the geosciences than in other disciplines. For example, we typically use such phrases as, "granites are intruded…," or, "sandstone was deposited during…," because it is hard to attribute the act to any specific active subject.
9. **Be careful about commas, semi-colons, and colons**. Many writers have problems with the use of commas, semicolons, and colons. Here are their main uses:
   A. Comma (,)
      1. To separate items in a series.
      2. Before (optional) and after a dependent clause (required).
      3. Before a conjunction (and-but-or) connecting two independent clauses.
      4. For clarity.
   B. Semicolon (;)
      1. To separate two independent clauses without a conjunction.
      2. To separate items in a list if the items have internal punctuation (e.g. Skotheim, 1975; Cronin, 1997).
   C. Colon (:)
      1. To introduce a list (as in this paragraph).
      2. Before an explanation, example, restatement, or quotation.
      3. Part of the large intestine.

   Note the use of punctuation marks in this document. Here's another example: valleys with rivers, flood plains, and terraces; slopes with landslides and gullies; and mountains with horns, arêtes, and cirques.

10. Hyphenate compound adjectives to a single unit. “The sandstone is fine-grained.” “This is a fine-grained sandstone.” “The theory is out of date.” “Tom uses an out-of-date theory.”
11. **Avoid non-sequiturs**, which we will denote in grading with “NS.” A non sequitur occurs when a thought doesn’t follow logically from another. An example would be "*Because geology is becoming more diversified, it has always embraced empiricism*. " The thought about empiricism doesn’t follow logically from diversification.
12. **Avoid “excess to-be” phrasing**, which we will denote in grading with “XS2B.” For example, avoid beginning sentences such “There are many ways that a rock may become rounded.” One clear indicator of XS2B sentences is “there are… that… ” A better phrasing would be, “Rocks may become rounded in several ways.”
13. **Avoid indefinite references**, particularly “they” (“them”) and “it”: “The geologists separated the rock hammers from the shovels and took them to the moraine.” To what does “them” refer? Be careful about starting sentences with “This.” Always clarify what “this” refers to by adding a noun clause such as “This quality,” or “This increasing trend” or “This new idea.” Add clarity to your prose by either avoiding “this” altogether, or immediately clarifying what “this” refers to by adding a noun immediately after the referent. As an interesting exercise to catch #12 and #13 problems is to search for “that” and “this” in your draft to assess your usage.
14. In general, **avoid using second person pronouns** as in “Geology makes you aware of complicated issues.” The second person works well when giving instructions, as in this manual, but rarely elsewhere. If you want to make more general statements, a better construction is “Geology makes one aware…” or “Geology makes me aware.”
15. **Avoid terms with an unintended temporal connotation**s. Use “because” rather than “since” in sentences such as, “*Since* we have to wait here anyway, why don’t we play hacky sack?” Also use “whereas” rather than “while” in sentences such as, “Igneous rocks crystallize from a melt, *while* metamorphic rocks recrystallize in the solid state.” Use “typically” rather than “often” in sentences such as, “Granites are *often* intruded into orogenic belts.”
16. **Be sure to use the correct tense.** A common error is to mention information from a field trip (which occurred in the past) as if the same conditions do not still exist. What is probably wrong with each of the following? “The moraine *was* littered with giant granitic erratics.” Have the boulders been recently hauled away? “The foreset beds *dipped* east.” When did they stop?
17. **Avoid enhancing adverbs**. “The fault trace is *very* sinuous.” “Dendrochronology is *much* more precise than weathering rind geochronology.” Almost every use of “quite” in these cases is *quite* wrong (for example).
18. **Avoid unnecessary editorial opinions** that mean nothing. “Bergman *et al*. (1992), *in their excellent study* of the Alpine Fault, determined that…”
19. **Avoid dangling and misplaced modifiers**. “Learn basic methods of defending yourself from an experiences instructor.” “Using new radiocarbon data, the slip rate was modified.”
20. Avoid using “basically” and “*per se*.” Both are commonly misused, and are rarely helpful or appropriate. Beginning a sentence with “Basically…” is a poor habit in conversation, and awful in written work.
21. A few faculty “pet peves” of misused geologic terms in the popular press. DON’T USE THEM:

“Mudslide”- no such thing. Mud *flows*. It isn’t coherent enough to slide!
“Tectonic Plates”- *Lithospheric* plate interactions create tectonic effects, hence “plate tectonics.”
Rocks do not “outcrop” (used as a verb). They “crop out.”

Common Latin abbreviations

ad lib	*ad libitum*	"to speak offhand, without notes"
c. or ca.	*circa*	"approximately"
cf.	*conferre*	"compare"
e.g.	*exempli gratis*	"for example"
etc.	*et cetera*	"and others" - "and so forth"
et seq.	*et sequens*	"and the following"
et al.	*et alii*	"and others"
f. ff.	*folio, folios*	"following page, pages"
ibid.	*ibidem*	"in the same place"
i.e.	*id est*	"that is"
in re	*in res*	"in the matter of " - "in regard to"
N.B.	*note bene*	"note well"
non seq.	*non sequitur*	"it does not follow"
op. cit.	*opere citato*	"in the work cited, or quoted"
pro tem	*pro tempore*	"for the time being"
Q.E.D.	*quod erat demonstratum*	"which was to be proved"
q.v.	*quod vide*	"which see"
viz.	*videlicit*	"namely"
vox pop	*vox populi*	"voice of the people"

Frequently used Latin words or phrases

ad nauseam	"to a sickening degree"
bona fide	"in good faith, genuine"
in situ	"in its original place"
infra	"below"
passim	"scattered references here and there"
per se	"in itself, by itself"
personna non grata	"a person out of favor"
prima facie	"at first view"

References Cited

Hansen, W.R., ed., 1991, Suggestions to authors of the United States Geological Survey: U.S. Government Printing Office, Washington, D.C. 289 p.

Jackson, J.A., ed., 1997, Glossary of Geology: American Geological Institute, Alexandria, VA. 769 p.

Appendix 2: Field Notebooks

An outstanding field notebook serves many potential purposes.

1. It is a valuable record of what you have seen, heard, discussed, and thought about in the field.
2. You may not be able to return to the field easily when you are performing subsequent lab work. Your field notes may be your only way to test new ideas against your fieldwork.
3. It may contain the data which will lead to an oral presentation, a paper, and/or a thesis.
4. It may be a graded portion of a course.
4. It may be something you and your relatives will find interesting decades in the future.

For one or more of these reasons, *keep your notebook in a safe place*. More than one graduate student has lost a notebook with critical data for his/her thesis. For particularly important notes, you may consider photocopying or scanning your notes, and keeping separate records in two places.

A field notebook should enhance and not interfere with learning. Don't write down everything a field trip leader says without thinking about it or asking questions. You are not a tape recorder. Filter the information through your brain. Your notes are your own. Feel free to pose questions that you might address as more data are discovered.

Neatness and organization are essential. For efficiency, use standard abbreviations (e.g., the geologic time symbols). A labeled sketch may be more valuable than 100s of words.

Before the field

1. Write your name with indelible ink on the front and back of your notebook. Write your name, address(es), and phone number(s) near the front.
2. Consider putting a title on the inside and an abbreviated title on the outside and spine (e.g., Alaska, 2000).
3. Paginate the entire notebook; start a table of contents near the front.
4. Depending on the situation, enter appropriate emergency information near the front or back: e.g., who to contact and how, allergies, search and rescue phone number, hospital address, phone number of embassy.
5. Start an “address book” of key contacts, potential people to visit, people who might provide information, people who might help with transportation in the field, etc. This list might include home and work addresses, email address, and home, work, and cellular phone numbers.
6. Consider gluing or taping into the notebook (near the back and/or front) one or more of the following: maps, lists of flora and fauna, geologic time scale, stratigraphic column, checklists of data to be recorded.
7. How is your notebook going to be organized? One way is to put observations and sketches on the right, and interpretations and questions on the left.

In the field, every day

1. General location: country, state, county, mountain range, coast, island, national or state park, nearest town, etc.

2. Weather: temperature, precipitation, wind velocity and direction (winds are named from whence they come), humidity, cloud cover, visibility, etc. This information may be pertinent to soils or vegetation, or may help you remember the day and/or location. If the weather varies much during the day, note the changes.

3. If your particular focus is geology, mention the soils and vegetation. They may be important clues to the geology (e.g., particular plants grow on serpentinite). The approximate age of landforms such as moraines and landslide scars may be revealed by vegetation. If your focus is bedrock geology, note landforms (e.g., fault scarps) and surficial deposits. If your focus is geomorphology and surficial geology, note the bedrock geology (e.g., resistance to weathering and erosion).

4. If your particular focus is biology, mention the geology. Plant distribution is greatly influenced by bedrock types, landforms, surficial deposits, and soils. Particular plants have specific requirements for moisture (soil porosity and permeability) and trace elements (mineralogy) Burrowing animals may prefer one surficial sediment to another. The flora and the fauna are very much influenced by aspect (the direction a slope faces) due to temperature and moisture differences, and by drainage (e.g., a wetland vs. a hilltop).

5. As appropriate, expand your “address book.”

In the field, every stop

1. Specific site. This location should be described accurately enough so that you could get back here. It might include a street address, latitude and longitude or UTM co-ordinates, elevation, aspect, which side of stream, how far and in what direction from a landmark, etc.

2. Data on whatever may be relevant: humans, animals, plants, ecosystems, ecotones, rocks, sediments, soils, structures, landforms, processes, rates, facilities, pollution, scenery. Some of this data may be re-entered elsewhere in your notebook, as I mention later.

3. Consider drawing and labeling a sketch, diagram, map, or cross-section. One of more sketches per outcrop or stop is common. A sketch can be much better than, or *can* reduce the length of, an outline or narrative. Do not worry if you don't think you're an artist. You never will be if you don't try, and your sketches will improve with practice. Would color help? Some sketches stand alone without labels. You might be drawing scenery or a flower; such sketches should have titles (e.g., Hunter Peak across Clarks Fork, Indian paintbrush on Hood Canal bluff). Most sketches need lots of labels (e.g., rock types and ages, landforms, fauna and flora). Maps and cross-sections need scale and orientation (e.g., north arrow or direction of view).

4. Keep a dialog of multiple working hypotheses, questions, and tentative interpretations. These can help you at later stops by refreshing your memory of previous work.

5. Notes about photographs taken. What is it? What is the scale? What direction are you facing? Some people prefer to record photos site by site; others record all photos in a separate section of the notebook. Include an estimate of the frame number on the film roll.

Every evening after field work

1. Review your field notes. Is there anything that might be important that you remember now but did not note in the field?

2. Consider entering data into a computer for analysis and/or separate storage.

3. Summarize the day's observations, hypotheses, conclusions, etc.

4. Do you need to revisit any of the sites?

5. If there is field work the next day, plan for it. Be prepared.

Appendix 3: Presentations

The most important guideline for making a good presentation is “be professional.” In the most common type of oral presentation the speaker has most of the information in memory with notes to assist. Have good notes that are brief enough to read quickly (in poor lighting) as you speak. **Rehearsal is essential.** Notes should be considered a back-up to jog your memory should you overlook or forget something. We don’t recommend that you read a paper verbatim, but should you choose to do so, be so familiar with the text that you can look at both your audience and your audiovisual aids. Some speakers actually memorize a paper. If you choose to do so, you had better have notes or text handy in case you forget it.

Do not rehash an old paper or speech to meet the requirements of another class, unless you have specific faculty authorization.

Audiovisual aids usually add substantially to a presentation. They illustrate important points and help organize a talk. Aids could include PowerPoint, slides, overheads, an audio and/or video tape, large samples, large posters, or some form of computer assistance. Handouts are also possible, but passing maps, pictures, and even handouts to the audience may be disruptive. Do you want the audience to be listening to you, or looking at maps, newspaper clippings, graphs, pictures, samples, or whatever it is you are passing around? You can make slides or overheads of most of these items, or scan them for a PowerPoint presentation. Samples can be on a table for the audience to inspect before and/or after your presentation.

Plan ahead and make the slides, overheads, and or other audiovisual material well in advance. Include a map to alert the audience to the geographic location. Make sure your audiovisual aids will be readable from the back of the room. Maps or other materials held up on small sheets of paper in front of the audience are generally useless (not to mention frustrating to the audience). If it can't be read from the back of the room, make it bigger.

Order any equipment necessary (VCR, laptop computer, projector, etc.) well in advance. Be sure to give credit to authors of material in your audiovisual aids if it is not yours; otherwise, you are plagiarizing.

There is a tendency to project too much information onto the screen at once. Audiovisual aids are meant to illustrate or stress key points, outlines, maps, cross-sections, diagrams. Audiovisual aids are not meant to replace the text of a talk. The audience can read faster than you can talk, and may get bored by the repetition. *Never* simply read your PowerPoint or overhead screens or turn away from the audience to read what you are projecting.

Some speakers have a problem with timing. There is usually a fixed amount of time for your presentation: 5 minutes, 15 minutes, 50 minutes, or whatever. Often this time limit includes time for questions and discussion. Don't be a person who hasn't even made your main point when the time is up. *Practice, and time your rehearsals!* Use the time allowed or slightly less. Fifteen minutes does not mean 20 or even 16 minutes.

Here are some other suggestions for a good presentation:

1. Maintain audience contact: look people in the eye.
2. Practice your presentation to friends. Request suggestions for improvement.
3. Be aware of your speed: few oral presentations are too slow; many are too fast. If the rehearsal is long, don't simply talk faster. Cut out non-essentials.
4. If the moderator has introduced you and stated the title of your presentation, do not orally repeat the title. Find a smooth segue into your material.

5. Make sure the audience knows when your speech is over. Say “thank you” and/or ask for questions.

6. Finally, *never apologize for anything*: for few or poor audiovisual aids, for not knowing enough, for being ill prepared. It’s better, of course, that you prepare so well that there is nothing to apologize for, but if you think some aspect of your presentation is substandard, don't tell the audience. The audience will judge your presentation anyhow, so don't negatively prejudice your listeners.

Appendix 4: Senior Graduation Timeline

Be aware of the following deadlines regarding registration for courses. Also, be aware that an "academic week" (referred to below) differs from a "calendar week."

Fall Semester

- The 10th day of instruction is the last date to register for all classes needed for the fall semester.
- The middle of the 6th week of the semester is the last date to submit your Application for Degree Candidacy to the Registrar (May graduates).
- The end of the 6th week of the semester is the last date to submit your application for Honors in Major Study to the Chair of the Geology Department (May graduates).
- The end of the 6th week of the semester is the last date to drop a course with a grade of "W."
- The end of the 10th week of the semester is the last date to drop a course without a grade of "F."
- The middle of the 13th week of the semester is the last date to complete examinations in major study (December graduates).
- The Monday of the 13th week is the last date to submit Honors theses to library for Fall semester Honors candidates (December graduates).

Spring Semester

- The 10th day of instruction is the last date to register for all classes needed for the spring semester.
- The middle of the 6th week of the spring semester is the last date to submit your Application for Degree Candidacy to the Registrar (December graduates).
- The end of the 6th week of the spring semester is the last date to submit your Application for Honors in Major Study to the Chair of the Geology Department (December graduates).
- The end of the 6th week of the semester marks the end of the period to drop a course without record.
- The end of the 10th week of the semester is the last date to drop a course with a grade of "W."
- The end of the 10th week of the semester is the last date for academic departments to notify the Registrar regarding students who have been accepted to candidacy for Honors in Major Study (May graduates).
- Thursday of the 13th week: Honors Theses for May graduates are due in the library for Honors candidates (May graduates).
- The middle of the 13th week of the semester is the last date to complete examinations in major study (May graduates).
- Beginning of the 17th week- Commencement.

Appendix 5: Senior Thesis/Project Timeline

(negotiate any changes with your advisor)

Second Monday of classes (9/12/05)	Proposal due, blocks for thin sections (if any) cut and shipped.
Sixth Monday of classes (10/3/05)	Preliminary outline and list of references due.
Eighth Monday of classes (10/24/05)	Maps (if any) due in computerized form (assuming summer fieldwork, otherwise set up a time with your advisor).
First Monday of December (12/5/05)	Preliminary analytical work due (petrography, structural analysis, chemistry, etc.).
Second Monday of December (12/12/05)	Preliminary Abstract and Introduction due.
Second Monday after Spring Break (4/3/06)	First draft due.
Last Monday in April (4/24/06)	Final draft due.

Honors Theses must be turned into the Library by the deadline printed in the College Calendar (typically the Thursday two weeks before finals begin).

The Department requires that a copy of all theses (including honors) and senior research projects be turned in to the advisor(s). Furthermore, the student must catalog samples, maps, cores, etc. for storage in the department. An electronic copy of the thesis/paper, plus any diagrams, posters, data, spreadsheets, photos, etc. must be copied to a well-labeled CD-ROM and turned in to the project advisor.