A Field-Based, Writing Intensive Undergraduate Course on Pacific Northwest Geology

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ABSTRACT

At Spokane Community College, a course in *Pacific Northwest Geology* provides students with a field-based approach to learning about the geology of the Pacific Northwest. This sophomore-level undergraduate course is a writing intensive course and meets the "W" (writing) requirements at Spokane Community College. The students participate in six laboratory field exercises where they document basic outcrop observations then submit three field reports that follow a specific field report format. Students are encouraged to view the reports as professional documents that will be provided to a client or fellow researcher. A final group project involves the creation of a web site virtual geology tour. Upon completion of the course, student field observational skills and technical writing abilities are greatly improved. Because of the high number of field trips involved, this lab science course is popular among both earth science majors and non-majors.

INTRODUCTION

Northeastern Washington State provides a rich diversity of geology. In the Spokane area, several key geologic features include the Columbia River Basalts, the Channeled Scablands, the Priest River metamorphic core complex, the Paleozoic continental margin, and the mid-Proterozoic Belt Supergroup. With only several hours of driving, students can observe the Coeur d'Alene mining district, Hells Canyon, the Cascade arc, two Mesozoic tectonic suture boundaries, and accretionary terranes. In all, this area provides an exceptional opportunity for undergraduate field instruction using a variety of spectacular, and very accessible, geologic features.

At Spokane Community College (SCC), a course in *Pacific Northwest Geology (Geology 210)* provides students with a hands-on, field-based approach to learning about the geology of the Pacific Northwest (Buddington, 2003). *Geology 210* is a writing intensive course that places a strong emphasis both on field observations and on technical report writing. At SCC, transfer students pursuing an Associate of Arts degree are required to successfully complete a writing intensive course, i.e., a "W" course. To meet the "W" designation, fifty percent or more of the class grade must be based on writing assignments. At SCC, there is a "W" course committee that annually reviews course proposals by detailed evaluation of the submitted course curriculum. *Geology 210* meets both the "W" course and laboratory science requirements for degree completion. At SCC, laboratory courses such as *Geology 210* consist of seven contact hours weekly (three hours of lecture and two, two-hour laboratory sessions) with a total of twenty laboratory sessions per quarter. This emphasis on the laboratory experience is unique and allows for detailed instruction and hands-on learning of scientific technique and methodology. *Geology 210* takes advantage of this format by combining a high number of field experiences (along with in-lab exercises) for sophomore-level students. *Geology 210* consists of six mandatory lab field trips, which are local and three non-mandatory weekend regional field trips. A final group project requires students to visit a field site (no instructor supervision) with fellow group members. The opportunity for numerous field trips has created a popular interest from students wishing to take a laboratory science class. The laboratory field trips visit sites within a twenty minute drive of the campus and focus on one outcrop or site only. By visiting only one outcrop per lab trip, students spend a minimum of one hour at a specific site, which ultimately allows them to investigate and document the site in considerable detail.

Field trips for freshman and sophomore-level geology students are a popular form of teaching geology but often have limited or vague outcomes for the students (Kern and Carpenter, 1986; Manner, 1995; Malone, 1999; Thomas, 2001). The *Geology 210* laboratory field trips address this problem by requiring the students to document detailed field observations and write a technical site report. Previous papers on writing exercises in undergraduate geology courses indicate that writing is an important second component in helping undergraduates enhance their understanding of geological field relations (Griffith, 1982; Macdonald, 1991; Macdonald and Conrad, 1992; Wells, 1997). Repeated field and writing exercises early in the undergraduate experience clearly give students needed practice at field observation and technical writing, but also increase student understanding of their local and regional surroundings (Conrad and Macdonald, 1991; Snow, 1991; Mirsky, 1992; Rice-Snow, 1997). Finally, writing exercises help augment the laboratory and field experience, and allow for a productive research approach to learning earth science (Biersdorfer and Haynes, 1991; Niemitz and Potter, 1991; Huntoon, et al., 2001).

In *Geology 210*, particular emphasis is placed on the field report being a professional document that will ultimately be presented to a client or to earth science professionals, e.g., environmental engineers, mining company geologists, etc. Students are consistently reminded that the site reports are based on field data and that return to the site is generally not an option (however, many do return on their own time), and the quality of a report will be judged principally on their field observations. Students can not submit a report if they have not actually visited the site with their field partner.

To culminate the term, a final group project is required where the students create a virtual geologic field trip. Individual groups visit a site of their choosing, document their field observations, and with the help of the instructor and the campus webmaster, create a virtual field trip that is included in the class web site for a period of one year.

LABORATORY FIELD EXERCISES

The six required laboratory field trips offered during the term are two hours in length and consist of two igneous

I.	**Field Notes (20 pts.)**	**Points**
	field trip name, date, site number	(2)
	location: general description and township/range	(2)
	rock/outcrop descriptions	(8)
	detail and comprehensiveness	(4)
	outcrop sketches with labels and descriptions	(4)
II.	**Report Format and Content (40 pts.)**	
	introduction and purpose statement	(5)
	site location: township/range and on map	(5)
	site descriptions	(10)
	summary/conclusions	(5)
	referencing	(5)
	labeled figures with descriptions:	
	site location map	(3)
	sketches or photos	(3)
	neatness, clarity	(4)
III.	**Grammar & Spelling (15 pts.)**	
	sentence structure	(5)
	word usage and terminology	(5)
	spelling	(5)

Figure 1. Grading rubric for Pacific Northwest Geology field trip notes and reports. Points possible for the three major grading categories and for the specific required criteria are shown in parenthesis.

rock sites (one volcanic, one plutonic), two metamorphic sites, one fossiliferous sedimentary site, and one Quaternary glacial sediment site. At the outcrop, students are assigned to work in pairs and are provided with a topographic map and field equipment such as hammers, goggles, hand lens, and compass (with inclinometer). The objectives of the field visit are provided to the student along with a field method primer that summarizes the basics of making outcrop observations and how to write rock descriptions. To attend a field trip, each student is required to have a field notebook (which is for sale in the college bookstore). The objectives of the site visit are for students to learn how to: (1) locate field sites on a topographic map, (2) designate and record site numbers, (3) make rudimentary field observations including mineral and rock identification, rock texture and outcrop structure recognition, and the interpretation of relative age relationships, (4) effectively document field observations, including detailed note taking and the creation of outcrop sketches (or photographs) and, (5) collect and label a sample. During the first site visit, the instructor walks the students through an outcrop point-by-point emphasizing the importance of comprehensive documentation. For the remainder of the lab field trips, students are required to work in pairs without the direct guidance of the instructor. Using the Socratic Method, the instructor circulates among the groups to address specific questions, but emphasis is placed on self-discovery. Field notebooks are handed in following each field trip and are graded based on the observations documented and sketches created.

Each site is picked for a set of specific field relationships. For example, one field trip visits an outcrop of Columbia River basalt (CRB) that exhibits multiple lava flows. Prior to the visit, students are given a slide lecture on the Columbia River flood basalt province and they are provided with a handout of an idealized CRB flow stratigraphy. At the outcrop, students are directed to document the basalt and flow relations and ultimately to determine how many flows are exposed. The students are required to sketch the relationships they have observed. Because the students have been presented a slide lecture on CRB geology in advance of the site visit, this exercise becomes relevant and, in fact, exciting. Another laboratory field trip visits a Tertiary-aged granite roadcut that exhibits significant structure (e.g., small faults) that presented geotechnical engineering challenges to the road builders. Students make basic rock observations as well as measure fracture and fault sets that occur throughout the roadcut. Students are directed to the relationships of outcrop structure and weathering with respect to slope stability and geotechnical engineering techniques such as rock bolting and slope grading.

FIELD REPORTS

During the second week of the term, the students are provided with a sample field report based on a format that is to be strictly followed. The sample field report contains figures (and figure descriptions) and a reference page. One entire class session is devoted to discussing the required report format including figure description technique and reference citation technique along with the required reference page format. In the class discussion, the importance of figure numbering and reference citation is emphasized. Each report is required to have at least one primary reference. For each site visited, a minimum of one geologic map of the area is available in the laboratory for student examination. Also available to the students are professional reports directly related to the area. The provided geologic maps and reports (of the study areas) can be used by the student as their required reference. Each report is to contain a title (including the general site location), an introduction (which is to provide a definite purpose statement), a site description section (including figures), a conclusion section, and a reference page. Finally, each report is to include a minimum of two figures: one is the site location map and the other is an outcrop sketch (or photograph), both with relevant figure descriptions.

The lab report requirements are provided in rubric form (grade sheet) designating the grading standards (Figure 1). Grading is based on a variety of criteria including: (1) report format, (2) minimum requirements including references, sketches, and citations, (3) content and depth of outcrop observations and, (4) grammar and spelling. Emphasis is placed on documented observations and not on genetic implications. Students are allowed to include in the conclusion section a discussion on geologic formation and genetic implications (based on their interpretation or past research of the area), but the bulk of the report involves the site description section (with figures). Finally, students are encouraged to work together while gathering and documenting field data, but each report is to be an individual effort. A total of three site reports are required during the term as designated by the instructor.

Although many of the report criteria discussed above are simple concepts and second nature to most professionals, sophomore-level science students find writing a coherent technical report (from their field notes) very challenging. For most of our students, this is a first attempt at technical writing and these reports, although generally short in length, are very time consuming. Grading of the first report is typically the most arduous. A significant effort is made to correct improper writing technique and grammar. A concerted effort is also made to discourage students from the "creative" writing style they have become so accustomed

Quarter	# of Students	Report #1	Report #2	Report #3	Change
Spring 2000	14	80.7	78.9	84.0	3.3
Spring 2001	13	81.7	84.0	84.6	2.9
Spring 2002	14	79.8	86.9	82.9	3.1
Spring 2003	4	83.0	75.4	82.6	-0.4
Spring 2004	11	93.0	88.5	92.8	-0.2
Spring 2005	22	86.0	90.0	89.3	3.3
Weighted Avg.	78	84.1	85.5	86.6	2.5

Table 1. Grading data from Pacific Northwest Geology field trip reports.

to in high school and freshman-level college English classes. To say the least, a considerable amount of red ink is used in the grading of the first report. The most common writing errors displayed include improper capitalization of terms and names, excessive wording, and the improper use of descriptive terminology. In general, the quality of the student reports increases significantly (with respect to these writing errors) by the second and third reports, and in fact, students comment on how much more comfortable they are with technical writing by the end of the term.

ASSESSING STUDENT WRITING

Assessment of student writing has been done by grading student field reports based on the report rubric provided to the students prior to the first writing assignment. The rubric is divided into three major categories: field notes, format and content, and grammar and spelling (Figure 1).

Table 1 presents the grading results for the class from 2000 to 2005. The data are the average class scores for the three required student field reports. In general, the average score from the first to the third report increased several percentage points indicating improvement in student field skills and writing abilities. The weighted average for each report is based on a total number of seventy eight students with a total change in weighted average of 2.5 percent. For the 2003 class, the final report average actually dropped. The reason for this drop is difficult to determine but the total number of students enrolled was abnormally low (four total) and most likely indicates a non-representative student population.

One interesting aspect to the data is that several classes actually dropped in average score from report one to report two. Again, it is difficult to explain this change specifically other than to note that the second field trip examines a more complex outcrop geologically and the students are provided minimal guidance or prior direct discussion about the outcrop from the instructor. Other variations in the trends from report one to reports two and three are minor and may also be the result of lower than normal enrollments or fewer geology majors enrolled for a given year. Nonetheless, the overall trend in student scores for field report three indicates a significant improvement in student field and writing skills when compared to the previous two field exercises.

FINAL CLASS PROJECT: THE VIRTUAL FIELD TRIP

The final project for the term is a group project where students determine their own groups and project topics. The project objective is for each group to create a virtual field trip that will be posted on the class web site. Groups determine the site they wish to study and visit. Each member of the group is required to visit the site and contribute with field observations and personal research of the area. Group members work closely with the campus webmaster to create a virtual field trip for the site of study. The virtual field trip format loosely follows the site report guidelines (discussed above), but students are encouraged to add "group flare" to their group website. Beyond the basic site location and geology (including maps and site photos), the virtual field trip pages often include local history and activities (hiking, climbing, etc.), along with other points of general interest such as environmental issues including wildlife and watershed information. These interactive virtual tours are graded primarily on content, site format, and user-ability. Because each group works closely with the campus webmaster, each tour follows a basic framework regarding HTML technique; thus minor emphasis is placed on overall web design. A strict timeline is presented during the third week of the term in order to ensure convenient scheduling and organization with the webmaster. Groups are not allowed to wait until the last week of the quarter to complete their site design and development. Accuracy of content, grammar, and spelling is checked (and graded) by the instructor before final posting of the site.

This project integrates the field and writing abilities developed by the students throughout the quarter. Because the students produce a product that is presented on the class website (and essentially to the campus and public) for one year, they take great pride and care in producing a quality product, which in turn can be viewed by friends and family members. Overwhelmingly, the *Geology 210* students comment on how much they learned during the project, and of equal importance, how much they truly enjoyed the project. To view student websites from past *Geology 210* classes, go to: http://users.scc.spokane.edu/ABuddington/ G210 proj/

CONCLUSIONS

Improvement in observational and technical writing skills by individual students that have completed *Geology 210* is considerable. Students learn how to work in groups while in the field and they learn the importance of observation, documentation and record keeping as part of scientific methodology. Ultimately, the high number of field trips allows our students to learn the local geology first hand, while developing basic field skills that they take with them into upper level earth

science classes (at other institutions) or to future professions. Finally, the Pacific Northwest Geology class at Spokane Community College culminates with a project that is not only extremely enjoyable for the students but very educational in regards to their local and regional geologic surroundings.

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