

# **A FIELD BASED APPROACH TO INTRODUCTORY GEOLOGY INSTRUCTION**

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As part of the NSF-funded VCEPT project, geology faculty at Mary Washington College have developed and pilot tested a two-semester sequence of geology courses which are taught in a non-traditional, discovery oriented style. The guiding philosophy of the course development is to ensure that students learn about geological principles through collaborative learning in a variety of field settings that were carefully chosen to provide good examples of a range of geologic processes and environments. The design goals of these courses include improvement in student retention of concepts, increased student interest in earth science, improved critical thinking skills and the promotion of collaborative learning. Development of the courses required multiple visits by geology faculty to numerous field sites in order to determine the suitability of using each site to teach fundamentals such as mineralogy, formation of igneous, sedimentary, and metamorphic rocks and deformation features. Students are provided with field notebooks, local topographic maps and basic field tools such as Brunton compasses and hand lenses. Each student maintains his or her own field notebook in order to record increasingly sophisticated observations regarding geologic features within eastern Virginia. Eventually, teams of students present and defend an overall chronology of geologic events for the mid-Atlantic Appalachian region. Course assessment tools include written student comment sheets, standardized course reaction questionnaire scores and tracking of students who decide to continue within the geology major.

In recent years faculty members in the Department of Environmental Science and Geology at Mary Washington College have been engaged in a thorough revision of the introductory, two-semester geology course sequence. The course development work has been carried out with the support of the NSF-funded Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT). The courses which are being revised are GEOL 111: Introduction to Geology and GEOL 112: Evolution of the Earth. These courses are provided for prospective majors, pre-service teachers, and general education students alike. Within the Mary Washington College curriculum, as at most institutions, these geology courses have always been offered as traditional lecture classes with a two hour lab each week.

## **Course Development Goals**

Throughout the past several decades demographic changes have altered the composition

of our college student population, and earth science curricula have undergone modifications in order to reflect growing environmental concerns. A review of the literature regarding geologic education, however, reveals that one feature of earth science education has not changed and that is the vital importance of the field experience. Authors of papers from the 1960's [1], 1970's [2], 1980's [3, 4], and 1990's [5, 6, 7, 8] all speak with unanimity regarding the central role that field-based instruction should play within the geology curriculum.

In a typical curriculum, short field trips are used in order for students to see examples of geologic features which have already been studied in class or lab. Faculty involved in course revision at Mary Washington believe that a more ambitious approach should be taken which would allow for students, working in groups, to discover and learn many of the basic principles of geology in the field environment rather than in the classroom. The desired goals of a field-based course design include creating opportunities for active student participation in the discovery and learning process, developing cooperative group dynamics, improving understanding and retention of geologic principles, and exciting a greater interest in pursuing more advanced science classes.

In accordance with this goal, geology faculty members spent several months investigating potential field sites which could be incorporated into the two introductory geology courses. Each field site had to meet several criteria. First, the site must have geological features which are appropriate to the curriculum of either physical or historical geology. Second, each site must be reasonably accessible on public land with suitable parking for vans. Finally, safety considerations of each site must also be taken into account. As a result of these criteria, nine separate field locations were adopted for use. Most of the sites are located within the Fredericksburg area and are situated in public parks.

### **Testing of Pilot Courses**

In order to assess the effectiveness of field-based, discovery oriented instruction, two pilot courses were offered during the 1997 summer session at Mary Washington College. The purpose of offering these courses in the summer term was to permit greater class time flexibility and to ensure a smaller student enrollment in order to test out a variety of field-based teaching strategies. It was also recognized that presentation of course material in a

radically new manner would be a challenge for the faculty and that it might be easier for the faculty members to experiment without the additional distractions of a normal fall or spring semester. At the end of each summer term outcomes assessment material in the form of standardized SIRII questionnaires (see Appendices) were distributed to the students. These are the same forms used in the regular semester classes which provided a comparison of student attitudes toward the heavily revised course curriculum versus the more traditional class offerings. Comment sheets were also provided for anonymous written responses which is also the standard practice during the fall and spring terms. The participating students did not know that the geology classes would be taught in a nontraditional manner at the time of enrollment. A summary of the outcomes assessment data are provided as appendices to this paper.

The design of both introductory geology courses was similar so that continuity was maintained for students who participated in both pilot courses. Daily quizzes were given to improve retention of concepts and ensure that students were keeping up with the material. Each student was provided with a field notebook and topographic map to document his or her observations. At each field site students were provided with an initial briefing in order to make sure that they would remain well focused on the lessons that were intended for that day. This is particularly important in field sites that contain many varied geologic features that can prove distracting. Students then proceeded to record their own observations and reach tentative conclusions about their significance before the course instructor led group discussions regarding the features observed.

During the second term course, students were divided into small groups in which they devised the geologic history of the Fredericksburg, Virginia, region by integrating information obtained from a series of field trips conducted over a period of several weeks. At the end of the process each student wrote a paper justifying the particular geologic history he or she had derived. In addition, each team then made in-class presentations of their conclusions.

As evidenced by the SIRII data, the student responses to the revised courses were extremely positive. The results indicated that the students were more enthusiastic about the material, felt more actively involved in the learning process, and reported improved independent thinking skills. Initial faculty concerns that students would find the unfamiliar

course format confusing appear to be unfounded. Students consistently gave high scores to questions regarding effective use of class time, clarity of exam questions and increased interest in the subject matter. A tangible result of the summer experience was that four students, of the total of sixteen participants, continued as geology majors in the following fall semester. Participating faculty continue to monitor the progress and assess the preparation of these students as they enter upper-level courses and compete with peers who were enrolled in traditional introductory geology classes. ■

## Appendix A

## SIRII – Assessing Courses and Instruction

Comparison of student course reaction questionnaires collected for the pilot Geology 111 course offered in the summer of 1997 and a traditional class taught during the previous fall semester. Both the fall semester class and the pilot course were taught by the same instructor.

Responses: NA (Not Applicable) 5 (Very Effective) 4 (Effective) 3 (Moderately Effective)  
2 (Somewhat Ineffective) 1 (Ineffective)

		100 LEVEL COURSES	GEOL 111 Traditional	GEOL 111 Revised
1.	Instructor's explanation of course requirements	4.24	4.26	4.80
2.	Instructor's preparation for each class	4.38	4.67	5.00
3.	Instructor's command of the subject	4.51	4.65	4.80
4.	Instructor's use of class time	4.22	4.59	4.80
5.	Instructor's way of summarizing points	4.06	4.06	4.90
6.	Instructor's ability to make clear presentations	4.08	4.27	4.80
7.	Instructor's command of English	4.66	4.80	4.90
8.	Instructor's use of examples	4.24	4.43	4.80
9.	Instructor's use of questions	3.98	3.76	4.90
10.	Instructor's enthusiasm for course	4.38	4.27	4.90
11.	Instructor's helpfulness	4.26	4.54	4.90
12.	Instructor's respect for students	4.36	4.75	4.90
13.	Instructor's concern for students	4.11	4.03	4.90
14.	Availability of extra class help	4.15	4.25	4.90
15.	Instructor's willingness to listen	4.39	4.53	4.90
16.	Information about grading policy	4.22	4.40	4.88
17.	Clarity of exam questions	3.92	3.54	4.77
18.	Exam's coverage of important concepts	4.09	3.57	4.88
19.	Quality of instructor's comments	3.82	3.77	5.00

## Appendix A (continued)

		100 LEVEL COURSES	GEOL 111 Traditional	GEOL 111 Revised
20.	Quality of textbook	3.89	3.86	4.55
21.	Helpfulness of work to understand material	3.94	3.59	4.33
22.	Helpfulness of group discussions	**	na	na
23.	Term project	**	na	na
24.	Helpfulness of lab exercises	**	3.98	4.50
25.	Student group projects	**	na	na
26.	Case studies or role playing	**	na	na
27.	Course journals	**	na	na
28.	Instructor's use of computers	**	na	3.90
29.	My learning increased in this course	3.51	3.43	4.11
30.	I made progress achieving objectives	3.44	3.08	4.00
31.	Interest in the subject area increased	3.45	3.28	4.44
32.	Course helped me think independently	3.50	3.14	4.33
33.	Course actively involved me in what I learned	3.58	3.43	5.00
34.	I studied and put effort into this course	3.57	3.66	4.00
35.	I was prepared for each class	3.33	3.29	4.11
36.	I was challenged by this course	3.62	4.08	4.22

NOTE: \*\* Means not reported

## Appendix B

## SIRII – Assessing Courses and Instruction

Comparison of student course reaction questionnaires collected for the pilot Geology 112 course offered in the summer of 1997 and a traditional class taught during the previous fall semester. Both the fall semester class and the pilot course were taught by the same instructor.

Responses: NA (Not Applicable) 5 (Very Effective) 4 (Effective) 3 (Moderately Effective)  
2 (Somewhat Ineffective) 1 (Ineffective)

		100 LEVEL COURSES	GEOL 111 Traditional	GEOL 111 Revised
1.	Instructor's explanation of course requirements	4.24	4.67	4.84
2.	Instructor's preparation for each class	4.38	4.89	5.00
3.	Instructor's command of the subject	4.51	4.78	5.00
4.	Instructor's use of class time	4.22	4.72	4.69
5.	Instructor's way of summarizing points	4.06	4.33	4.61
6.	Instructor's ability to make clear presentations	4.08	4.33	4.92
7.	Instructor's command of English	4.66	4.83	5.00
8.	Instructor's use of examples	4.24	4.39	4.92
9.	Instructor's use of questions	3.98	4.13	4.77
10.	Instructor's enthusiasm for course	4.38	4.39	5.00
11.	Instructor's helpfulness	4.26	4.33	4.92
12.	Instructor's respect for students	4.36	4.28	5.00
13.	Instructor's concern for students	4.11	4.11	4.77
14.	Availability of extra class help	4.15	4.40	5.00
15.	Instructor's willingness to listen	4.39	4.41	4.92
16.	Information about grading policy	4.22	4.39	4.77
17.	Clarity of exam questions	3.92	4.00	4.38
18.	Exam's coverage of important concepts	4.09	4.00	4.46
19.	Quality of instructor's comments	3.82	4.22	4.69

## Appendix B (continued)

		100 LEVEL COURSES	GEOL 111 Traditional	GEOL 111 Revised
20.	Quality of textbook	3.89	3.94	4.69
21.	Helpfulness of work to understand material	3.94	3.64	4.69
22.	Helpfulness of group discussions	**	na	4.63
23.	Term project	**	na	4.66
24.	Helpfulness of lab exercises	**	3.59	4.77
25.	Student group projects	**	na	4.53
26.	Case studies or role playing	**	na	na
27.	Course journals	**	na	na
28.	Instructor's use of computers	**	na	4.45
29.	My learning increased in this course	3.51	3.39	4.69
30.	I made progress achieving objectives	3.44	3.22	4.15
31.	Interest in the subject area increased	3.45	2.89	4.46
32.	Course helped me think independently	3.50	3.28	4.69
33.	Course actively involved me in what I learned	3.58	3.17	4.69
34.	I studied and put effort into this course	3.57	3.72	4.23
35.	I was prepared for each class	3.33	3.17	3.69
36.	I was challenged by this course	3.62	3.94	4.07

NOTE: \*\* Means not reported



## References

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