**March 2010 Addendum to the**

**Department of Geological Sciences Fall 2009 Assessment Report**

**Compiled by Department of Geological Sciences**

**Submitted by Thom Wilch, Chair**

**March 19, 2010**

The Department of Geological Sciences created a Skills Assessment Matrix for the purpose of assessing skills and knowledge that we expect of our students. The matrix is shown on page two of this document and lists several skill areas that are being assessed in the 2009-10 academic year.

The table below lists the assessment results of eight skill areas that are included in this addendum to our 2009 Assessment Plan and Report. These assessments were carried out during the fall semester 2009. The table also lists one new area of assessment (#9), which needs to be incorporated into our assessment plan. The Department of Geological Sciences has taught Geological Field Methods (Geology 314) in the Rocky Mountains for 40 years. This program recruits students from across the USA and as such it is both a nationally recognized and distinctive program at Albion College. The national recognition of the program is assessed with enrollment data and analysis of US News and World Report ratings of participants’ home institutions, as well as comparative data from other Field Camp programs.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Goal Areas | Fall 2009 Course or Activity  | Assessment Tool |
| 1. | Communication: Oral Skills | Geology Colloquium | Rubric |
| 2. | Critical Thinking: Critical Reading | Geology Colloquium | Rubric |
| 3. | Critical Thinking: Application of Scientific Method | Geology 103 | Rubric |
| 4. | Critical Thinking: Application of Scientific Method | Geology 101 labs | Rubric |
| 5. | Earth Science Methods: Field Skills | Geology 201 | Rubric- pilot |
| 6. | Earth Science Methods: Field Skills | Geology 306 | Rubric- pilot |
| 7. | Earth Science Methods: Map, Imagery, GIS Skills | Geology 111 | Rubric |
| 8. | Content Areas: Plate Tectonics | Geology 101 | Exam Questions |
| 9. | National Recognition of Geology Program | Geology 314 | Enrollment Data |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Goal Areas** | **Courses in Geology Curriculum (2009-10 Version)** |   |   |   |
|   | **101** | **103** | 104 | 106 | 111 | 115 | **201** | 202 | **203** | **204** | **205** | 208 | 209 | 210 | 211 | 212 | 216 | 306 | 307 | 309 | 310 | 311 | 312 | 314 | **Colloquium** | Dir. St. Research  | **Senior Exam** |
|   | **Intro** | **Earth H** | Resources | Hazards | GIS | Oceans | **Structure** | GdWater | **Min** | **Pet** | **Sed Strat** | Geomorph | Paleo | Regional | Rem Sens | Volc | Env. Eng. Geo | Glaciers | Geochem | Vert Pale | Adv Pet | AdvGIS | Ore Deposits | Field camp |
| **Communication** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Writing Skills | I |   | I | I |   | I | E |   | E | E | E | E | E |   |   | E | E | **E** |   | I | E |   | C | E |   | C |   |
| Oral Skills | I |   | I | I |   | I |   | I | I | E |   |   |   | EA |   | E | E | E |   | E | E |   |   |   | C A |   |   |
| **Critical Thinking** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Problem Solving | I | I | I |   |   | I | E | C | E | E | C | E | C | E | I | E | I | E | C | C | E | E | E | C |   | C | A\* |
| Critical Reading  |   |   |   |   |   |   | E | E |   |   |   | E |   | C |   | E |   | C |   |   | E |   |   |   | C A |   |   |
| Quantitative Reasoning | I |   |   |   |   |   | C | E | E | E | I | E | I |   |   |   | E | I | C | I | E | E |   | E |   |   | A\* |
| Application of Scientific Methodology | E**A** | E**A** |   |   |   | I |   | E |   | E | C | E | C |   |   |   | I | E | E | C | E |   | E | C |   | C |   |
| Independent Research | I |   |   |   |   |   |   | E |   | I |   | E | E |   |   |   | E | E | E |   | C | E | E | C |   | C |   |
| **Creativity & Initiative** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Independence of Thought | I | I | I |   |   |   | I | I |   | E | E |   | E | E |   |   |   | E | E | E | C |   |   | C | C | CA |   |
| Integrative Thinking | E | I | I | I | I | I | I | E | E | E | E | E | E | E | E | E | E | E | C | E | C | E | C | C | C | CA | A\* |
| Initiative | I | I | I | I | I |   | I | I |   | E | E |   | E | E |   |   | I | E | E | E | E |   |   | C | C | CA |   |
| **Earth Science Methods** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Field Skills | I |   |   |   | I |   |   | CA |   | E | E | C |   | CA |   |   | I | CA |   |   |   |   |   | C |   | E |   |
| Lab Skills | I | I |   |   |   |   | E | C | C | C | C | E | E |   |   | E | E | E | C | I | C |   | E | C |   | E |   |
| Map, Imagery, GIS Skills | I | E |   | I | CA |   | E | I |   | E |   | C |   |   | C |   | E | E |   |   | E | C |   | C |   |   | A\* |
| Info. Technology Skills | I |   | I |   | C |   | I | E | I | E | I | E |   |   | C | E | I | E | E | I | C | C | E |   | C | E |   |
| **Content Areas** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Plate Tectonics | EA | E | I | E |   | E | I |   |   | E | E |   | I |   |   | E |   |   |   | E | E |   |   | E |   |   | A |
| Earth History | I | E |   |   |   | E |   |   |   |   | C |   | C | E |   | E |   | C |   | C |   |   |   | C |   |   | A |
| Solid Earth Composition/Structure  | I | I | I | I |   |   | C |   | C | C | I |   |   |   |   | E |   |   |   |   | C |   |   | C |   |   | A |
| Surface & Atmos. Processes | I | I | I | E | I | E |   | E |   | I | E | C | I |   | I | E | C | C | E | I |   |   |   | E |   |   | A |
| I = topic introduced |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E = topic emphasized |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C = comprehensively covered |
| A = 2009-10 assessment; A\* = Senior exam and Colloquium Assessments will be expanded to include these areas. Yellow highlight is Fall 09 assessment, pink highlight indicates Fall 09 and Spring 10 assessment; and blue highlight indicates Spring '10 assessment. |

1. **Goal Area- Communication: Oral Skills (Geology Colloquium; Rubric)**

The Geology Department colloquia are held 2:10-3 p.m. on Friday afternoons during both fall and spring semesters.  The colloquia feature presentations by junior and senior geology and earth science majors and minors, as well as faculty and guest speakers. Presentations can be based on 1) independent faculty-mentored research; 2) off-campus geology experience; or 3) a peer-reviewed journal article.  Presentation topic must approved by a faculty member.   It is strongly recommended that students consult with faculty members whose teaching/research is most similar to the presentation topic.

The student oral presentation rubric (below) was completed after each colloquium presentation by all faculty members attending the presentation (n=4-7). The actual rubric sheets also contain areas for faculty to make constructive comments in each of the areas: organization and format: talk content; visual aids. The scores and comments for each student were aggregated and typed up and a copy of aggregate feedback was given to the students. The aggregate scores of 9 students are listed below. One student was evaluated on a completely different trial rubric, which we ultimately decided not to use.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|   | Excellent = 4 | Good = 3 | Fair = 2 | Weak = 1 | Sr Mean | Jr. Mean | Total Mean |
| Organization and format | Slides are simple, legible and neat. Clear introduction and summary, with well-articulated "big picture" tie-in. Organized talk with very logical progression of ideas.  | Organization and format could be improved in one key area stated in Excellent column.  | Organization and format could be improved in two key areas stated in Excellent column. | Organization and format could be improved in three or more key areas stated in Excellent column.  | 3.31 | 2.93 | 3.14 |
| Talk Content | Thorough knowledge of the topic. Correct pronunciation of terminology. Basic scientific questions are clearly stated and addressed. Assertions are well supported with evidence.  | Talk content could be improved in one key area stated in Excellent column.  | Talk content could be improved in two key areas stated in Excellent column. | Talk content could be improved in three or more key areas stated in Excellent column.  | 3.43 | 3.04 | 3.25 |
| Visual Aids | Figures (photos, graphs, tables) are professional, legible, and neat. Figures are well labeled and include scales. Figuresilluminate aspects of the presentation. Text outlines key points appropriately.  | Visual aids could be improved in one key area stated in Excellent column.  | Visual aids could be improved in two key areas stated in Excellent column. | Visual aids could be improved in three or more key areas stated in Excellent column.  | 3.30 | 2.92 | 3.13 |
| Speaker and delivery | Speaker is professional in manner. Conveys concepts in an effective and engaging manner. Vocal projection is clear and audible. Delivery at an appropriate rate and level for the audience. Welcomed and thoughtfully addressed questions.  | Speaker and delivery could be improved in one key area stated in Excellent column.  | Speaker and delivery could be improved in two key areas stated in Excellent column. | Speaker and delivery could be improved in three or more key areas stated in Excellent column.  | 3.31 | 2.64 | 3.01 |
|   |   |   |   | Total Mean | 3.34 | 2.88 | 3.14 |

Analysis of results

The fall 2009 semester was the pilot for our Oral Skills Assessment Rubric. Results indicate that senior geology/earth science majors had higher mean scores in each area and overall compared to junior majors/minors. We consider this to be a positive result, since student present multiple times in their junior and senior years. Each student who presented last semester received feedback on their current level in each category with specific comments and suggestions to apply to their next presentation. As this is a new assessment tool it will take several more semesters to evaluate its full impact but we anticipate continued improvement in this area.

1. **Goal Area- Critical Thinking: Critical Reading (Geology Colloquium; Rubric)**

We used the same student oral presentation rubric to assess critical reading skills. In this case we only used the Talk Content category to assess the critical reading skills. Presentations were based on 1) independent faculty-mentored research; 2) off-campus geology (summer REU) experience; or 3) a peer-reviewed journal article.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|   | Excellent = 4 | Good = 3 | Fair = 2 | Weak = 1 | Sr Mean | Jr. Mean | Total Mean |
| Talk Content | Thorough knowledge of the topic. Correct pronunciation of terminology. Basic scientific questions are clearly stated and addressed. Assertions are well supported with evidence.  | Talk content could be improved in one key area stated in Excellent column.  | Talk content could be improved in two key areas stated in Excellent column. | Talk content could be improved in three or more key areas stated in Excellent column.  | 3.43 | 3.04 | 3.25 |

Analysis of results

Again, the fall 2009 semester was the pilot for our Critical Reading Assessment Rubric. Results indicate that senior geology/earth science majors had higher mean scores as compared to junior majors/minors. Critical reading skills are practiced in several upper-division geology courses and in all research projects. The results are frequently presented in colloquium presentations. In our new rubric we can provide specific feedback to students on their current level, areas to target for improvement and areas where they are already strong. We anticipate continued improvement in this area

**3. Critical Thinking: Application of Scientific Method (Geology 103; Rubric)**

One of the Geology Department’s learning goals is application of the scientific method, which is also one of the "Scientific Analysis" mode learning goals (to test hypotheses or other scientific theories). The following assessment was conducted by Dr. William Bartels in Geology 103: Introduction to Earth History.

For Geology 103, I decided to assess student’s understanding and application of observation, hypothesis development, and hypothesis-testing as it applied to a group of extinct reptiles they had learned about in lecture. The project involved the examination of two skeletons of flying reptiles (pterodactyls) hanging in the Science Complex Atrium, which was part of a larger laboratory examining dinosaurs and other fossils on display in the Science Complex. Students worked as individuals or in groups of 2 or 3.

Scientific methodology and hypothesis testing is described in their textbook and in lecture without specific reference to the problem.

The learning goal is assessed in the ability of the students to develop three hypotheses explaining the differences between the two skeletons and the evidence they would seek in closer examinations of the skeletons, the records of where they were found, or specimens in other museums. I evaluated the 41 students according to the table below.

|  |  |
| --- | --- |
| # Students | Description of Rating |
| 1 | Student was unable to formulate a reasonable and testable hypothesis. |
| 40 | Student posed at least one reasonable and testable hypothesis  |
| 37 | Student posed at least two reasonable and testable hypotheses  |
| 24 | Students posed three reasonable and testable hypothesis |
|  |  |
| 4 | Student could construct no adequate tests for any hypothesis |
| 37 | Student could construct at least one adequate test for any hypothesis |
| 37 | Student could construct at least two adequate tests for any hypotheses |
| 8 | Student could construct three adequate tests for all hypotheses |

The conclusion from this assessment is that with a single exception, all of the students could formulate a reasonable and testable hypothesis explaining the differences in the skeletons. In addition, 90% (37/41) were able to formulate two hypotheses and 59% (24/41) were able to formulate three. In terms of testing their hypotheses, less than 10% could not construct a single adequate test for any hypotheses, regardless of how many they may have formulated. However, 90% (37/41) of the students were able to construct two adequate tests. Finally, 20% (8/41) were able to provide sound tests for all three of their hypotheses.

Outcomes and Conclusions

The students were not graded on this exercise, although they did not know it at the time. The single student who was unable to formulate a single hypothesis had been disengaged throughout the class and put little effort into anything. I am unwilling to put much inference on his outcome.

Three additional students, working as a group, were not really able to formulate original ideas. Their single hypothesis was straight out of their lecture notes on another group, and their proposed tests were generally unrelated fragments of knowledge gleaned from other parts of their lecture notes. I am not sure how to assess their performance.

All remaining students could formulate and test at least two hypotheses.

The students who were successful at the two hypothesis & test level, were able to take information given on related retile groups and apply those methodologies and observations to the pterodactyls. The students who could formulate the third hypothesis were able to take more abstract concepts from the course and apply them here. Their ability to then formulate a test of that third hypothesis was fairly limited however, with only 8 of the 24 (33%) suggesting an adequate test.

Knowing that I would be conducting this assessment, I was very careful to avoid direct reference to how to test hypotheses in these situations. Later in the course, I go through a detail analysis of another group of reptiles to illustrate hypothesis testing, but it comes after they have completed this assessment.

Given the fact that 60% could come-up with an original third hypothesis but 2/3 of them not an original test, I feel that I can give them greater insight into this project by introducing multiple hypothesis testing in an earlier lab exercise, perhaps using an invertebrate fossil group such as trilobites. I will, therefore, repeat the exercise in the Fall of next year.

I have designed a different assessment for hypothesis formulation and testing for this semester that will use a similar methodology but use dinosaurs instead.

1. **Critical Thinking: Application of Scientific Method (Geology 101 labs: Rubric)**

One of the Geology Department’s learning goals is application of the scientific method, which is also one of the "Scientific Analysis" mode learning goals (to test hypotheses or other scientific theories). The following assessment was conducted by Drs. Menold, McRivette, and Van de Ven in Geology 101 (Introductory Geology) labs. The assessment report submitted to C&RC is copied below. The "Scientific Analysis" mode assessment focuses on the following learning goal: Test hypotheses or other scientific theories.

For Geology 101, the faculty teaching the course and laboratory (McRivette, Menold, Van de Ven) decided to assess student’s understanding and application of hypothesis-testing in group student research projects that are a component of the lab. The research projects are introduced in the lab manual (Attachment #1) and detailed in lab handouts (Attachment #2). The scientific method was introduced in lecture, is described in the course textbook, and was discussed in lab sessions in conjunction with introduction of the research projects.

The learning goal is assessed in the reports associated with the research projects. Students were told to pose a testable hypothesis and to test it with their research. Of the 52 enrolled students, 51 completed research project reports. Understanding of hypothesis-testing was assessed on a 4-point scale, according to the table below.

|  |  |  |
| --- | --- | --- |
| **# of Students** | **Rating** | **Rating Description** |
| **2** | 0 | Students failed to mention their hypothesis in their papers |
| **12** | 1 | Students posed a hypothesis but did not adequately test it, the quality of the hypothesis was so weak that it was difficult to test |
| **22** | 2 | Students posed a hypothesis and tested it adequately, the quality of the hypothesis was acceptable but tended to be a little to general to be tested adequately in lab study |
| **15** | 3 | Students posed a hypothesis and tested it, and posed a follow-up hypothesis, the quality of the hypothesis was high and was appropriately tested |

The 4-point rating scale is not linked directly to the grading of the papers, although there is a correlation in that students who failed to mention a hypothesis most likely omitted other important aspects from their papers.

My conclusion from this assessment is that 96% of the students (49/51 students) understood the concept of a hypothesis (rating > 0). Examples of reports earning a rating of “0” are available upon request. Of these, 76% (37/49 students) were able to successfully test their hypothesis through independent research (rating > 1). Of these, 41% (15/37 students) understood the iterative process of hypothesis-testing that is an important extension of the scientific method (rating = 3). Examples of reports earning a rating “3” are available upon request.

## In light of these results for Geology 101, an introductory level science course that serves a large portion of the student body in meeting their scientific mode requirement, it seems appropriate that we should concentrate specifically on setting higher goals for the number of students rating 2 or higher according to the scale used for this assessment. A goal of 80% attainment of this rating is an appropriate target at this juncture. The existing procedures for introducing and emphasizing the scientific method are sound, but may benefit from the addition of a document to be provided to students in lab as part of the research project that reinforces the components of scientific methodology.

## Attachment 1: Lab Manual Assignment Description

## Weeks 4, 6, and 11: Introduction to Group Research Projects

General Requirements

Research is fundamental to science, so it is our belief that research belongs in an introductory science course. We are asking (and would rather think of it as inviting) you to complete a research project this semester. Past students have found that the ability to work independently, in groups, outdoors, and on a project of their own choosing and design have made this an enjoyable part of the course.

We have the following requirements that the research project must:

* be a group effort
* be geological
* be based on the scientific method and involve formulating a hypothesis, and collecting and interpreting data to test the hypothesis

Read the In Greater Depth 1.4 Box (p. 22-23) for a review of the Scientific Method.

Schedule

You will work on this project both in scheduled lab time and on your own time. This week, we will devote time in lab to discuss the various possible projects and several of the techniques available to you. The group will be required to prepare a prospectus of the research project. The prospectus should include the following:

* the problem to be solved (the question you hope to answer)
* a hypothesis or hypotheses
* the basic design of the project (how many measurements or samples will be collected, where, why; how samples will be analyzed)
* how the results will be interpreted (what are you looking for, what will support one conclusion over another)

The project will require completion over period of time and will likely involve travel and field work. You will have several weeks to complete the necessary work before the due date (Week 11-12). Please note that, while we have scheduled a lab for work on the project, *you will almost certainly find it necessary to devote additional time outside of lab to complete the sample collecting, lab analyses, etc.* It is therefore critical that you make steady progress between now and the due date – do not put off field work that may not be possible to complete later in the semester when weather may interfere, or wait until the last minute to schedule analytical time. We will be very happy to help you and we will need to assist with some aspects of the research project. It is your responsibility to request help, ours to give it.

Final Report

Each member of each group will write a short paper describing the project and its results. This must be in your own words – it is an individual, not a group, product. The results of the project will be presented in class on the day indicated on the syllabus. Both papers and presentations should include maps, charts, text, etc. More details about the presentation will be given.

Papers are due on the day of the presentation and should follow the outline below:

Introduction: describing the objectives of the project and the hypothesis(es)

Methods: describing how data was collected

Data: the “facts” consisting of maps, tables, graphs, text, etc., describing the data

Interpretations: analysis of the data explaining what it means and an evaluation of possible sources of error

Conclusions and recommendations: summary statement (bulleted is okay) of the research and hypothesis test results, and recommendations for further research

Evaluation of group work: an honest assessment on the “group” experience: What was each person’s role in the project? Was the work distributed evenly?

*Additional information will be presented in lab.*

**Attachment #2: Project Descriptions**

1. Broad-scale view of the Kalamazoo River hydrology

Chris Van de Ven, cvandeven@albion.edu, will help with this project

This group will examine the hydrology along a broad length of the Kalamazoo River. Your primary tools for study will be online stream gage and historical data, complemented by field observation and documentation of the stream gage locations. The USGS maintains a series of stream gages on the Kalamazoo River.

Background data you need to acquire include:

* Locate the 3 closest stream gages to Albion on the Kalamazoo River
	+ Plot them as placemarks on a Google Map or Google Earth
* You will research what data these stream gages record and what they mean
	+ What is the discharge and stage height at flood level?
	+ What is the watershed area for each gage?
	+ What is the relationship between watershed area and base flow?
* Evaluate the historical records they have recorded
	+ Including the flood-recurrence interval graphs
	+ What is the recurrence interval for flooding?
	+ What is the recurrence interval for
* How do landuse and landcover affect stream characteristics and responses to precipitation?
* Others??

Some ideas for your project include…

* Visiting the 3 closest stream gages
	+ Photograph each stream gage
	+ Record the river and channel characteristics upstream and downstream of the gages
	+ Record the landuse patterns at the gage as well as up- and downstream
* Monitor and graph stream levels
	+ What is the baseflow at each gage?
* Record the timing and size of precipitation events
	+ Determine the rate of response at each gage
* Create a topographic profile across the floodplain at each gage
	+ How does it change downstream?
* Calculate the river gradient for each section of river.
* Others??
1. Heavy metal contamination of soils due to urbanization, industrial uses, and/or agricultural practices

Carrie Menold, cmenold@albion.edu, will help with this project

There are many possible sources of contamination urban soils. It usually suspected that heavy industry, landfills, and major chemical spills are the major causes of contamination of the environment. However, it is also quite likely that much contamination comes from personal and residential use of common materials. One example is lead contamination resulting from weathering of old (pre-1978) paint (lead-based). Such sources of contamination can be insidious. They are widespread, and thus difficult to contain. Often, there is no obvious culprit to blame and require to clean up the mess. In rural areas, agricultural practices, particularly the application of certain pesticides and fertilizers, can result in accumulation of heavy metals in the soil. This group will study the heavy metal content of soil samples to investigate possible sources and causes of contamination. This project entails:

* designing a sampling strategy to test your hypothesis. This should include control samples (samples from non-contaminated locations).
* preparing soil samples for analysis, by grinding and pressing pellets using special machines available in the department.
* analyzing samples using the automated x-ray fluorescence (XRF) spectrometer in the Dow Lab to determine heavy metal concentrations in your samples.
* preparing maps and charts to evaluate your results.

**Local hydrology of the Kalamazoo River**

Mick McRivette, mmcrivette@albion.edu, Putnam 256, will help with this project

This group will examine the hydrology along the Kalamazoo River near Albion. Primary tools for this study will be stream velocity meters (from which stream discharge can be obtained) and analysis for the total suspended sediment load carried by the river, complemented by field observation and map analysis and interpretation. The USGS maintains a series of stream gages on the Kalamazoo River, but none in the Albion area.

Stream discharge will change along the length of a stream due to the influence of tributaries and exchanges between surface and ground water. Discharge is also sensitive to seasonal climate variations and short-term weather perturbations. The amount of suspended sediment transported by a stream may vary with stream velocity, which is itself related to discharge and its contributing factors, especially short-term weather variability. In addition to data collected in the field, you will have access to USGS 7.5” topographic maps of the Albion area.

This project entails:

* studying local maps and designing a measuring/sampling strategy (several locations along the stream) to test your hypotheses.
* using the current velocity meter, measuring tape, and graduated rod to measure stream velocities and channel dimensions at measuring/sampling locations.
* calculating discharge for each of your cross-sections.
* collecting and analyzing samples to find sediment load transported by the stream at measuring/sampling locations.
* evaluating your hypotheses about the predicted changes in discharge and sediment load along the stream (and possibly associated tributaries) based on your results.

**5. Earth Science Methods: Field Skills (Geology 202; Rubric- pilot)**

Field notes are important as a basic professional skill geology in general; in groundwater geology they are important for two reasons. 1.) The groundwater course is pre-professional, in that many students will likely go on to work in this area. Good field notes are an essential professional skill because they form the basis of all further work and reports. Field notes can become legal documents if the project involves litigation. 2.) Much of the field work involves drilling multiple wells and recording data in them. In order to interpret tests done in one lab, it is essential to have good data on the locations of wells, the layers they penetrate, and the way in which they were constructed (depth, screened interval, packing around casing). Without these data, the results of well tests are impossible to interpret.

Field (and one lab in which we did permeability testing) notes were collected and graded 5 times throughout the semester. They were graded on a scale of 0-20. Because the grading criteria are the same as those used by the Geology Department in its assessment plan, a simple translation from the point scale used in the class to the assessment scale is possible, and is presented below.

|  |  |  |
| --- | --- | --- |
| Assessment Score | Grade | Description of assessment scale |
| 4 | 18-20 | No concerns, professional quality notes |
| 3 | 16-17  | Good student notes with a few omissions  |
| 2 | 14-15  | Generally good notes but with several omissions, poor organization or other detracting features |
| 1 | 12-13 | Notes marginally acceptable, data generally available but hard to find, significant omissions.  |
| 0 | 0-11 | Unacceptable data. Organization severely impedes understanding, Several significant omissions, or incorrect data |

The graph below shows the grades of each student as they progressed throughout the semester with the heavy line (series 12) the class average. The heavy dashed horizontal lines mark the boundaries used in the geology department rubric between professional, strong student, acceptable student, weak student and unacceptable notes. In general, the data show improvement and convergence of scores In the acceptable to strong student note range throughout the term. The last lab was a surveying lab, conducted in a hurried way in the face of a brewing storm (which did in fact cut the lab short). I believe that this is the reason for the dip in scores.

Though the results show improvement, my goal is to have all students taking professional quality notes by the end of the term. Next time I teach this course, I will prepare a handout showing the sort of notes I expect and discuss this prior to going into the field . This year I lectured on the goals of each lab prior to going into the field and in the field, at the start of the first two labs modeled good notes for the students in my own book.

1. **Earth Science Methods: Field Skills (Geology 306; Rubric- pilot)**

Dr. Wilch conducted a similar field note assessment (to that described above in 5) in his Glaciers and Climate Change (Geology 306) class in fall 2009. Taking thorough and accurate notes in the field is a difficult but critical task in geology. Observations, measurements, data collection, and interpretations are best recorded at the exposure. This rubric is designed to be used to assess field note-taking by students who are making independent geological observations or collecting original data in the field. The five point rating scale is not linked directly to the grading of the field notebooks, although there is a rough correlation. Field notes are emphasized in several upper level geology courses and are comprehensively covered in our summer field camp course, Geology 314, Geological field methods. It is our expectation that prior to field camp, students will be taking notes at a satisfactory level. Field camp students should ultimately be performing at a strong to professional level.

Students were assigned field notebook grades based on the specific criteria that related to the lab assignments. Student notes were also assessed according to the following more general rubric. The grades and assessment were aligned. This advanced course enrolled 10 students.

|  |  |  |
| --- | --- | --- |
| Rating | Description | No.  |
| 0 = unacceptable student-level notes  | Notes are illegible and incomplete. Basic site information (location, date, time, weather, purpose) is very weak or absent. Key observations and sketches are critically flawed. No interpretations/hypotheses or confusion of observations and interpretations. Notes are flawed and would not be useful to other geologists who have not visited the site. | 0 |
| 1 = weak student-level notes | Notes are mostly legible but lack organization and consistency. Site information (location, date, time, weather, purpose) is weak and lacking important points. Key observations and sketches are lacking important information or clarity. Interpretations/hypotheses are weak and may be confused with observations. Notes are lacking in multiple areas and would be only marginally useful to other geologists who have not visited the site. | 1 |
| 2 = satisfactory student-level notes | Notes are legible and moderately organized. Site information (location, date, time, weather, purpose) is acceptable but not complete. Key observations are included but detail could be improved. Sketches of site, exposure(s), and features are included but could be improved in clarity, labeling or scale. Interpretations/hypotheses are included but are not well supported by observations. Notes lack detail but would still be useful to other geologists who have not visited the site. | 6 |
| 3 = strong student-level notes | Notes are legible and reasonably well-organized. Site information is complete (location, date, time, weather, purpose). Observations are appropriate to exposure or site and are mostly thorough. Sketches of site, exposure(s), and features are clear and have appropriate labels, directional indicators. and scale. Interpretations/hypotheses are included and supported by observations. Notes would be clear and useful to other geologists who have not visited the site. | 3 |
| 4 = professional-level notes | Professional level. Notes are legible and well-organized. Site information and observations are detailed and complete. Thoughtful and, in some cases, multiple interpretations/hypotheses are included in notes and clearly separated from factual observations. Notes would be very clear and useful to other geologists who have not visited the site. | 0 |

No. refers to the numbers of students who were evaluated at each rating level.

Analysis of Results:

This was the first time that this rubric has been used to evaluate student’s ability to take field notes. Students were instructed in note-taking at the beginning of the course and at several points throughout the course. There were four labs spent entirely in the field and one three-day weekend field trip. The field assignments involved making observations, collecting data and collecting samples of glacial deposits exposed in local gravel pits and in exposures along the Lake Michigan shore. There were two major papers associated with threes field assignments.

The instructor made suggestions on the notes several times throughout the course but the notebooks were graded only one time. This is an advanced course in geology. The students included sophomores to seniors, mostly geology majors, with a wide range of experiences in geology. The mode (6/10) evaluation score was a 2, which indicated satisfactory student-level notes. As stated in the introduction to this document, the expectation of the department is that students will be taking satisfactory notes prior to taking our capstone course, Geology 314. Two of the students enrolled in Geology 306 have completed the capstone Geology 314. Three students received a stronger rating of 3 and one student received a weaker rating of 1. Although the data were not systematically collected, it appears that the stronger evaluations were received by generally high-performing and more experienced students and the lower evaluations were received by students with the least amount of experience in the course.

Two suggestions to improve the assessment are: 1) to assess the field notes on two or more occasions during the semester; and 2) to include an analysis of how many field-note intensive classes each student has taken prior the current course. It is anticipated that use of this or similar rubrics in other field intensive courses will result in more intentional teaching of note-taking skills and an overall improvement in note-taking quality.

**7. Earth Science Methods: Map, Imagery, GIS Skills (Geology 111; Rubric)**

Dr. Van de Ven assessed map, imagery, and GIS skills in his Geography and GIS (Geology 111) in fall 2009. By the three-dimensional and temporal nature of geologic data, the ability to interpret, evaluate, and manipulate spatial data is an important task for geologists. Geologists must be able to interpret information often found in disconnected and sparse outcrops, interpolate the relationships between outcrops across both the ground surface, assess their three-dimensional nature, and evaluate what that means about past environments and conditions. Geographic information systems (GIS) is an interdisciplinary tool that is increasingly used by geologists, as well as biologists, archeologists, historians, political scientists, and economists to map, evaluate, interpolate, and manipulate all types of spatial data. Each of two midterm exams in Geol. 111 includes a take-home practical exam. By the second midterm exam, they are expected to be able to complete basic spatial analyses that include interpreting spatial relationships, efficiently searching and selecting specific subsets from large datasets based on their spatial patterns or attributes, deriving new data, maps, and information from given data, and design and create effective, concise maps. This assessment is based on students’ performances on the second midterm take-home exam. It evaluates students’ ability to complete GIS tasks, given a set of data and questions by the second midterm take-home exam.

|  |  |  |
| --- | --- | --- |
| Rating | Description | No. of students  |
| 0 = unacceptable GIS and map skills  | Maps are missing critical data or elements. Students show little or no ability to evaluate spatial data, to see spatial relationships between data, and are not able to manipulate given data to highlight or select features showing those relationships. | 0 |
| 1 = weak GIS and map skills | Maps are mostly legible but lack organization, and/or consistency. Some critical data or map elements are missing or incorrectly represented. Students show minimal or inconsistent ability to evaluate spatial data. Are able to conduct some basic data manipulations, but are unable to complete more sophisticated multi-step analyses. | 2 |
| 2 = satisfactory GIS and map skills | Maps are legible and moderately organized. Maps data and elements are acceptable, but not complete or neatly organized. Students are able to conduct all basic spatial queries and manipulations, but still have difficulty completing more sophisticated multi-step analyses.  | 2 |
| 3 = strong GIS and map skills | Maps are legible and reasonably well-organized Maps data and elements are complete and neatly organized. Students are able to conduct all basic spatial queries and manipulations, and can consistently completing more sophisticated multi-step analyses. | 6 |
| 4 = professional-level GIS and map skills | Maps are consistently legible, well-organized, and professionally arranged. Students frequently make map design decisions beyond the basics required that provide clarity and understanding. Students are able to conduct all basic and complex spatial queries and manipulations using efficient and direct steps.  | 3 |

Analysis of Results:

This assessment required an evaluation of students’ independent ability to create maps, manipulate data, and perform GIS analyses. These are the same goals as the take-home exam. The in-class exam evaluated students understanding of GIS processes, theories, and geographical understanding. Therefore, the take-home exam was also used to assess student understanding for this goal area. In this exam, students were required to create maps and do data manipulations that they had performed throughout the semester, in weekly labs, and in lecture exercises. The exam had two parts, which were subdivided into multiple steps.

In the first part, students were given data on hurricane paths, as well as outlines of US states and locations of US cities. Students were evaluated on their ability to manipulate the hurricane data to answer basic questions about the size, timing, number, and magnitude of hurricanes. The effort required to answer those questions ranged from simple 1-step queries of just the hurricane data, to more complex multiple step queries involving the hurricane data, states, and/or the cities data. This first section ended with the students designing a map to show select hurricanes overlaying a subset of states and cities. They were expected to include all map elements like a map title, scale, map key, etc.

In the second part of the exam, students were given topographic and geologic information and were expected to subset the data to find small areas that met multiple criteria. This required a nested set of queries and selections, including converting data between types (raster to vector). Once areas that met all criteria were founds, students were required to perform a basic calculation and create a map that included labels and the overlay of additional, background data. To evaluate students’ workflows and approach to this complex problem, they were required to write out the steps they took in their analysis.

For both questions, the range of knowledge required for full credit ranged from very basic data manipulations to quite complex, multi-step analyses that needed a thoughtful approach to solve. Maps were evaluated based on how well they completed the analyses, as well as the overall layout, color scheme, and completeness. No student earned 100% on the exam, but a few students produced clearly superior work on one or more portions of the exam. Their map layouts were clean, efficient, and complete. The majority of students showed very strong map and GIS skills. They created complete maps, but may have not selected an ideal way to display the data or overlooked a map element. Most of these students completed most, but not all of the sophisticated analyses, but did not have trouble with the more basic analyses.

Some improvements to the assessment are: 1) to evaluate map design skills separate from GIS skills; and 2) to incorporate student critiques of existing maps in addition to creating their own maps. It is anticipated that map and GIS skills will be assessed through a practical exam in the future, but that exam design and evaluation can be designed with an eye toward assessment as well as understanding of curricular materials.

1. **Content Areas: Plate Tectonics (Geology 101; Exam Questions)**

Student mastery of the ‘Plate Tectonics’ content area was assessed in Geology 101 (Introductory Geology) in fall 2009. Plate tectonics is the ‘unifying theory’ of modern geology and forms the fundamental framework for the specific concepts covered throughout the course. As such, a significant portion of the course is devoted to the exploration of plate tectonic theory directly, while the plate tectonic context of other concepts is routinely emphasized throughout the remainder of the course. It is the single most important content area presented in Geology 101.

Assessment of the plate tectonic content area was performed through a series of exam problems throughout the semester. Each of the three midterm exams and the final exam included a problem requiring the student to draw a plate tectonic boundary and to indicate and/or label several important features on the drawing. Students were instructed that they were responsible for this material prior to each exam via a study guide. The problems became progressively more detailed throughout the semester, adding new features presented in the most recent portion of the course. This approach was taken 1) in the hope that students would benefit from and demonstrate improved mastery of the content as a result of being regularly responsible for understanding the systematics of a plate boundary, and 2) to provide the instructor with the opportunity to evaluate student mastery in a timeframe that would allow for additional emphasis as required. Examples of the problems from the first midterm exam and the final exam are provided below:

*From first midterm exam*:

Draw a cross section of an ocean-continent convergent boundary. Add arrows to show the direction each plate is moving and label the following features:

continental plate oceanic plate volcanoes earthquakes trench

*From final exam:*

Draw a cross section of an ocean-continent convergent boundary. Add arrows to show the direction each plate is moving and clearly label the following features:

lithosphere asthenosphere continental crust oceanic crust

volcanoes subduction-related earthquakes site of melting trench

fold & thrust belt accretionary wedge sedimentary basins

As the problems became progressively more complex, their point value increased. The results presented in the table below are therefore expressed as percentages. Answers to the problems were scored strictly, such that each significant error resulted in point deduction. Thus, a score of 80% or greater on the final exam problem is taken to indicate an appropriate level of mastery for students enrolled in Geology 101. Results are shown for the 52 of the original 55 enrolled students that were enrolled at the end of the semester for each of the exams.

|  |  |  |
| --- | --- | --- |
| Exam | Mean score: plate tectonic problem (%) | Mean score: exam total (%) |
| Midterm exam 1 | 65.6 | 76.5 |
| Midterm exam 2 | 67.3 | 67.4 |
| Midterm exam 3 | 69.1 | 72.8 |
| Final exam | 75.3 | 75.3 |

Analysis of results:

Overall, the mean scores for the exams show a trend of improvement in student performance on the plate tectonics problems throughout the semester, especially between midterm 3 and the final exam. Much of the end of the semester was devoted to a concerted re-emphasis of plate tectonic theory in class, partly according to the original course structure and partly in response to a lack of significant improvement in scores over the three midterm examinations.

Despite this improvement, the mean score for the 52 students fell short of the 80% target (1 student did not attempt to answer the problem; the mean for the remaining 51 students is 76.8%). The score distribution for the final exam problem is shown in the histogram plot below.



Of the 51 students that attempted the final exam problem, 23 students (45.1%) met or exceeded the 80% threshold. Three additional students were 0.5 points (out of 15 possible) shy of an 80% score. Five students (9.8%) received scores of 60% or lower.

It is worth noting that, with the exception of the first midterm exam, mean scores for the plate tectonic problems are very similar to the mean scores for the corresponding exams. Based on this apparent correlation, student performance on the series of plate tectonic problems may be representative of the overall performance of students in the course. While the plate tectonics mean scores are slightly lower than targeted, they are clearly commensurate with overall student performance and do not point to a glaring deficiency in emphasizing this area of content.

In response to these results, it is suggested that plate tectonic theory receive in-depth coverage in Geology 101 as early as possible within the course structure. Such an approach would differ from that employed in fall 2009, in which plate tectonics was introduced early, but covered in greater depth later in the course. It appears that this approach may have created a deficit of knowledge that could not be completely recovered later in the course. It is recommended that a similar assessment be performed with the proposed change in course structure to evaluate the effectiveness of the changes.

1. National Recognition of Geology Program (Geology 314; Enrollment Data)

We are presenting preliminary data and analysis on enrollments in our Geological Field Methods (Geol 314) course. These data do not yet fit into our assessment plan but we are working on expanding the plan to accommodate the data. The data sources include internal enrollment data collected by the department, US News and World Report College and University rankings, and data from Penny Morton, University of Minnesota Duluth who maintains a database on Geology Field Camp programs.

Albion College is one of only seven US liberal arts colleges that regularly offer a geology summer field camp program (see Table 1). Average annual enrollment in our program over the nine-year period from 2001 to 2009 is 20.0, more than 6 students greater than the average enrollment in the programs offered by the other institutions over the same time period. Four of these institutions run their summer field camp programs in alternate years only, a format we are moving to beginning in 2010.

Table 1.

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| --- |
| **Liberal Arts Schools with Geology Field Camp Programs** |
| *Name* | *Year Last Offered* | *Most Recent Enrollment* |
| Albion College | 2009 | 22 |
| Beloit College |  2009\* | N/A |
| Colgate University | 2009 | 16 |
| Fort Lewis College | 2009 | 10 |
| Mesa State College |  2008\* | 15 |
| Northland College |  2008\* | 10 |
| Wheaton College |  2008\* | 11 |
|  |  |  |
| \* Offered in alternate years through 2010 |

Over the nine-year period from 2001-2009, 180 students have enrolled in Albion’s summer field camp (see Table 2, next page) . Of these, 30 (16.7%) were Albion College students. The other 150 students came from 74 different institutions located in 27 states. These home institutions include Williams College (#1 Liberal Arts College according to the 2010 *U.S. News & World Report* rankings), Middlebury College (#4 LAC), Washington and Lee University (#14 LAC), Hamilton College (#21 LAC), Oberlin College (#22 LAC), Macalester College (#29 LAC), Whitman College (#36 LAC), DePauw University (#43 LAC), Franklin and Marshall College (#43 LAC), Washington University in St. Louis (#12 National University), Brown University (#16 NU), Vanderbilt University (#17 NU), the University of California – Berkeley (#21 NU) , the University of Rochester (#35 NU), Case Western Reserve University (#41 NU), Boston University (#56 NU), Trinity University (#1 Master’s University – West), California Lutheran University (#18 MU – West), and Alfred University (#20 MU – N). We have also drawn from several Michigan and GLCA institutions, including Calvin College, Central Michigan University, Eastern Michigan University, Grand Valley State University, Michigan State University, Wayne State University, Western Michigan University, DePauw University, Oberlin College, Ohio Wesleyan University, and The College of Wooster.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2. Geology Field Camp Student Home Institutions and Student Numbers (2001-2009)** |  |  |  |  |  |  |  |  |  |
| *Institution* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* |
| Albion College | 6 | 4 | 3 | 2 |   | 3 | 4 | 7 | 1 |
| Alfred University |  |   |   | 1 |   |   |   |   |   |
| Augustana College |  | 3 |   |   |   |   |   |   |   |
| Austin Peay State University |  |   |   |   |   |   |   |   | 1 |
| Binghamton University |  |   |   |   |   |   |   | 1 |   |
| Boston University |  |   |   | 1 |   |   |   |   |   |
| Brown University | 1 | 1 |   | 1 | 3 | 1 | 2 |   |   |
| California Lutheran University | 1 | 1 |   | 2 |   |   | 2 |   |   |
| California State University - Los Angeles |  |   |   |   |   | 1 |   |   |   |
| Calvin College | 3 |   | 2 | 1 |   |   |   |   |   |
| Case Western Reserve University |  | 1 |   |   |   |   |   |   | 2 |
| Castelton State College | 1 |   |   |   |   |   |   |   |   |
| Central Michigan University | 1 |   | 1 |   | 3 | 3 |   | 1 | 3 |
| Clemson University |  |   |   |   | 1 |   |   |   |   |
| College of Wooster |  |   | 1 |   |   |   |   |   |   |
| DePauw University | 1 |   |   |   |   |   |   |   |   |
| Eastern Michigan University |  |   |   |   |   | 2 |   |   |   |
| Franklin and Marshall College |  | 1 | 3 | 1 | 1 |   |   | 2 | 3 |
| George Mason University |  |   |   |   |   |   |   | 2 |   |
| Grand Valley State University |  | 2 |   |   | 3 | 1 |   | 1 | 3 |
| Guilford College |  |   |   |   |   | 1 |   |   |   |
| Hamilton College |  |   |   |   |   |   |   |   | 1 |
| Lawrence University |  |   |   |   |   |   | 1 |   |   |
| Lock Haven University |  |   |   |   |   |   |   | 1 |   |
| Macalester College |  |   | 1 |   |   | 1 |   |   |   |
| Marshall University |  |   |   |   |   |   |   |   | 1 |
| Michigan State University |  |   |   |   |   |   |   |   | 1 |
| Middlebury College |  |   |   |   |   | 1 |   |   |   |
| Muskingum College |  |   | 1 |   |   | 1 |   |   |   |
| North Carolina State University |  |   |   |   |   | 1 |   |   |   |
| Oberlin College |  | 1 |   |   |   |   |   |   |   |
| Ohio University |  | 2 |   |   |   |   |   |   |   |
| Ohio Wesleyan University |  |   |   |   |   | 2 |   |   |   |
| Old Dominion University |  |   | 1 |   |   |   |   |   |   |
| Rider University |  |   |   |   | 1 |   |   |   |   |
| Slippery Rock University |  |   |   |   |   | 1 |   |   |   |
| Southwest Minnesota State University | 1 |   |   |   |   |   |   |   |   |
| St. Norbert College |  |   | 1 |   |   |   |   |   |   |
| Texas A&M University |  |   | 1 |   |   |   |   |   |   |
| Texas A&M University - Corpus Christi |  |   |   | 1 |   |   |   |   |   |
| Trinity College |  |   | 2 | 1 |   |   |   |   |   |
| Tulane University |  |   |   |   |   |   |   | 2 |   |
| Univeristy of Arizona |  |   |   |   | 2 |   |   |   |   |
| University of California - Berkeley |  |   |   |   |   |   | 1 |   |   |
| University of Delaware |  | 3 |   |   |   |   |   |   |   |
| University of Houston |  |   |   |   | 1 |   |   |   |   |
| University of Maine |  |   |   |   |   |   |   | 1 | 3 |
| University of Maryland |  |   |   |   |   | 2 | 1 | 4 | 1 |
| University of Puget Sound |  |   |   |   | 2 |   |   |   |   |
| University of Rhode Island |  |   | 1 |   | 1 |   |   |   |   |
| University of Rochester |  |   |   |   |   |   | 2 |   |   |
| University of South Florida | 1 |   |   |   |   |   |   |   |   |
| University of Texas - San Antonio |  |   |   | 1 |   |   |   |   |   |
| University of Toledo |  |   |   |   |   | 1 |   |   |   |
| Vanderbilt University |  |   |   |   |   |   | 1 |   |   |
| Virginia Polytechnic Institute and State University |  |   |   |   | 1 |   |   |   |   |
| Washington and Lee University |  |   |   |   |   |   |   | 1 |   |
| Washington University |  |   |   |   |   |   |   | 1 |   |
| Wayne State University |  |   | 1 | 1 | 1 |   | 1 |   |   |
| Western Michigan University |  |   |   | 1 |   |   |   |   |   |
| Whitman College |  |   |   |   |   |   | 2 |   |   |
| Williams College |  |   |   |   |   |   |   |   | 1 |
| Winona State University |  |   |   |   | 1 | 2 |   |   | 1 |
| Wright State University |  |   |   |   |   | 4 |   |   |   |

For the 2010 program, we have received 69 applications from students attending 29 institutions located in 15 states (see Table 3). Home institutions include Williams College, Macalester College, Whitman College, Franklin and Marshall College, Smith College (#18 LAC), Bates College (#25 LAC), Brown University, the University of Rochester, and California Lutheran University.

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| **Table 3. Geology Field Camp Applicant Home Institutions (2010)** |
| *Institution* | *2010 Applicants* |
| Albion College | 6 |
| Bates College | 1 |
| Brown University | 1 |
| California Lutheran University | 2 |
| Central Michigan University | 8 |
| Franklin and Marshall College | 4 |
| Grand Valley State University | 6 |
| Macalester College | 1 |
| Mesa State College | 1 |
| Oakland Community College | 1 |
| Rutgers University | 4 |
| Slippery Rock University | 3 |
| St. Norbert College | 5 |
| SUNY Fredonia | 1 |
| Temple University | 2 |
| University of Alaska Anchorage | 1 |
| University of Alaska Fairbanks | 1 |
| University of Cincinnati | 1 |
| University of Maine | 4 |
| University of Michigan Flint | 1 |
| University of Nebraska at Omaha | 1 |
| University of Rhode Island | 2 |
| University of Rochester | 1 |
| Wayne State University | 2 |
| Whitman College | 3 |
| Williams College | 2 |

Of the 180 student enrollees for the years 2001-2009, at least 10 currently remain enrolled at their home institutions to complete their undergraduate degrees. A minimum of 62 of the remaining 170 students (36.5%) are known to have continued to graduate school in pursuit of a M.S., M.E., and/or Ph.D. degree in the geosciences or a related field. Field camp alumni pursued these studies at some of the premier graduate institutions in the country (according to 2006 *U.S. News & World Report* rankings), including the Massachusetts Institute of Technology (MIT) (#2 Earth Science graduate school, #2 Geology graduate school), Stanford University (#3 ES, #1 Geo), the University of California – Berkeley (#4 ES, #8 Geo), the University of Texas (#9 ES, #5 Geo),the University of Wisconsin (#9 Geo), the University of Washington (#11 ES, #10 Geo), the University of Chicago (#15 ES), Brown University (#19 ES), and the University of Colorado (#25 ES).

Future Plans. The enrollment data presented here suggest that the Geology Field Camp program is a distinctive program that successfully recruits students from top-tier colleges and universities. These results support the department’s continuation of this distinctive academic program.