I. Revised Assessment Plan

In 2007-2008, the Geology Department reviewed our existing assessment plan and decided to make revisions. These revisions were based on a number of considerations.

1. The department is on the verge of curricular revisions, prompted by:
   - Retirements and new hires have shifted our department’s strengths slightly. We need sufficient flexibility in the curriculum to absorb those changes.
   - Both students (through interviews) and alumni (through surveys) have told us they believe a different sequence through the petrology courses would be preferable.
   - For years we have observed how stress levels rise and performance drops for our students in the spring semester. We recognize that our spring schedule is overloaded with fieldwork, and in general has a higher workload than the fall semesters.
   - We recognize that in an era of declining resources, we need a curriculum flexible enough to withstand budget fluctuations, enrollment changes, and faculty leaves. Our current curriculum is both large in terms of units, and relatively rigid. We want to consider ways of streamlining the curriculum, introducing a bit more flexibility, while maintaining a high quality program recognized by employers as the best in the region.

2. In attempting to implement our existing assessment plan, we found portions to be unworkable. We initially planned to measure students’ mapping skills with a rubric to be used across courses. Instructors found that the skills required in different courses were different enough that developing a common metric was not desirable. We now want to look to other ways of measuring this particular aspect of student learning.

3. We also perceive a need to measure some aspects of student learning we had not previously considered. Several faculty members, through informal assignments and observations, noticed that students do not seem to be retaining some fundamental geological concepts as they move through the program. Often instructors discover this deficiency at terribly inopportune times – just when students need a particular skill they should already have mastered, for example. We see a need to identify the fundamental geological concepts students should master, develop a mechanism to communicate this information to students, and design an assessment tool to both enforce this requirement and measure student’s mastery of these concepts.

4. Finally, the Geology Department has been selected to participate in the pilot launch of the University’s new program review procedure. We welcome the opportunity to build our self-study around some of the concerns outlined above, and to use the self-study process to concentrate on moving our assessment plan forward.
A. Program Goals: adopted May, 2000

I. Students are prepared for professional and/or graduate study in the geosciences;
II. Students develop a deep understanding of Earth systems: how Earth systems work and how they interact;
III. Students develop their ability to solve geologic problems through the use of scientific method;
IV. Students develop a deep curiosity about how the Earth works, and a lifelong appreciation of the Earth's place in space and time; and
V. Students develop their technical communication skills: seeking and processing technical information; and communicating technical information and conclusions in both oral and written form.

B. Learning Outcomes
The Department has identified four major learning outcomes to further these goals.

1. Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems
2. Students will be proficient in solving geologic problems.
3. Students will be proficient in geologic mapping.
4. Students will be proficient writers, skilled in the genres of scientific and technical writing.

C. Methods of Assessment
We propose to use four tools for measuring student performance in the areas outlined above. Two of these, field camp grades and a writing rubric, are already in place. Two more components – a geologic knowledge inventory and key problem-solving assignments – will be added to our plan for 2008-2009.

Field Camp Grades: Like most geology programs, we require B.S. students to complete a four-to-six week field camp as a culminating experience. Like most small programs, we currently do not offer our own field camp, so we expect students to attend field camps offered by other geology departments. We exert tight quality control on the camps we will allow our students to attend. To qualify, a camp must be 4-6 weeks long, address broad aspects of geology, require a written field report, and have a reputation as a challenging program. Our geology program is much stronger than most in developing students’ field skills, so we want to ensure that our students attend camps that further develop their skills, rather than camps that are aimed at field novices.

Using field camp grades as an assessment benchmark serves several functions:
- Field camp grades are a direct measurement of students mapping skills.
- Field camp grades are also a holistic measure of students’ abilities to synthesize everything they have learned in their B.S. program to solve geologic problems.
- Using grades given by other schools lets us calibrate our expectations of our students against those of other geology departments. Because we only allow our students to
attend some of the best field schools in the country, we are measuring our students’ abilities against a national standard for excellence in geology.

- While geology as a discipline has a certification exam in California – the Professional Geologist exam – students will not take that exam until long after they have left us, and many will never need to take the exam in the course of their career as a geologist. So field camp grades stand in as a proxy for a licensing exam as an external benchmark of program quality.

**Writing Rubric:** For several years we have measured quality of student writing through a common rubric, both in General Education courses and courses in the major. We collect copies of the rubric for assignments in the majors’ courses to use in tracking student writing.

**Geologic Knowledge Inventory:** We propose to develop an inventory of fundamental geologic concepts to measure our students’ mastery of these concepts. Each student will receive a booklet that outlines these basic concepts. An inventory instrument will be developed to be administered in several key courses – at the beginning and end of the junior year, and at the beginning and end of the senior year. Students will be tracked longitudinally to be sure that each student is making progress in their mastery of these essential concepts.

**Key Assignments in Geologic Problem Solving:** Our students already complete many assignments that make use of their problem-solving skills. We propose to identify a small number of these assignments and track student performance.

**D. Relationship between Goals, Learning Outcomes and Methods**

Table 1 summarizes how the goals, learning outcomes and methods are related.

**E. Mechanics of Assessment**

Table 2 summarizes the logistics of each assessment method, including the person responsible, the frequency of assessment, and an approximate schedule.

**F. Closing the Loop**

Each year, the Assessment Coordinator and the Chair will meet to plan how best to use our assessment data. Typically we will present the data at a faculty meeting and let the entire faculty consider how to use the assessment data in improving course design.

**II. Assessment Activities for 2007-2008**

During this academic year, the Geology Department carried out three primary activities in program assessment:

- Revision of our existing assessment plan (see discussion above and attached revised plan)
- Collection and analysis of field camp grades
- Collection and analysis of writing rubric scores

The learning outcomes we addressed were:

1. Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems
2. Students will be proficient in solving geologic problems.
3. Students will be proficient in geologic mapping.
4. Students will be proficient writers, skilled in the genres of scientific and technical writing.

Field Camp Grades:
   Like most geology programs, we require B.S. students to complete field camp as a culminating experience. Like most small programs, we currently do not offer our own field camp, so we expect students to attend camps offered by other geology departments. We exert tight quality control on the camps we will allow our students to attend. To qualify, a camp must be 4-6 weeks long, address broad aspects of geology, require a written field report, and have a reputation as a challenging program. Our geology program is much stronger than most in developing students’ field skills, so we want to ensure that our students attend camps that further develop their skills, rather than camps that are aimed at field novices.

   We value field camp grades as a measure of students’ mapping skills, and as a holistic measure of mastery of geologic concepts and ability to solve geologic problems. Field camp is a culminating experience that truly taps all the skills and knowledge it takes to be a successful geologist. This assessment measure addresses all four of the learning outcomes listed above.

   This year, we developed a procedure for collecting and analyzing student scores. A relatively small number of students attend field camp each year, because only B.S. students are required to attend field camp (not B.A. students) and because we are a modestly-sized program. Therefore we decided to begin a three-year cycle of data collection and analysis. For this first year, we collected field camp data on all of our alumni from the past five years whose field camp grades were accessible through CMS. Because some of our graduate students during that period also received their B.S. with us, we were also able to capture field camp grades for some previous classes. These grades (Table 1) serve as our baseline

<table>
<thead>
<tr>
<th>Grade</th>
<th># of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9</td>
</tr>
<tr>
<td>A-</td>
<td>6</td>
</tr>
<tr>
<td>B+</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>11</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>Average Grade</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Table 1: Field Camp Scores, 2002-2007

The average score of 3.4, with only a single student scoring a C, is satisfactory evidence that our students on the whole are achieving mastery of geologic problem solving. This average compares favorably with other universities using this standard for assessment, including Minnesota State University (3.1, 2007) and California State University, San Bernadino (3.2, 2001) (http://gradstudies.csusb.edu/outcome/GeologyBABS_00-01_SR.pdf, http://www.mnstate.edu/assess/CSNS/Geosciences/GEO_Report_07.pdf)

   The strength of this measure is that it gives a holistic measure of our students’ potential as geologists, and it allows us to calibrate our expectations of our students against an external standard. By that standard, we are doing very well as a department in preparing high quality geologists. The weakness is that it does not allow us to tease apart the components that lead to success in geology so that we can improve our program even further.
We conclude from this analysis that:

- Overall our program is achieving program goals I-V (see assessment plan) as measured through learning outcomes 1-4.
- We can safely put this assessment measure on a three-year collection cycle since we seem to be on-track now.
- We need a finer-grained metric to investigate our students’ mastery of specific areas of geologic practice.

Our response is to proceed with:

- Establishment of a procedure for analyzing field camp grades on a three-year cycle.
- Development of another assessment metric to measure mastery of specific aspects of geologic problem-solving (see revised assessment plan).

Writing Rubric: The use of a common writing rubric has become well-established practice since we adopted this assessment method in our initial assessment plan of 2000. The writing rubric is used in at least three upper division classes in the major. Our field classes use variations on the same rubric, as field reports have very specific requirements not found in other genres of scientific writing. This year we collected and compiled available data from 2005-2007. The rubric is attached to this report; results are shown in Table 2.

<table>
<thead>
<tr>
<th>Item</th>
<th>Possible score</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td>Clear Thesis</td>
<td>5</td>
<td>3.9</td>
</tr>
<tr>
<td>Organization</td>
<td>10</td>
<td>8.3</td>
</tr>
<tr>
<td>Analysis and Evidence</td>
<td>10</td>
<td>8.2</td>
</tr>
<tr>
<td>Clarity</td>
<td>10</td>
<td>7.9</td>
</tr>
<tr>
<td>Voice and Audience</td>
<td>10</td>
<td>7.7</td>
</tr>
<tr>
<td>Research and References</td>
<td>10</td>
<td>7.7</td>
</tr>
<tr>
<td>Format</td>
<td>5</td>
<td>4.3</td>
</tr>
<tr>
<td>Grammar, Spelling, Sentence</td>
<td>5</td>
<td>3.7</td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Impression</td>
<td>10</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Table 2: Writing rubric results from majors courses.

Some strengths and weaknesses became apparent, both in student performance and in our assessment methodology.

Student Performance:

- Geology students in general had better technical writing skills than the students in General Education courses.
- Especially when prompted with assignments that required outlines of the paper, students tended to write well-organized papers.
- Students were able to master the technical vocabulary needed to write papers, even in paleontology where the biological vocabulary could be daunting.
• Students in general are not skilled in writing abstracts, and many students need assistance with the fundamentals of writing.

• Students tended to do what was easy rather than what was necessary in researching papers. Unless forced to actually go to the library, students limited their research to papers accessible on-line. This is a problem in geology, where the CSUS library has sparse resources, especially when all the resources of the UC system are available within a few miles at the UCD Medical Center Library.

• Many students had never written technical papers before, and had great trouble in shedding the structures and voice they learned in writing English papers. For example, most students wrote long, rambling introductions. Many referred to themselves repeatedly in their papers.

Assessment methodology:

• The rubric is useful both in assessing and in improving student writing. At least one instructor provided students an opportunity to revise papers already graded using the rubric. The rubric provided information to the students on what to work on in a revision.

• The rubric provides a mechanism for instructors to talk about writing and reach a common agreement on what they value in good writing.

• The analysis has led directly to revision of our instruction. Students are now given opportunities to practice writing abstracts. We are now assembling a student guide to technical writing for students to be used in all courses with writing assignments to ensure consistency in our approach to improving student writing skills.

• The primary weakness of the assessment method is in tracking. Someone needs to remind instructors to make copies of the completed rubric forms before they are returned to students. Someone needs to oversee the entry of rubric data into a database. We are still regularizing the implementation of the data collection and analysis.

We conclude from this analysis:

• While our instruction in writing is fundamentally sound, we need to provide students with a more consistent standard, and greater opportunities to practice meeting that standard.

• We need to make writing assessment a more regular part of our department business.

Our response is to:

• Develop a writing manual for students. We have begun this process and plan to complete such a booklet next semester.

• Discuss the placement of more frequent writing assignments across several courses rather than a few end-of-semester major projects.

• Anchor writing assessment in the regular cycle of department work by including assessment discussions as a regular feature of our bi-annual department retreats.
III. Planned Assessment Activity for 2008-2009

During 2008-2009, the Geology Department will conduct a self-study inquiry, focused around these questions:

1. How well does the content and structure of our curriculum train students to solve geologic problems?
2. How well does the content and structure of our curriculum meet the workforce needs of California?
3. How well does the structure of our programs meet the needs of our faculty to maintain fulfilling professional lives?

As part of our inquiry into question #1, we plan to develop a Geologic Knowledge Inventory to administer to students several times during the junior and senior year. This effort will also help us measure Learning Outcome #1. We also plan to identify specific assignments in upper division courses that address the most important components of geologic problem-solving. We will track student performance in these assignments to measure Learning Outcomes #2 and #3. These efforts will complement our analysis of field camp grades in measuring our success in preparing high quality geologists.
Table 1: Relationships Between Goals, Learning Outcomes and Methods

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>Learning Outcome</th>
<th>Program Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Camp Grades</td>
<td>1, 2, 3, 4</td>
<td>I, II, III, IV, V</td>
</tr>
<tr>
<td>Writing Rubric</td>
<td>4</td>
<td>I, V</td>
</tr>
<tr>
<td>Content Knowledge Inventory</td>
<td>1</td>
<td>I, II, IV</td>
</tr>
<tr>
<td>Geologic Problem Solving</td>
<td>2, 3</td>
<td>1, II, III, IV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Program Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI.</td>
<td>I. That students are prepared for professional and/or graduate study in the geosciences;</td>
</tr>
<tr>
<td>VI.</td>
<td>II. That students develop a deep understanding of Earth systems: how Earth systems work and how they interact;</td>
</tr>
<tr>
<td>VII.</td>
<td>III. That students develop their ability to solve geologic problems through the use of scientific method;</td>
</tr>
<tr>
<td>VIII.</td>
<td>IV. That students develop a deep curiosity about how the Earth works, and a lifelong appreciation of the Earth's place in space and time; and</td>
</tr>
<tr>
<td>IX.</td>
<td>V. That students develop their technical communication skills: seeking and processing technical information; and communicating technical information and conclusions in both oral and written form.</td>
</tr>
<tr>
<td>Students will master a set of fundamental geologic concepts essential to understanding and solving geologic problems.</td>
<td></td>
</tr>
<tr>
<td>Students will be proficient in solving geologic problems.</td>
<td></td>
</tr>
<tr>
<td>Students will be proficient in geologic mapping.</td>
<td></td>
</tr>
<tr>
<td>Students will be proficient writers, skilled in the genres of scientific and technical writing.</td>
<td></td>
</tr>
</tbody>
</table>
### Table II: Actions, Responsibility and Timing in Implementing Assessment Methods

<table>
<thead>
<tr>
<th>Description</th>
<th>Next Steps</th>
<th>Who</th>
<th>When</th>
</tr>
</thead>
</table>
| **Field Camp Grades**  
  Use to get holistic picture of success of program | Collect from students as they complete field camp  
  Set up 3-year collection and analysis cycle.  
  Include results in assessment report | Clerical staff  
  Judi Kusnick and Dave Evans | Summer/Fall  
  May | |
| Writing  
  Continue to use rubric as an assessment tool, but collect data in only one or two courses | Put existing data into a spreadsheet to confirm our gut feelings about where students need better instruction  
  Analyze writing data  
  Revise writing instruction based on data  
  For assessment report, include a description of our actions to date and the changes that have already been made:  
  - Changes in writing prompts  
  - Planning new writing course/unit  
  - Writing exercises | Clerical staff  
  Judi Kusnick takes to faculty  
  Faculty  
  Judi Kusnick and Dave Evans | February  
  March  
  April  
  May | |
| Geologic Knowledge Inventory  
  Booklet for students describing what they should know; test administered in key classes to get longitudinal picture | Create booklet based on 5-10 learning outcomes, tie to learning goals.  
  Create assessment items  
  Pilot  
  Administer test in selected classes  
  Analyze data  
  Use data to revise courses  
  Include results and projected actions in assessment report | Faculty all contribute  
  Faculty all contribute  
  Judi Kusnick  
  Selected faculty  
  Faculty meeting  
  All faculty  
  Judi Kusnick and Dave Evans | September  
  October  
  October  
  December, May  
  February  
  Spring  
  May |
| **Geologic Problem Solving**  
Use specific course assignments to measure students’ ability to solve geologic problems | **Choose specific assignments based on group analysis of learning outcomes and goals of assignment.** | Faculty | September |
| Specific faculty collect student work | Selected faculty | Academic Year |
| Faculty consider student work at group meeting | Faculty | Dept. Winter and Fall retreats |
| Revise courses based on student work | Selected faculty | Academic year |
| Results in assessment report | Judi Kusnick and Dave Evans | May |