Carleton College Geology Department Assessment Plan
January 2009

This is obviously a work-in-progress. We began defining program outcomes for Geology majors in the early 1990s, identifying where in the curriculum students achieved those goals. More recently, we have worked to make the goals assessable and to define assessment instruments. This document assembles some of the pieces that have also been described and presented elsewhere.

1. **Mapping to college-wide goals** (March 2008) - The following form illustrates how the Geology Department has mapped some of its program goals to institution-wide student outcomes (from the College Mission Statement).

Carleton College Student Learning Outcomes

At Carleton, we value intellectual curiosity, risk taking, courage, the development of wisdom and creativity. These qualities are an integral part of who we are and because we do not want to lose sight of them, we state them here, along with the more measurable objectives listed below.

Carleton College graduates should be able to:

1. **Demonstrate that they have acquired the knowledge necessary for the continuing study of the world's peoples, arts, environments, literatures, sciences and institutions**.
2. **Demonstrate substantial knowledge of a field of study and the modes of inquiry or methodologies pertinent to that field.**
3. **Analyze evidence** i.e. identify underlying assumptions in particular theoretical orientations, methodological approaches or arguments; present opposing viewpoints and alternative hypotheses; recognize quantitative and qualitative claims, etc.
4. **Formulate and solve problems** i.e. locate, analyze, synthesize and evaluate information; discern patterns, coherence and significance; explore a situation, phenomenon, question or problem to arrive at a hypothesis or conclusion about it, come to well-reasoned conclusions or solutions, etc.
5. **Communicate effectively.**
6. **In their chosen field of study, conduct disciplinary and/or interdisciplinary research and/or undertake independent work, including artistic creation and/or production.**

Carleton Students						
Dept/Program	**Student Learning Outcomes**					
Students should be able to:	1	2	3	4	5	6
Think like a scientist		X	X	X		X
Communicate effectively in a variety of ways					X	X

Locate and evaluate information	X	X				X
Measure, collect and interpret data	X			X		X
Reason and visualize three-dimensionally		X		X	X	
Tackle complex problems		X	X	X		X
Learn the limits of knowledge	X		X			X
Work with others in groups					X	
Have an array of field experiences		X	X	X		
Do research and carry out projects on a variety of scales		X	X	X	X	X

2. General Statement of Assessment of geology learning outcomes and program (March 2008, updated January 2009):

As mentioned in the statement of goals, our aim is to give our students as many opportunities to gain scientific knowledge and the practical skills that we have identified. Program-related assessment takes place within courses, at the end of the senior year, with alumni reflection and outcomes, and by a variety of counting measures. The undergraduate major in Geology currently requires a minimum of seven courses and a senior project (comps). Assessment in these courses is subject-specific and includes performance on exams, written reports, poster and oral presentations. In addition to course-specific evaluation, the department each year assesses the success of the senior projects (comps) of graduating seniors. The department also implements an exit survey/interview to graduating seniors. The purpose of the exit survey is to solicit students' opinions on how well the geology program prepared them for their adventure after college. The department has also implemented some alumni surveys, including yearly surveys of the alums who are in graduate school. These surveys are very informative to our faculty and geology majors. We maintain current addresses of our geology alumni, we publish an annual newsletter and we see many of them at least twice yearly at national meetings where we host a get together. These mechanisms allow us to informally sample alumni opinion on a range of issues and to quantify alumni outcomes. Finally, we maintain records of course enrollments, numbers of majors, number of students taking more than one geology class, numbers on department field trips, etc. All of these elements factor into regular (formal or informal) program assessment within the department and into periodic (about every 10 years) formal self-studies and program reviews by internal and external reviewing committees.

3. **Using Senior Projects (comps) to assess program goals (March 2008):**

We propose to focus our assessment efforts related to graduating seniors and their comps projects on four of the goals outlined in the table above:

1. Communicate effectively in a variety of ways. We will be able to evaluate communication naturally through the overall evaluation of students' comps papers and comps talks. In geology, both papers and talks always include visualization of concepts, data and interpretation, so we should be able to evaluate writing, oral presentation, and visual representation skills.

Faculty comments (general) on comps papers (written communication) for class of 2008:

Faculty comments (general) on comps talks (oral communication) for class of 2008:

Faculty comments (general) on student uses of visual representation in their comps project for class of 2008:

3. Locate and evaluate information. For several years, we've required students to submit their "References Cited" sections of their comps papers as ENDNOTE bibliographies. In 2004, a small study showed some of the changes in student citation practice through time. We propose to update this study with a similar analysis of the ENDNOTE bibliographies of student papers submitted in 2008. This study will have the additional benefit of allowing us to identify any persistent problems with ENDNOTE and to work with Ann Zawistoski to fix them up.

4. Tackle complex problems. In geology, students begin the comps process with a proposal for a project, execute the project and then communicate the results. Both through conversations that department faculty have with their comps advisees and through the products (paper and talk), faculty can determine (qualitatively, at least) the students' ability to tackle complex problems as well as the degree to which that proficiency has improved through the comps process. In many cases, the "discussion" section of a student's comps paper offers strong clues about the student's abilities to tackle complex problems.

A number of instruments available would allow us to develop rubrics for proposals and for papers. Here, for instance, is a list of characteristics that Elizabeth Murphy describes and identifies in on-line discussions related to students' ability to solve ill-structured problems. Murphy, Elizabeth, 2004, Identifying and Measuring Ill-Structured Problem Formulation and Resolution in Online Asynchronous Discussions: Canadian Journal of Learning and Technology, v. 30, accessed on March 6, 2008 from http://www.cjlt.ca/content/vol30.1/cjlt30-1_art1.html (the following language comes from Murphy's table 3):

- Articulating the problem
- Viewing Perspectives
    - Perceiving causes or contexts for the problem
    - Understanding the nature of the problem and the way it manifests itself

    - Determining the extent of the problem
- Building Knowledge
    - Identifying unknowns or gaps in knowledge
    - Accessing and reporting on external sources of information
    - Determining the value of information
    - Reflecting on one's thinking
- Identifying Solutions
    - Proposing solutions and strategies with or without justification
- Evaluating Solutions
    - Agreeing with solutions proposed by others
    - Proposing alternative solutions
    - Weighing alternative solutions
    - Critiquing solutions proposed by others
    - Rejecting/eliminating solutions that are judged unworkable
- Acting on Solutions

One of the baseline philosophical principles in geoscience is something called "The Method of Multiple Working Hypotheses," a term coined in a seminal essay by Thomas Crowder Chamberlain published in *Science* in 1890 (http://arti.vub.ac.be/cursus/2005-2006/mwo/chamberlin1890science.pdf is a link to a 1965 reprint of the paper, again from *Science*. It is interesting to note that the textual elements Murphy looks for under "evaluating solutions" align nicely with this philosophical method.

We will probably not have a full-blown rubric in place this year, nor would we necessarily apply it to all student comps projects, but we think we can promise a discussion.

5. We will assess whether students have had an array of field experiences by creating a table showing the opportunities members of the class of 2008 have had for field work during their four years and trying, as best we can from field trip data, transcripts and comps projects to identify which experiences individual students in the class have had.

4. Example showing how to map program goals onto courses. This is a general matrix that can be subdivided into more detail, as desired. This matrix concept has been used by the Geology Department at the College of William and Mary and by the Geology Department and other programs at Carleton College.

Courses→ Skills↓	110	120	210	220	230	240	250	255	
General skills									
Computer skills									
Field skills									
Lab skills									
Interpretive skills									