Department of Geosciences – San Francisco State University

Assessment Report for Geosciences Undergraduate Programs

May 2010

I. General Background

The Department of Geosciences has three undergraduate majors programs. These include a Bachelor of Science in Geology, a Bachelor of Science in Atmospheric and Oceanic Sciences (with concentrations in Meteorology or Oceanography), and a Bachelor of Arts in Earth Sciences. The B.S. in Geology is the oldest and most established of the three, while the B.S. in Atmospheric and Oceanic Sciences and the B.A. in Earth Sciences have recently undergone major revisions that preclude a detailed long-tern assessment of student learning objectives at this early stage in their development. The three undergraduate degree programs are addressed individually in different parts of this report.

II. Bachelor of Science in Geology

Introduction

Since submitting the last assessment report for the BS in Geology program, the Department of Geosciences has:

1. Completed a set of student learning objectives for the BS degree in Geology.
2. Created a matrix that shows where those objectives are embedded in the curriculum.
3. Produced a detailed outline of specific student learning objectives for each of the required basic core courses in our BS degree in Geology and identified each of these objectives with a corresponding program learning objective.
4. Developed a strategy for how to measure the outcomes at the program level.
5. Measured the student learning outcomes for specific activities in each of seven required courses for this program

Broad Student Learning Objectives for the BS Geology Program

For the BS in Geology program, the Department of Geosciences has set up four broad student learning objectives aimed at developing the following competencies in our students:

A. Ability to investigate geologic problems by making observations and collecting data in the field/laboratory
B. Ability to analyze and interpret geologic data in terms of geometric, spatial and temporal relationships

Analysis of Assessment Data and Assessment Analysis Plans for 2010–2011

Histogram plots of course activity scores in required courses for the BS in Geology major show no apparent trend over time, although there is fluctuation from year to year. We note that there are differences among the data that are available for each course: some courses have been newly revised and show data for only a few years; and some courses include scores for activities and exams, others for activities only. For these reasons, there is considerable variability among mean scores for different courses. There is also variability among mean scores for activities within the same courses that reflects differences in the difficulty of specific activities. In our next iteration, we plan to include all course components and to distinguish between scores of activities and exams (exam scores tend to be lower than activity scores).

This was our first attempt to see how well the program learning objectives are represented in the individual required courses, and we were pleased to find that indeed all of the program objectives were well represented in the BS Geology core course activities. A major benefit of this process has been the increased communication among instructors, who are now much more aware of what is being taught in the other required courses. We are already beginning to communicate more about how we can coordinate topics among courses and build upon what students have already learned in prior course activities. The process is also helping us to better communicate to our students the individual course learning objectives and how these course objectives articulate with the overall program objectives. We plan to put the learning objectives on our department web site, and we are exploring ways to help our students create ePortfolios, which will further help them to understand the context of their learning.

Our ongoing and future assessment efforts include the following:

1. As described above, our analysis of the learning objectives is leading to better understanding of the curriculum and better communication among the instructors. We are using this analysis to improve coordination among the courses.
2. To help students to be more successful in their courses, we are looking at the timing of major assignments in the core classes that students commonly take concurrently.
3. One of our program goals has been to better integrate basic math and science principles into the geology curriculum. We have created a new Quantitative Geology course (Geol 125) to provide students with better preparation for the more quantitatively demanding majors courses. This course was first offered in 2008, and is now taken by many of our majors prior to taking geology core and advanced core requirements. During the next year, we will be exploring ways to evaluate the effects of this course on student learning.
4. As noted above, we are continuing to discuss the use of digital portfolios to provide students with an avenue for compiling artifacts of their learning and to help them track their progress and reflect on their emerging skills.

oceanography, global climate change, and the evolving quantitative and communication skills currently demanded by the profession.

A distinguishing feature of this B.S. degree program is the extensive set of pre-requisites for the majors courses, many offered by the Mathematics and Physics and Astronomy departments. This poses a significant advising challenge to students entering the program, since many decide to become majors at a point where they need to make up deficiencies in their math and physics competencies before proceding with required majors courses. Although the introductory GE courses our department offers in meteorology and oceanography (currently METR and OCN 100 and 101) are not required for the major, these courses are a primary recruitment ground for new majors, and provide us with the opportunity to advise students to take the requisite math and physics courses in time to graduate without unnecessary delays.

These introductory GE courses are in the process of being completely redesigned with the help of a major grant we recently received from the National Science Foundation, and will be offered in all three disciplines (Geology, Meteorology and Oceanography) starting in Fall 2010. We are hoping that the new courses (now labeled GEOL 104, METR 104 and OCN 104) will help us not only recruit new students into the major, but also allow us to provide timely advising to help them achieve the student learning objectives for this major.

The six members of the Department of Geosciences faculty that teach in this program have produced a mission statement for the program, a set of program-wide student learning objectives and a curriculum and roadmap to graduation for the program. With the two new oceanography professors now in place, a two-year course rotation schedule is being set up so that students in both concentrations encounter a minimum of delays on their way to graduation. We created a "common core" that both meteorology and oceanography students will take as part of their B.S. Minor revisions of the common core now in place will be submitted to the Curriculum Review and Approval Committee of the Academic Senate in Fall 2010.

Mission statement

The mission of the BS in Atmospheric and Oceanic Sciences is to provide students with a foundation in oceanography and meteorology that has a unique focus on the relations and general principles across these disciplines. The program is dedicated to preparing students to successfully contribute to important societal issues, such as global climate change, coastal impacts and weather forecasting, and be successful in a wide range of careers in applied meteorology and oceanography, as graduate students, teachers or in industry.

TABLE 1

Objective	Place in curriculum where objective can be assessed	Method of Assessment
A. Scientific Principles and Methodologies	METR 201, OCN 200, METR 400, METR/OCN 405, GEOL 458	Based on performance on exams and written reports, details being discussed
B. Phenomena and processes in the ocean and atmosphere	METR 201, OCN 200, METR/OCN 202, METR/OCN 320, METR 400, METR/OCN 405, METR 410, METR 420, METR 430, METR 450, METR 520, METR 530, OCN 420	Based on transcript analyses, performance on exams and written reports, details being discussed
C. Application to societal issues	METR/OCN 405, GEOL 458, CHEM 680, METR/OCN 756	Based on performance on exams and written reports, details being discussed
D. Critical thinking and communication	METR 400, METR/OCN 405, GEOL 458	Based on performance on exams, written reports and oral presentations, details being discussed

Assessment methods for the BS in Atmospheric and Oceanic Sciences

We are following a multi-pronged set of assessment methods for this degree program. As we did with the B.S. in Geology Program, we will assess student learning outcomes using student performance on individual course activities, whether labs, written reports, oral presentations or exams. For ease of comparison across courses and activities, student performance in each activity will be scored on a scale of 0 to 10, with 10 representing a perfect score for the activity in all courses.

In addition, we will be administering the survey instrument described in Appendix J to students graduating from this program, starting in Spring 2010, and we are discussing the potential use of electronic portfolios as an assessment tool in this program.

21 students that graduated from the meteorology concentration (or its predecessor), only 6 had completed this course during the 4th semester, while 10 completed that course during their 6th semester or later. Students in this latter category either had to postpone graduation or take this course concurrently with majors courses, a less that ideal situation that forces us to slow down the content delivery of our advanced courses while we ensure that students have the necessary quantitative skills to successfully complete our advanced required classes.

5) Another problem that has been apparent to the meteorology faculty has been the attrition that occurs when students take the METR 420 class, Dynamic Meteorology, which is a particularly challenging class (with METR 410 and additional physics and math courses as prerequisites) where students study the forces that govern atmospheric dynamics. Traditionally, this course is offered ahead of METR 430, Synoptic Meteorology, where students get to apply the concepts learned in METR 420 to real-time weather forecasting situations.

Actions taken as a result of assessment analysis and future assessment plans

1) Prof. Janssen, a physical oceanographer with particular interest in the use of quantitative methods, proposed the creation of a new course, the METR/OCN 320 class, which will address topics covered in MATH 228 using specific examples drawn from the fields of meteorology and oceanography. The course will be offered for the first time in Spring 2011, and will replace one of the Physics course requirements for the majors, so as not to exceed the number of units required for this program. We expect that this course will help address the broad student learning outcome B in Table 1 above and will assess its student learning outcome in the coming years.

2) After much consultation and study of other meteorology programs across the nation, we have decided to modify aspects of METR 430 to make it more accessible to students at an earlier stage in their careers. The hope is to give students better motivation to go into greater depth into the physical basis for atmospheric dynamics, what METR 420 accomplishes, by seeing a "preview" of applications of this knowledge ahead of taking METR 420. This change in the sequencing of the meteorology curriculum will be implemented in Fall 2010. We will monitor the student experience with the new course sequence closely.

3) We will complete the specific student learning outcomes for both concentrations in time for the start of Fall 2010, so that course activities, tied to learning outcomes, are in place. We will include learning outcomes of these assessments in next year's report.

Analysis of Assessment Data and Assessment analysis plans for 2010-2011

Since this program provides the students with more flexibility in course selection than our B.S. courses, we will focus our assessment analysis on four courses that serve as either "gateway" (GEOL 104, METR 201 and OCN 200) or "capstone" courses (GEOL/METR/OCN 405). Assessment of the gateway courses will provide us with data on the acquisition of basic quantitative skills and familiarity with the scientific method at an early stage of the career, while the capstone G/M/O 405 course can provide assessment data at a point where students are near to completion of their degree.

GEOL/METR/OCN 405, "Planetary Climate Change" (3 units lecture, 1 unit lab) is required for students in both the B.S. program in Atmospheric and Oceanic Sciences and in the B.A. program in Earth Sciences. It is also an elective for students in B.S. program in Geology, the B.S. program in Environmental Studies, and the Liberal Studies program. Moreover, it was designed originally to help pre-service high school science teachers meet geosciences subject-matter requirements for admission to California teaching credential programs, so pre-service teachers majoring in Biology, Chemistry, and Physics also take the course.

The course integrates multiple disciplines, including meteorology, oceanography, geology, physics, chemistry, mathematics, astronomy (planetary science), and some biology, to address the fundamentally interdisciplinary problem of planetary climate change. Because it draws on multiple physical science disciplines and is designed to serve students with a relatively wide range of backgrounds (from Liberal Studies to majors in one of the geosciences), it is not reasonable to make any particular course a prerequisite for GEOL/METR/OCN 405. At the same time, we teach the course as an upper division science majors course (consistent with its prefix and number), which assumes that students already have a relatively high level of critical thinking, graph reading, communication, and computer skill, and to a lesser extent quantitative thinking skill, as well as substantial geographic and other basic knowledge about the world, how it works, and how we describe its features and measure its properties. Ideally, the course functions as a kind of senior-year capstone course, pulling together and applying a wide range of disciplinary knowledge and skills that students acquire over the course of an undergraduate education.

The high expectations that we place on students in the course, together with the wide range of students that the course serves and the difficulty of specifying any particular prerequisites, presents a dilemma. For a number of years, we have set the prerequisite at 6 units of physical science coursework, which all students from all of the course's potential audiences can meet by their senior year. This prerequisite is relatively weak, but we have hoped that the course's science-department prefix and upper-division level numbering, together with appropriate advising, would send sufficient signals about the level of expectations we have for students to succeed in the course.

However, in Fall 2009 a significant number of students enrolled in the course who were only marginally prepared. They met the minimum prerequisite but barely, and (based on