Department of Geological Sciences

Assessment Plan and Implementation Report

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Introduction

The Geological Sciences department has approached assessment of student learning outcomes by conducting a ongoing review of undergraduate curricular structure, course content, and course sequence over the last three years. This process has involved exit surveys of two cohorts of graduating seniors, and multiple faculty meetings, focus groups, and one faculty retreat involving most of the faculty who teach core courses within the major. Due to radical staffing changes in the department during this time, approximately 40% of our core courses have been redesigned over the last three semesters and taught for the first time by new Assistant Professors. Because of this fact, most of our efforts have focused on finding opportunities for aligning course sequences and identifying student learning outcomes. Implementation of assessment data collection for specific outcomes has begun starting in Fall 2003, and will grow and continue during the foreseeable future.

Attached also to this report are working documents resulting from our efforts to streamline our undergraduate curriculum and to articulate specific learning objectives which flow from our broad learning goals. The learning goals within the Earth Sciences are more meaningfully conceptualized as a matrix of threads of content area specialization within the major vs. technical and intellectual abilities acquired through a course sequence, rather than a linear progression of abilities. Our specific learning outcomes measures are designed to measure technical and intellectual abilities within curricular content threads, and will evolve to measure transfer of abilities across content threads as well.

This latest call by the University for assessment plan reports is also the first time we have been asked to assess our graduate program. As such this portion of our plan is relatively underdeveloped compared with undergraduate assessment, as it is not clear how we can meaningfully assess our highly individualized program beyond our current requirements for progress toward graduation. Earth student in our graduate program must turn in an approved thesis and orally defend it. In addition, at least one person on the thesis committee must hold a tenure-track position outside of our department. Our plans and activities, such as they are, are presented as the last section of this report.

Undergraduate Program - B.S. Degree in Geological Sciences

1. Mission Statement

Graduates of the SDSU Geological Sciences department become skilled in the analysis of the earth system and its components, and graduate ready to lead the professional and academic community in the geosciences.

2. Three to Five Student Learning Goals

As mentioned in the introduction, the department has defined five learning goals, three of which are best thought of as orthogonal to the other two. Our learning goals are broken into three content conceptual threads which run longitudinally through the curricular sequence (see the "Content Threads" table appended to this report), and two main areas of geoscience methods, norms, and epistemology which are emphasized in different settings at all times throughout the curriculum in all content areas. These are described in the figure "Technical and Intellectual Abilities" appended to this report.

Content Threads

Students graduating from the Geological Sciences department will understand:

1. Earth History and Systems, emphasizing Life on Earth and Sedimentary Systems
2. Field-Based geological and geophysical investigations, emphasizing Earth Structure and Dynamics
3. Earth Materials and Composition in all parts of the geosphere

Geoscience Methods, Norms and Epistemology

Students graduating from the Geological Sciences department will be adept in:

4. Nature and Collection of Evidence in the Earth Sciences
5. Geoscientific Data Interpretation: Methods and Paradigms

3. Two Learning Outcomes for Each Learning Goal

We have identified many learning outcomes for our major, especially for goals 4 and 5. We highlight here those that we are actively assessing now, which are also those that have been identified by faculty and students being among the most important to make sure are learned well.

With progressive skill and sophistication as they progress through the major, students should be able to...

Content Threads

Goal 1, Objective 1: *Understand the history of life on Earth using common fossil taxa.*

Goal 1, Objective 2: *Integrate sedimentological and stratigraphic data to reconstruct penvironmental history.*

Goal 2, Objective 1: *Integrate diverse physical and structural data to reconstruct Earth history and understand Earth's physical dynamics.*

Goal 2, Objective 2: *Apply appropriate physical and mechanical principles to quantify and predict the actions of Earth processes and resulting physical structures.*

Goal 3, Objective 1: *Identify and understand the relationships between the basic chemical building blocks that make up minerals and rocks.*
Goal 3, Objective 2: *Integrate chemical data to understand active and past Earth processes using compositional clues.*

Geoscience Methods, Norms and Epistemology
Goal 4, Objective 1: *Construct accurate and interpretive geologic or geophysical maps in the field from data gathered during field-based investigations.*
Goal 4, Objective 2: *Communicate the results of any type of Earth science investigations via complete, concise, and coherent written and oral reports.*

Goal 5, Objective 1: *Understand how to use the investigative method of multiple working hypotheses in authentic geological and geophysical investigations.*
Goal 5, Objective 2: *Understand and interpret Earth systems and complex system-scale interactions from the integration of diverse geoscientific data.*

4. Assessment Measures

The direct measures of assessment used for measuring all of our objectives below are all embedded assessments, and are for the most part already in place and in use in our department in key courses. At this point our assessment activities are best developed at the lower curricular levels, the 200/300 level specifically, but certain higher level assessments also exist within capstone courses and the capstone Senior Thesis report and an oral defense.

Emphasizing direct measures of student learning, a brief description of the measures that will be used should be provided for each outcome.

Content Threads

Goal 1, Objective 1: *Understand the history of life on Earth using common fossil taxa.*
Measure: Laboratory final examination in Geo 537 – Geobiology

Goal 1, Objective 2: *Integrate sedimentological and stratigraphic data to reconstruct environmental history.*
Measures: Laboratory/field final examination in Geo 105 – Historical Geology
Incoming initial assessment of sedimentological knowledge – Geo 537 - Geobiology

Goal 2, Objective 1: *Integrate diverse physical and structural data to reconstruct Earth history and understand Earth's physical dynamics.*
Measures: Field exercise in Rainbow Basin – Geo 200 – Geologic Inquiry and Problem Solving
Final field and practical examination – Geo 306 – Structural Geology

Goal 2, Objective 2: *Apply appropriate physical and mechanical principles to quantify and predict the actions of Earth processes and resulting physical structures.*
Measure: Incoming assessment of physics skills – Geo 307 – Geophysics

Goal 3, Objective 1: *Identify and understand the relationships between the basic chemical building blocks that make up minerals and rocks.*

Measures: Embedded examinations in Geo 221 – Mineralogy
Complimentary incoming assessment in Geo 224 (soon 324) – Petrology

Goal 3, Objective 2: *Integrate chemical data to understand active and past Earth processes using compositional clues.*

Measures: Incoming assessment – Geo 530 – Geochemistry
Incoming performance assessment – Geo 525 - Petrography

Geoscience Methods, Norms and Epistemology

Goal 4, Objective 1: *Construct accurate and interpretive geologic or geophysical maps in the field from data gathered during field-based investigations.*

Measures: Embedded exercises in Geo 200 – Geologic Inquiry & Problem Solving
Embedded exercises in Geo 306 – Structural Geology
Embedded exercises in Geo 508 – Advanced Field Geology

Goal 4, Objective 2: *Communicate the results of any type of Earth science investigations via complete, concise, and coherent written and oral reports.*

Measures: Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 105 – Historical Geology
Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 221 - Mineralogy
Final exercise in Geo 508 – Advanced Field Geology
Senior Thesis

Goal 5, Objective 1: *Understand how to use the investigative method of multiple working hypotheses in authentic geological and geophysical investigations.*

Measures: Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 105 – Historical Geology
Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 221 - Mineralogy
Embedded exercises in Geo 306 and Geo 307 – Structural Geology and Geophysics
Embedded exercises in Geo 508 – Advanced Field Geology
Senior Thesis

Goal 5, Objective 2: *Understand and interpret Earth systems and complex system-scale interactions from the integration of diverse geoscientific data.*

Measures: Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 105 – Historical Geology
Joint embedded exercise in Geo 200 – Geologic Inquiry & Problem Solving and Geo 221 - Mineralogy
Embedded exercises in Geo 306 – Structural Geology
Embedded exercises in Geo 307 – Geophysics
Embedded exercises in Geo 508 – Advanced Field Geology
Senior Thesis

All student work will be initially collected and evaluated by individual course instructors, and then forwarded to the department assessment coordinator for compilation and aggregate analysis. This will enable direct programmatic feedback from the assessment coordinator to the faculty in terms of monitoring the acquisition and transfer of key content understanding and process skills. Senior theses are kept on file and archived by the department and individual thesis advisors. Many senior theses also result in published scientific reports, which are also noted and kept on file.

5. Assessment Timeline

Most of the measures collected above are in place currently in courses taught each year. The timeline for collection of these data will be on a semester-by-semester basis, with reporting from course instructors to the assessment coordinator happening continuously as embedded assessments are completed and evaluated. The 2004-2005 year assessment activities will focus on systemizing the collection of these data for existing assessments, and in constructing the necessary new assessment measures to cover all of the objectives at at least one curricular level in the major sequence. Through time the intention is to install embedded measures for all of these goals at all curricular levels, in order to gather complete longitudinal data for all of these learning goals.

6. Annual Assessment Report

The Geological Sciences department will submit its annual assessment report on October 15, as that will allow us to assimilate and analyze data collected from our capstone summer courses, and senior theses, thus creating entire annual sequences of data each year.

Graduate Program - M.S. Degree in Geological Sciences

1. Mission Statement
Graduates of the SDSU Geological Sciences department become skilled in the analysis of the earth system and its components, and graduate ready to lead the professional and academic community in the geosciences.

2. Three to Five Student Learning Goals
Our student learning goals are defined by three characteristics of a professional scientist.

Education: Our students will define their area of specialization and remain current in that area.

Research: Our students will be able to define a significant research question and conduct independent scientific research.

Communication: Our students will be able to communicate the results of their research to an audience of experts and non-experts.

3. Two Learning Objectives for Each Learning Goal
Education:
Objective 1: Students will select a curriculum of advanced courses that provide the necessary preparation in their area of specialization.

Objective 2: Students will maintain currency in their area of specialization by reading journal articles and attending scientific meetings.

Research:
Objective 1: Students will define a significant research question within their area of specialization and design a program of experimentation to address that question.

Objective 2: Students will perform the experiments to answer their research question making adjustments and/or additions to the program as the need arises.

Communication:
Objective 1: Students will describe the results of their experiments in written form in a written dissertation conforming to standards of scientific writing in their discipline.

Objective 2: Students will describe orally the results of their research program formally and informally to a mixed audience of experts and non-experts.

4. Assessment Measures

Education:

Objective 1: Students will submit to the Graduate Advisor of the Department of Geological Sciences an Official Program of Study consisting of 30 (or 31) units of courses conforming to the standards of the Graduate Division and the Department with the approval of the Thesis Advisor. This should occur no later than the student's third semester in the program

Objective 2: Students will read original journal articles and discuss them in group meetings and/or seminar courses monitored by faculty, as appropriate to the student's research specialization.

Research:

Objective 1: Students will present their proposed program of research as a formal Thesis Proposal presented in written form to the entire Geological Sciences faculty. When faculty approval for each proposed project is secured, the research is clear to move forward toward completion. This should occur no later than the student's third semester in the program. Any students participating in research involving human subjects must also submit a full IRB protocol for review, and all necessary approvals need to be secured before any data collection commences.

Objective 2: Students will conduct the research described in their Thesis Proposal making adjustments and additions as necessary to meet the goals outlined in the proposal. Satisfactory progress will be based upon evaluation by the Thesis Advisor and other members of the Thesis Committee. Ultimate approval will be based upon the written dissertation and oral Thesis Defense.

Communication:

Objective 1: Students will describe the results of their research in a written thesis conforming to the standards of the Graduate Division and the Department of Geological Sciences. The content of this thesis will be evaluated by the student's Thesis Committee who may approve, approve with changes, or disapprove based upon both content and style.

Objective 2: Students will present the results of their research at a public Thesis Defense seminar scheduled at a time advertised widely in the department and attended by the student's Thesis Committee as well as other interested parties all of whom may ask questions. Following the presentation the Thesis Committee will meet privately to judge the presentation and either approve, approve with qualifications, or disapprove. The results will be communicated to the Graduate Advisor of the Department of Geological Sciences.

5. Assessment Timeline

All of the measures above are currently in place and operate on the schedule described above for each student. As student proceed through their program at different rates, there is no master schedule for the entire graduate program, but the sequence and timing of the stages above is kept as consistent as possible for each student in the program. All reporting of results is done continuously with regular communications between the departmental Graduate Advisor and each individual student's Thesis Advisor.

6. Annual Assessment Report

The Geological Sciences department will submit its annual assessment report on October 15, as that will allow us to assimilate and analyze data collected from our capstone summer courses, and senior theses, thus creating entire annual sequences of data each year.