Program Review

Department of Geology
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Part 1: Program Strengths

The Department of Geology has many reasons to be proud of its program, including the breadth of its degree and course offerings, its research, its service to the community and the quality and accomplishments of its students.

1.1 Ability to Modify Curriculum and Degree Programs

The Department reviews its curricular and degree offerings on a regular basis and has had particularly intense discussion as part of the Program Review. Based on these discussions, revisions to the degree programs are being made at multiple levels:

*Geology Minor:* increase the rigor to include at least one Upper Division major course, rather than permitting all requirements to be met by GE courses;
*B.A. Earth Sciences:* increase rigor for the prospective teachers in this program by requiring earth materials and structural geology;
*Introductory sequence for B.S. majors:* shift from Geol 3/4L/7 to Geol 1(1L)/7 to allow for a more in-depth examination of earth materials and earth history;
*Content of Geol 3 and 4L:* revised to enhance the earth systems approach;
*Earth Systems capstone course:* new course to be offered as an elective, as an alternative and/or compliment to the existing synthesis course in Tectonics; it provides an interdisciplinary, in-depth view of the “spheres” interacting on Earth; and
*M.S. Writing Preparation:* require higher TOEFL scores for non-native speakers and a more-detailed, written Statement of Purpose in the application.

1.2 Strong Tradition of Self Assessment

In 2003, the Department comprehensively re-examined the content, goals, and articulation of all courses in the major. This led to many changes in individual courses, course sequencing, and degree programs. For the most part, these changes worked out well, with some subsequent modifications over time. An example of a modification was the increase of Geology 122 (Petrology) from a four-unit to five-unit course, which also included concepts from Geology 120 (Mineralogy). After teaching the course as a 5-unit course one time, it was determined that a refocused 4-unit version would better meet the needs of the students, and the course was changed back with Mineralogy restored as a separate course. Similarly, the current revision to require Geol 1 (with a required accompanying lab) instead of 3 and 4L revises a decision made in 2003, reflecting the current changes to the B.S. describe in Sec. 1.1. Over this same time frame, a number of the Geology electives have been increased from 3-unit to 4-unit courses because of the appreciable amount of work required of the students in these classes and the faculty’s recognition that it was difficult to cover the necessary material with only two hours of lecture plus a lab.

In addition to the modifications to the curriculum, the discussion in 2003 led to a formulation of Student Learning Objectives (SLOs) at both the undergraduate and graduate levels. These were described in our 2005 Program Review. The Department regularly evaluates
these SLOs, and then summarizes and reports the results. Modifications to the teaching methods or content and/or to the assessment approach are made as needed.

1.3 **Excellent Reputation in COS, SJSU, CSU, and Beyond – Evidence From Faculty Activity Since the Last Review**

The Faculty actively engages in a wide range of research, professional organization, and consulting activities. Since the last review in 2005, the Faculty has obtained funding for 38 grants for a total amount of $2,553,000. One grant is a joint collaboration with one of our part-time instructors. Funding agencies include the National Science Foundation, U.S. Geological Survey, NASA, Earth Systems Education Alliance, and the Netherlands Research Center for Integrated Solid Earth Sciences. Of these grants, six for a total of $306,482 were made through the Tower Foundation from entities such as Chevron, Intel, and the Heller Foundation.

The Faculty has published 70 refereed papers, as well as 5 non-refereed articles since the last review in 2005. In addition, there have been a number of articles published in circulars and online (e.g., internally-reviewed and on the U.S. Geological Survey website) that were closely peer-reviewed. A faculty member has edited a book on the geology of Barbados, and another member edited a book on the importance of crustal sections, both for the Geological Society of America. The Faculty gave 98 presentations with abstracts (many with their students) and 38 additional professional presentations without abstracts, both nationally and internationally. A number of individuals have also supported the department’s teacher-training activities by giving presentations, beyond the numerous (19) one-day events and seven one-week workshops given by the two faculty members primarily involved.

Department members have also chaired multiple sessions at professional meetings and acted as Chair and as Technical Chair at a regional meeting (Cordilleran Section of the Geological Society of America). They have served on multiple NSF panels and acted as peer reviewers on NSF proposals. Faculty have received external recognition (e.g., Honorary Membership in the Pacific Section of the Society for Sedimentary Geology, appointment as Research Associate of the Paleontological Research Institution in Ithaca, NY, recipient of “most cited article award” from Terrestrial, Atmospheric and Ocean Science Journal). They have acted as associate editor and on the editorial board of internationally-recognized journals (e.g., *Tectonics*, *Geology*). They have also served as peer reviewers for scientific journals such as *Science*, *Geology*, *Geological Society of America Bulletin*, *Earth and Planetary Science Letters*, *Tectonics*, *Journal of Petrology*, *Journal of Geology*, and *Tectonophysics*, among others. In addition, faculty members interact with consulting companies and regulatory agencies, bringing practical applications into the classroom as well as providing contacts for future student employment.

With respect to science education at the national level, faculty members have served on major committees (e.g., the College Board’s A.P. Science Redesign Writing Team, the College Board’s Science Academic Advisory Committee, and the Writing Team for the Next Generation Science Standards based on the National Academies’ Science Framework, Deep Earth Academy, Centers of Ocean Science Education Excellence Program, and NSF-MARGINS Education Advisory Committee).

These activities recognize the scientific excellence of the Faculty and offer the students research experiences at both the graduate and undergraduate level, provide examples/case studies for discussion in courses, and facilitate contacts for collaborations and future employment. The
Department is also proud of its long-term, part-time faculty who have given multiple oral presentations with abstracts, led teacher-training workshops, and participated heavily in interactions with the community, such as acting as science fair judges or science bowl moderators and presenting at career fairs. One part-time instructor is actively involved in projects to increase the participation of under-represented groups in the geosciences.

The high quality of the Masters theses produced by the Department is widely recognized across campus and beyond. In the last seven years, theses from the Department have won Best Thesis awards twice, and students from the Department have received this recognition seven other times, the most of any department in the University. In addition, one student won the SJSU Outstanding Student Research Award. An M.S. thesis from the Department was also recognized as Best Thesis by the Western Association of Graduate Schools, the only time that University has received that honor. The Graduate School has never rejected theses submitted by our students, and any required modifications to the theses are minor. Many of our students give presentations on their results at regional and national professional meetings (including winning best student poster at the Cordilleran Section [western U.S.] Geological Society of America Meeting), in addition to the required presentations to the Department during the weekly Geology Club talks. Additionally, undergraduates are being involved to a greater degree in research; two seniors completed Honors theses with faculty this academic year, and at least five undergraduates have given presentations at regional or national meetings during the review period.

Our students are well prepared to meet a wide variety of society needs as evidenced by the range of employers: local, state and federal government agencies, environmental, geologic, and geophysical consulting firms, petroleum companies, and teaching institutions (K-14 and universities). Their course activities include the preparation of consulting-style reports on topics such as groundwater or fault investigations similar to what would be sent to a regulatory agency. This type of undergraduate instruction prepares students both to write a comprehensive report and to integrate multiple aspects of a geologic study. Similarly, the field map and report prepared during the culminating summer-field experience prepares them well to synthesize complex geologic information from field studies.

The Department has had a number of international collaborations with universities in Australia, England, France, Italy, the Netherlands, Scotland, and Turkey. Faculty members have also participated in international research groups, such as United Nations Educational, Scientific, and Cultural Organization, International Atomic Energy Agency, and Institute of Earth Science (Taiwan). Research projects have been carried out in Australia, Brazil, Italy, Mauritius, Mexico, Oman, and Switzerland. Students have come to the Department from many countries, including Scotland, China, India, the Philippines, Japan, Taiwan, and Scotland. These interactions have enriched both the students’ and faculty members’ perspectives on global issues.

Lastly, the Department is known around campus as being organized and efficient, meeting deadlines effectively. This results, in part, from our being a very collegial department. When a task needs to be done, all members of the Department take their turns in contributing to what needs to get completed.

### 1.4 Long-standing support of GE and Science Education needs

The Department of Geology has long made significant contributions to the GE program (both Core GE in areas B1 and B3 and SJSU Studies in Area R). One unusual offering that meets the needs of many students and is very popular is the 1-unit, free-standing laboratory course (Geol 4L) that satisfies Area B3. Several of the GE courses (Geol 3, 105, 111, and 171)
offer completely online sections, meeting an increasing demand from busy or distant students. The online General Oceanography course (Geol 105) has won awards and accolades for the high quality of its content and methods.

The Department has two faculty members who work half-time in Science Education. The Department offers an Earth Science course (Geol 103) needed for the Elementary Credential. It also offers a graduate level course (Geol 204) entitled Earth Systems Science for Teachers. In addition, faculty in the Department have obtained grants to offer a number of teacher workshops (most through BAESI, the Bay Area Earth Science Institute, which is housed within the Department) both during the summer and the regular academic year to provide professional development for K-12 teachers in earth science.

Part 2: Program Challenges

2.1 Equipment

Both faculty and student research is hampered by the lack of major analytical equipment, which requires them to travel to other facilities to perform the analyses. Major analytical equipment needed by the Department includes a research-grade X-ray diffraction machine, a desktop X-ray fluorescence machine, and a table-top scanning electron microscope. One or two additional four-wheel drive vehicles are also needed for the field program to replace aging, current vehicles. Equipment used regularly in instruction as well as in research that needs upgrading or replacement includes microscopes, geophysics equipment, a rock crushe, pressure transducers/data loggers for water levels, and computers for the computer lab (not to mention Faculty offices). Additional items that would benefit instruction and research include seismic data processing software, updated groundwater modeling software, a flow-through water-quality cell with sensors, updates for Adobe and other out-of-date software, and built-in computer projectors in the classrooms.

2.2 Faculty Recruitment

Over the last review period, the Department has lost one position, being reduced from 11 to 10 tenured/tenure-track faculty. Two of these faculty members have split appointments with Science Education. Retirements effective in the 2012-2013 academic year will reduce the faculty by 1.5 positions (one member entering FERP) to 8.5 positions (7.5 FTEF). The Department anticipates the need to replace two to four other faculty members in the time period before the next Review. The Department has prioritized four critical areas of expertise.

- Neotectonics—An individual who can teach Structural Geology and participate in the Field Geology program, preferably with expertise in Engineering Geology, Seismic Hazard Analysis, or both. This is a first priority as a replacement for a faculty member who will retire without FERPing in summer 2012. We hope to conduct a search for this position in Fall 2012.
- Sedimentology—A replacement for a faculty member retiring May 2012. We hope to hire a replacement in the next few years.
- Low-temperature geochemistry—Preferably someone with expertise in paleoclimate and/or watershed hydrology, to expand into an area of growing demand in the Earth Sciences.
- Hydrogeology—A replacement for a faculty member retiring May 2016.

The exact sequence of searches will be a function of the timing of retirements and participation in the FERP program.

The Department has experienced difficulties in hiring in the recent past (paleoclimatology and/or paleontology position went through three sequential searches) due to the high cost of living in the San Jose area and the limited start-up packages that were available. While selected candidates indicated that they very much liked the Department, our offers were turned down for financial reasons. An increase in starting salary and in the amount of start-up funds would greatly enhance our ability to recruit.

The Department’s ratio of tenure track to part-time faculty has been approximately 8.5 to 3 FTEF over the last five years, but will be reduced significantly in the next academic year with retirements. Because of the large number of GE offerings, this ratio has been satisfactory, although the impending retirements will put more strain on the tenured/tenure-track faculty. While assigned-time has generally been around 1 FTEF, that amount of assigned-time has not restricted course offerings in the majors or graduate program as typically the faculty member’s GE teaching load has been taken over by a part-time instructor.

### 2.3 Space Needs

Because of the large number (range: 11 to 17, with higher numbers recently) of introductory laboratories taught by our graduate students, it would be very helpful to have a centralized office room where all the T.A.s could be accessible to students during office hours. Currently, the T.A.s are scattered, with many squeezed into the Mineral Collections room. Because of the large number of rock samples collected in the course of field trips and research, additional space designed for rock storage is desperately needed. Other space needs include a room with large tables for students to work on maps and laboratory space for new hires.

### 2.4 Overworked Support Staff

Our head technician, Ginny Smith, is extremely overworked. She is very conscientious and spends large amounts of time as our computer guru, finance minister, and logistics person. In addition, she is also supplying IT assistance to other departments in the COS. Some of her duties need to be assigned elsewhere to relieve her from all the unpaid overtime. It would also help if specific hours were designated for her to work in Geology and others in COS. Our preferred solution is to have her (and other staff) be full-time in the Department. Hiring a student assistant to help with preparations for the now-split-session Geol 129 (field camp) would ease the double workload of preparing the field equipment. In addition, the office staff was cut from a full time position. The position was recently increased from quarter time to half time, but that still provides inadequate coverage of the office administrative needs.
Part 3: Program Synergies

3.1 Possible interdisciplinary program in Sustainability/Climate Change

The Department envisions an interdisciplinary program in Sustainability and Climate Change (SCC) to meet a growing student interest in these topics and serve a significant societal need for trained professionals prepared in the broad range of subjects needed to address sustainable resource use and the impacts of climate change. The program would integrate existing courses and expertise in several SJSU departments, such as Geology, Meteorology and Climate Science, Environmental Studies, Biology, and Communication Studies. At the outset, the program might simply provide a recommended sequence of core courses in a SCC concentration. Some courses would be housed in single departments; others would be team-taught, as is the case with the existing Global Climate Change course (COMM/ENVS/GEOL/METR 168). As the program develops, participating faculty and departments may design a stand-alone certificate or degree program in Sustainability and Climate Change. A coordinated interdisciplinary SCC program would strengthen grant proposals submitted by participating faculty to federal and private funding sources.

3.2 Connections Across Campus

The Department teaches several classes that are cross-listed and/or team taught with other colleges on campus, including the Global Climate Change course described above, Geol 111 with Environmental Studies in the College of Social Sciences, Geology 142 and 242 with Biology in the College of Science, Global Studies 1B in the online Global Studies program, and Geol 174 with Civil and Environmental Engineering and Chemical Engineering in the College of Engineering. A large number of Biology majors also enroll in the GIS/GPS course (Geol 137) because of its usefulness in biological studies. In addition, the Department of Civil and Environmental Engineering recently approached the Department about teaching a 3-unit service course for their undergraduates (about 70 per semester) in Engineering Geology. The Department and Civil and Environmental Engineering are currently working on content matter with a projected class offering in Spring 2013.

3.3 Increasing Existing Ties

While the Department already interacts with the U.S. Geological Survey, through graduate student thesis projects, presentation of research results of mutual interest at the Survey and at the Department’s Monday Geology Club meetings, and other research collaborations, we are examining ways to increase our interactions. Furthermore, some of our graduate and undergraduate students are gaining valuable experience working part-time at the Survey through student appointments. Similarly, we have interacted with Moss Landing Marine Laboratories in the past, and we expect scientists at MLML would be open to proposals for collaboration on both research and course offerings. A proposal is being discussed for a joint course in geologic oceanography between faculty in the department and MLML faculty. Interactions with the Santa
Clara Valley Water District and the Alameda County Water District have led to thesis projects as well as hiring of our students.

On campus, we are already pursuing closer ties with the Department of Biological Sciences, particularly through the link of paleontology, but that collaboration could be expanded, particularly if the Sustainability/Climate Change program were to be developed. There have been discussions of a joint concentration focused on evolutionary biology. There is also an existing collaboration on climate issues between faculty in Geology and Meteorology. The Department faculty further feels that there would be mutual advantages to increased interactions with the College of Engineering, particularly with Materials, Chemical, Civil, and Environmental Engineering, many of whom would be involved in the proposed Sustainability/Climate Change program.

3.4 Science Education

Faculty members Messina and Metzger have split appointments in the Science Education program; Metzger was director of the program for several years. Their many years of experience have enabled them to develop extensive ties and collaboration with colleagues in other departments in the College of Science, and in SJSU’s College of Education. Currently, Metzger is co-P.I. with Eugene Cordero (Meteorology and Climate Science, COS) and Grinell Smith (Elementary Education, COE) on a multi-year grant from NASA for environmental education.

The Department of Geology offers courses in teacher preparation at both the undergraduate (Geol 103) and graduate (Geol 204) levels.

Metzger and Sedlock are co-directors of the Bay Area Earth Science Institute (BAESI), a long-standing, highly successful program that provides professional development in the geosciences for local teachers of grades 4 through 12. Since 1990, BAESI has served over 2000 teachers via one-day workshops and field trips and multi-week workshops. BAESI works closely with the U.S. Geological Survey and industry representatives.

3.5 Interactions with the Community

Students from the Department have made presentations at local middle schools and high schools, collected donations for charities through the Geology Club, and served at local meetings such as the Santa Clara County Gem and Mineral Society. Faculty members have also given talks at local K-12 schools, made numerous public presentations to the local community (e.g., at King Library, Children’s Discovery Museum, Guadalupe-Coyote Conservation District, Cupertino City Office of Emergency Services, San Jose Rotary), and have served on public organizations (e.g., Science Advisor to the Children’s Discovery Museum, Gilroy General Plan Committee). They have also served as judges at science fairs and participated in careers days at local schools.

3.6 Interactions with other Universities/Colleges

Departmental faculty interacts with faculty and programs at a number of Bay Area universities, including Stanford and San Francisco State. A faculty member serves as one of two university representatives on the CSU-wide initiative, Council on Ocean Affairs, Science and Technology (COAST). On a national scale, there are research collaborations with MIT, Florida
State, USC, University of Louisiana, Woods Hole, Vanderbilt, Oregon State, Western Washington, Northern Arizona, University of Puget Sound, University of Wyoming, Ohio University, University of Kansas, and Pomona College. Faculty members have served on PhD committees at the University of Montana (1) and MIT (2), and on MS Thesis committees at Oregon State University (2) and Western Washington University (1).

Part 4: WASC Program Outcome Rubric

4.1 Comprehensive List

The Department’s Comprehensive List is Developed

The Comprehensive List has reasonable outcomes and direct expectations for the M.S., B.S., and B.A. degrees that are compatible with the broad categories of gaining geological knowledge and skills, written and oral communication, critical thinking, and information and quantitative literacy. Expectations for M.S. students are clearly higher than those for the Undergraduate degrees. There are no national disciplinary standards, but the outcomes are in part designed to meet the expectations of the California State Licensing Board for Professional Geologists.

The undergraduate SLOs 1, 4, 5, and 6 and graduate SLOs 2, 4, and 5 specifically address student ability to understand concepts and content of geological topics. The level of sophistication increases with the graduate SLOs; for example, undergraduate SLO 2 (using scientific method) and graduate SLOs 2 and 4 (solving sophisticated geological problems) touch on broadly similar themes, but the requirement of a M.S. thesis for all graduate students leads to a much higher level of achievement. Written and oral communication are addressed by undergraduate SLO 3 and graduate SLOs 1 and 3, again with an increase in depth for the graduate program. Critical thinking is an important component of most of the SLOs, and particularly SLOs 2, 4, 6, and 7 for the B.S./B.A. program and 2, 4, 5, and 6 for the graduate program.

The main shortcoming of the objectives is that the faculty has not developed formal standard criteria for evaluating the level of student mastery of individual outcomes. We intend to develop a grading rubric for oral presentations and written assignments in our upper-division courses in the Spring 2012 semester, for implementation in Fall 2012.

4.2 Assessable Outcomes

The Department’s Assessable Outcomes are Emerging, with Many Characteristics Developed for the M.S. Program

All of the undergraduate learning outcomes explain in a general sense how students can demonstrate their learning. This is primarily done by stating what classes allow students to meet the individual outcomes, but some of the outcome assessments are perhaps too qualitative. For example, many assessment statements refer to students developing skills by applying them in geologic situations with instructors evaluating skills and providing feedback. We will strengthen the assessment by developing rubrics for some classes and more specifically outlining
expectations in greensheets in all classes that meet a particular SLO. For example, in Geology 120 (Mineralogy) the greensheet would state approximately how many minerals a student will be expected to learn as well as the grading expectations for tests/labs involving classification (SLO 5). We plan on achieving “Developed” status for Assessable Outcomes by Fall 2012.

The M.S. outcome assessments range from relatively vague to specific. Qualitative statements similar to those for the undergraduate SLOs are made, although the successful completion and rigorous evaluation of a M.S. thesis (required of all M.S. students in Geology) by a three-member committee is in our view a strong form of assessment for most of the SLOs. Some of the SLOs, such as #3 (present results of scientific research in oral format), are more explicit, as all M.S. graduates must present the results of their research to the Department as part of the weekly speaker series, and these are evaluated by the committee and the faculty as a whole. The Department has developed an evaluation form for the speaker series, which is now being used for thesis presentations.

4.3 Alignment

The Department’s Alignment Plan is Developed

The undergraduate program is designed so that students receive an increasing degree of sophistication as they advance through the curriculum. The Department has developed a curriculum “road map”, which shows three tiers of required classes that satisfy the seven SLOs: 1) Introductory Level; 2) Reinforcement; and the 3) Capstone experience (Geology 129) where students synthesize material in a 4-week field geology course. Students are required to take the introductory classes first before moving on to all subsequent required classes, and the capstone course should be the last class taken before graduation. A similar “road map” has been developed for the M.S. program, which utilizes classes that meet the Graduate Writing Requirement, the required graduate seminar, thesis writing, and the oral presentation (thesis defense). To attain “Highly Developed Status,” a clearer explanation of grading and student support services is needed. We intend to work on this “explanation” in Fall 2012.

4.4 Assessment Planning

The Department’s Assessment Planning is Developed

At the time the SLOs were developed by the Department, a multi-year assessment plan was written. Data collection has followed that plan. In the plan, SLOs were presented in a matrix of required courses and the corresponding SLO to be assessed in the course. The level at which the BS/BA SLOs were to be evaluated was assigned to the “Introductory” or “Reinforcement” category depending on the course’s occurrence in the sequence of courses in the major. The results of the assessment have been reported annually for the SLO(s) to be assessed in a given year, according to the schedule. These results are reported to UGS in the Program Assessment Report. That report details how the SLO is incorporated into that specific course and what portion of the students enrolled achieved adequate mastery of that SLO. The report also
documents modifications made to the course to improve mastery of the SLO. Further, the results of the modifications are evaluated for evidence of enhanced student learning.

The evaluation of the MS SLOs is more complicated since many of the MS outcomes are primarily related to the thesis work. We have been completing the annual Program Assessment Report for the SLO corresponding to each year, but often the assessment does not fit well into the standard reporting format of Evidence of Learning, Changes to Pedagogy, and Evidence After Changes. This is because each individual thesis advisor works independently with each MS student, tailoring the learning experience to that individual student’s strengths and weaknesses. This on-going, dynamic relationship works well, as evidenced by the Department’s reputation on campus for producing high-quality theses and the number of our theses that have won the University Outstanding Thesis Award.

As the Department completes the first cycle of evaluating the SLOs since developing the assessment plan, it will be examining the success of that plan as part of its Program Plan review. The Department proposes to produce several rubrics on a trial basis to see how they function. We will begin with rubrics for writing, oral presentations, and math competency for undergraduates. At the graduate level, we will begin with rubrics in writing and oral presentation. These rubrics will be developed by the early Fall 2012 semester and implemented that semester. The Department will make any changes to rubrics and to the assessment plan if it becomes clear that they are necessary.

4.5 The Student Experience

The Department’s Student Experience is Emerging

Students are somewhat aware of the SLOs, although most of this awareness is a function of their interaction with individual faculty members. Relevant BS/BA SLOs are stated on the greensheets for the respective core courses and discussed at the beginning of the semester. The Department plans to begin including a discussion of all of the undergraduate SLOs in GEOL 120 (Mineralogy), the first course in the sequence that almost all majors will take at SJSU, be they continuing or transfer students. This will make expectations clearer earlier in the major. The Undergraduate Advisor also addresses the SLOs in individual discussions with advisees. For the MS SLOs, the primary way that students become aware and evaluate their own progress is through interaction with their thesis advisor, and to a lesser extent the other members of the thesis committee, as most of the SLOs are evaluated through thesis research work. The indirect consequence of the informality of making SLOs known to students is that the students may not be aware of the relationship between how they are assessed and the SLOs that apply to a certain course or activity.

We will involve students (specifically, the officers in the student-run Geology Club) in the development of the rubrics for oral presentations. Students will use the rubric for oral presentations to evaluate class or thesis talks by other students. In addition, students in the BS Capstone field experience (Geol 129), taken at or near the end of their studies, will be asked to self-evaluate their own abilities to meet the undergraduate SLOs.

The respective Curriculum committees (Undergraduate for the BS/BA, Graduate for the MS) will develop a plan to increase student awareness of SLOs by involving them, on a course-by-course (for the BS/BA) or thesis-by-thesis (for the MS) level, in defining what it means to be
competent in a certain SLO. They will then evaluate themselves with respect to their individual competency in each relevant SLO at the end of the semester.

The Department will post the SLOs on links on the respective programs (BS/BA or MS) on the web pages of the Department’s website. This will allow students to see the Department’s expectations before applying or early in their time in the Department. We plan on achieving “Developed” status for the Student Experience by the end of AY12/13.

Part 5: Student Learning in Program

5.1 Evaluation of Student Learning for SLOs

The Department of Geology identified the following learning outcomes for the undergraduate degree programs:

1. Develop the skill to read and accurately interpret topographic maps.
2. Use, formulate and test multiple working hypotheses based on scientific method.
3. Effectively communicate scientific ideas and results, both verbally and in writing.
4. Use the fundamentals of chemistry, physics, math, and computer science to solve geologic problems.
5. Classify and identify geologic materials, including soils, minerals, and rock.
6. Visualize and comprehend geologic structures and process in 4 dimensions (3D plus time).
7. Understand the interactions of the solid earth with the hydrosphere, atmosphere, and biosphere, and the effects of those interactions on human kind and the environment.

Assessment of these SLOs indicates that the students achieve a high level of competence in SLOs numbers 1, 2, 5, and 6, while requiring more reinforcement in SLOs numbers 3, 4, and 7. With respect to SLO number 4, the students typically are not able to apply basic science skills at the expected level at the beginning of the semester, but they are able use them acceptably by the end of the course. The Department proposes to modify SLO number 4 to replace computer science with biology, as being a more relevant fundamental science for geologic problems. The last part of SLO #7 will be modified to read “…effects of those interactions on earth history, humans, and the environment.”

The Department has identified the following learning outcomes for the graduate program:

1. Demonstrate scientific writing of acceptable quality.
2. Formulate scientifically sound and logistically reasonable plans for solving geologic problems.
3. Demonstrate ability to present results of scientific research orally.
4. Develop ability to apply modern laboratory and field investigation techniques to solve sophisticated geological problems.
5. Develop skills and knowledge to make use of scientific data and resources to support investigations.
6. Develop ability to think analytically.
The most problematic area of these graduate SLOs is the quality of the scientific writing, particularly with non-native English speakers. This has been addressed recently as part of the program review by increasing the minimum score required on the TOEFL exam from 80 to 90. In addition, the required Statement of Interest in the graduate application has been expanded to a longer and more detailed format to better assess an incoming student’s competency in writing, and the form for letters of recommendation now specifically asks for an evaluation of the student’s ability to write a satisfactory M.S. thesis.

5.2 Development of Rubrics for Program Level Outcomes

The Department will be developing rubrics for undergraduate writing, oral presentations, and math (SLOs #3 and part of #4) in order to a) clarify for students the Department’s expectations, and b) to evaluate the student’s progress towards achieving competency in the SLOs. In addition, the Department proposes to develop rubrics in graduate-level writing and oral presentations (SLOs #1 and 3). These rubrics will be developed by early Fall 2012 and evaluated that semester. Any modifications to the rubrics will be made following this evaluation. Sections 4.4 and 4.5 provided additional detail on the rubrics.

5.3 Evaluation of Internal Assessment Process of Student Learning

The assessment process for the SLOs needs to be formalized to a greater degree. Undergraduate SLOs are assessed in the context of specific courses, but the resulting assessments are not regularly discussed by the Faculty to determine how any shortcomings could best be addressed. M.S. SLOs are mostly evaluated in the context of the program as a whole. Since the outcomes are formally assessed (sent to UG Studies) in the Spring semester, we plan to reserve one of the later Faculty meetings each Spring to discuss the results of the formal assessment and SLOs in general. This discussion was recently carried out for the B.S./B.A. and M.S. SLOs assessed in Spring 2012.

The graduate SLOs are also evaluated relatively informally by each graduate advisor via the Master’s thesis. Based on the high quality of the theses produced, this approach appears to be working well and does not need to be more formalized.

5.4 Effectiveness and Currency of Pedagogy

The Department judges that its pedagogy is both effective and reasonably current, although it is kept this way by constantly updating the course content and teaching approach to accommodate different styles of learning. The involvement of graduate students and, increasingly, undergraduate students in research augments the classroom pedagogy by having them actively solve real geologic problems over an extended period of time. Requiring the thesis of all M.S. students assures an in-depth experience at the graduate level.

One factor that would improve the currency of the content would be an update of software (e.g., seismic processing and groundwater modeling), classroom computers/projectors, and instructional and research equipment (see Sec. 2.1). It is very difficult to stay current with outdated or missing equipment and software. Having additional technician support to set up and
maintain laboratory equipment and exercises would allow the faculty to focus on lab content rather than logistics.

5.5 Cultivating Global Citizens

Global citizens need scientific knowledge and skills to address global issues. The Department concludes that it provides all students (GE, majors, graduate students) with level-appropriate information to understand problems in the global physical environment. Furthermore, the BA majors will carry this exchange of knowledge further when they become teachers and share what they have learned with their students. The BS majors and MS students develop a number of skills sets that enable them to directly address global issues in water, energy, and materials resources, as well as insights into the consequences and mitigation of global climate change.

5.6 Developing Skills of a Global Citizen

Geology and earth science instruction are generally problem-driven, requiring students to integrate and analyze complex sets of data and information. This helps the students to develop the critical thinking and problem-solving skills needed by global citizens. Many of the laboratory exercises in GE, major, and graduate classes require students to work as groups, helping them learn successful team-building practices. Many courses require semester reports that synthesize activities or research, requiring the organization of written information in a clear and cohesive manner—an important skill of the global citizen. Similarly, at least half of the major classes require oral presentations summarizing the reports, further enhancing communication skills.

5.7 Action Items Developed from Evaluation

The following action items have been developed from the evaluation of student learning:

1. Review the results of the evaluation of individual undergraduate SLOs during a Faculty meeting in the Spring semester;
2. Modify the requirements for the written Statement of Purpose for the graduate application;
3. Include a list of SLOs in the greensheets of relevant classes and a class discussion of all undergraduate SLOs in Geol 120;
4. Prepare rubrics for
   a. Graduate scientific writing ability
   b. Graduate oral communications skills
   c. Undergraduate math skills
   d. Undergraduate oral communication skills;
   e. Undergraduate written communication skills, and
5. Seek funding for equipment and software update and acquisition.
Part 6: Required Data Elements

6.1 Problem Areas

The statistics on enrollment, retention and graduation are given in Appendix A. These were provided by the SJSU Office of Institutional Research. While the new students enrolled each academic year can be highly variable (Figure 1), the total enrollments (Figure 2) have increased over the last five years, particularly at the graduate level (SJSU has historically had the largest CSU Geology graduate program in northern California). While few undergraduates come to college expecting to major in geology, they are often inspired by a GE class to switch majors. This is also true at the graduate level where students with backgrounds in other disciplines (e.g., engineering, mathematics, physics or biology) switch to geology for graduate work. We would particularly like to increase undergraduate enrollment. In the past we have interacted with colleagues at local community colleges to inform their students about the SJSU program; reaching out to those colleagues on a regular basis could increase the number of transfer students entering the program.

![Newly Enrolled](image)

Figure 1. Students newly enrolled in a given academic year.
The undergraduate student population for majors has been dominantly male (averaging 70%) while the graduate student population has been dominantly female, although the percentage of male graduate students has been increasing over the last five years (from 27% to 46%).

In terms of undergraduate students reporting their ethnicity, about 12% have been Asian over the last five years and 15% have been Hispanic. There have not been significant upward or downward trends in the ethnic mix. The percentage of foreign students has increased from 0 to about 4% over the last three years. At the graduate level the student population is 6% Asian, 15% Hispanic, and 13% foreign, without any particular trends. Recruiting students from local community colleges could increase the diversity of our student population.

The average retention rate among Geology students based on F06 – F10 data are as follows: 73% for first time freshman, 98% for new transfer students, and 84% for graduate students. These rates seem good. The graduation rates indicate that it generally takes students longer than expected to graduate, with only 33% of freshmen graduating with their cohort. The percentages for transfer and graduated students are 53% and 37%, respectively. There are reasons for each of these low timely-graduation rates, often having to do with the requirements for supporting courses in mathematics, physics, and chemistry for students coming to the program from other majors. Also, the sequence of courses in the major can be difficult to finish in two years for transfer students who come in with minimal scientific background. At the graduate level, the additional course work to make up deficiencies for students switching to geology from other disciplines can account for part of the long time to finish. In addition, the thesis program is quite rigorous and sometimes the field seasons can be short, delaying the date of thesis completion. An additional issue at the graduate level is that many of our students take jobs before completing the thesis, making it difficult for them to complete the thesis in a timely manner. The undergraduate and graduate advisors will continue to advise students as effectively as possible to make progress towards graduation at a reasonable rate.
6.2 Progress towards University or College Strategic Plan Goals

The proposed development of a Sustainability and Climate Change program fits well with both the Dean’s and previous Provost Selter’s emphasis on interdisciplinary studies, and with current Provost Junn’s emphasis on Centers of Excellence. The Department could potentially contribute to additional Centers of Excellence relevant to California issues, including to centers focused on natural hazards mitigation, water resources, or excellence in science education.

We will involve students (specifically, the officers in the student-run Geology Club) in the development of the rubrics for oral presentations. Students will use the rubric for oral presentations to evaluate class or thesis talks by other students, as well as for self-evaluation.

Provost Junn’s emphasis on the effective use of technology is addressed by the large number of online courses offered by the Department as well as the mixed-mode delivery of a number of courses that utilize Desire2Learn to deliver course content, exams, and grades, and/or to facilitate student interactions through Discussion boards.

Part 7: Summary

The Department of Geology judges that it does a good to excellent job of preparing students for successful professional careers in the discipline and in teaching, particularly given the fiscal limitations that a) make hiring difficult, b) impede the use of state-of-the art equipment, and c) cause the support staff to be overworked. The collegiality and productivity of the Faculty, both tenure-track and part-time instructors, the high quality of our M.S. theses, and support for the SJSU, scientific, and broader local community are areas of particular pride. We intend to increase student awareness of the SLOs and produce selected rubrics to aid in the assessment of those SLOs. We will also seek ways to augment the undergraduate enrollments through contacts with local community college instructors and to facilitate progress towards graduation for the students enrolled.

A major challenge for the Department is the number of faculty who will be retiring in 2012 and the five years that follow. It will be critical for the Department to fill these positions to maintain the quality of the program and to allow it to take a lead in new avenues of interdisciplinary teaching and research, as outlined above.