

Appendix I-1: Program Review Self-Study Report Excerpt*

III.) Learning Outcomes and Assessment Results

A.) Learning Outcomes

- Familiarity with American, British, and Anglophone Literary Traditions
- Knowledge of other forms of cultural production
- Critical awareness of the role of ethnicity, race, class, gender and sexuality in these traditions
- Ability to apply appropriate critical methodologies to analyze a text or context
- Ability to write complex and persuasive expository prose

B.) Assessment Tools

- Final Exams from English 20A-B-C
- Papers or materials from English 102
- Final papers from English 193 (Senior Seminar)
- English Department Essay contest papers
- Logs of participation in Books Clubs and other department-sponsored extracurricular activities

Current status

We have completed phase one of our assessments, and our report is attached to this document. This year we move into the second phase-looking at student writing from English 20C and English 102. Each of the next three years will take us to another level of analysis, as described above and in the list of rubrics which are attached. The department has taken its commitment to learning assessment very seriously, and we are finding that is instructive for the faculty in ways that we did not anticipate.

* WSCUC Interim Report Review Panel: This document is Section III (i.e., Learning Outcomes and Assessment Results) of the UCR English Department's undergraduate program review self-study. It has been excerpted verbatim.

C.) Results of Recent Assessment

Level One Assessment Report

October 26, 2010

This assessment was conducted on random sets of short papers from English 20A (F-09) and Final Exams from English 20B (W-10).

Here is a restatement of the RUBRICS for this Level:

Level 1: 20A-20B and similar courses

- Relatively error-free prose
- Ability to distinguish periods, issues, motifs, and perspectives within a national literature
- Clear statement of thesis
- Some ability at close literary analysis

Report Summary:

The assessments were carried out by Professors Gui, Haggerty, and Yamamoto. They were evaluated on a scale of 1-4 (1 being the best). There was general agreement about relative assessments. In the category of "Relatively Error-Free Prose" samples were ranked from 1 to 3 in most cases. Some evaluators gave more 1's and some more 3's. In "Ability to distinguish periods," there were decent, but somewhat lower, marks for English 20A. There are explanations for this difference (see below). But again, no major problems were evident. In "Clear Statement of Thesis," 2's and 3's in most cases, some generally higher and some generally lower. And finally, "Some ability at close literary analysis," there was a greater range of responses, at least one evaluator was largely satisfied, while another was largely dissatisfied. But still, the overall effect is of a strong showing.

Numerical summary of all samples read by three evaluators:

Relatively error-free prose
Average score 1.5 (on a 1-4 scale)

Ability to distinguish periods, issues, motifs, and perspectives within a national literature
Average Score: 2.1 (on a 1-4 scale)

Clear statement of thesis

Average Score: 2.06 (on a 1-4 scale)

Some ability at close literary analysis

Average Score: 2.3 (on a 1-4 scale)

It is perhaps not terribly surprising that students taking their first classes in the major might score better on "error-free prose" than on "close literary analysis," but that is not cause to feel especially pleased with these results. In one of the classes assessed (20A), close analysis was one of the main objectives of the course. If students are not faring well on this type of assessment, then the methods of teaching close analysis might need to be rethought. "Clear statement of thesis" should of course be stronger too, and this result suggests that some basic writing instruction—such as how to formulate a thesis—might be included in the syllabi for 20A and 20B. In the area concerned with "Ability to distinguish periods, motifs, and perspectives within a national literature" is a bit misleading. After all, students in 20A were writing papers about a single work of literature, and it would be hard for them to demonstrate breadth of knowledge in this area. Students in 20B, on the other hand, represented by final exam writing, might do better in this area than in others, like "clear statement of a thesis" precisely because of the exam setting.

These results are not alarming, but they also remind us that beginning English majors still need serious and very basic writing instruction. The majors need work on developing thesis and performing close critical analyses. The majors need to be reminded that close analysis is not the same thing as summary, and they need considerably more practice in these areas. To the extent that these have not been featured in 20A and 20B, they should be made at least a part of the class syllabus. Because methods of literary analysis continue to be a focus of courses in the major, especially in 20C and 102, the next level of assessment should follow up on these concerns.

Learning Assessment results so far have not resulted in specific changes to the curriculum or courses. However, the English Department's Undergraduate Committee reviews these results on a regular basis and considers whether any changes should be made. The Undergraduate Committee also considers curriculum issues based on input from faculty and other sources.

Currently under discussion is a proposal to make some changes to the structure of our American Literature requirements, for example.

**UNIVERSITY OF CALIFORNIA, RIVERSIDE
STUDENT LEARNING OUTCOMES ASSESSMENT REPORT
2013-2014**

Program/Department and Major(s): **Department of Earth Sciences Geology Major, Geophysics Major**

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1. Student Learning Outcome(s) and Assessment Method(s) for 2013-2014

a. Please list all of the student learning outcomes for the major.

In 2010 the Department of Earth Sciences selected desired Learning Outcomes for the Geology and Geophysics majors that are listed below and referred to hereafter as ESLOs. These proved closely aligned with current and projected societal needs for Earth Scientists in the US as determined by the National Science Foundation-sponsored Future of Geoscience Education workshop held in Austin Texas in January, 2014. The majority of the outcomes are identical for the two majors; where there are differences, they are highlighted.

1) Development of disciplinary knowledge

Geology: Graduates will have mastered a broad set of topics in Earth Sciences, including fundamentals of the Earth's composition, history, physical state, climate, and the evolution and persistence of life.

Geophysics: Graduates will have mastered a broad set of topics in Mathematics, Chemistry, Physics, Geophysics and broader Earth Sciences, including fundamentals of the Earth's composition, history, physical state, and climate.

2) Lab/field/computer skills

Graduates will have acquired both cutting-edge and classical skills in field, laboratory, and computer/analytical techniques in Geology/Geophysics.

3) Oral/written presentation skills

Graduates will have mastered written and oral communication skills, and will be able to work effectively both individually and in groups.

4) Ability to apply and synthesize information

Graduates will be able to apply, synthesize, and evaluate their knowledge and skills to quantitatively solve novel problems in Geology/Geophysics over a wide range of spatial and temporal scales.

5) Ability to articulate science-based views of Earth processes

Graduates will demonstrate the ability to understand and articulate a science-based view of physical processes.

6) Ability to make critical personal/professional judgments based on their scientific understanding

Graduates will be able to use their knowledge and skills to make sound economic and policy decisions in both the personal and public spheres.

b. Please indicate the learning outcome(s) assessed in 2013-2014.

In 2012-2013 we assessed 3 learning outcomes in 4 classes from the geology and geophysics majors. Learning outcomes 3–5 were targeted, all of which deal with higher learning goals, including communication, and synthesis.

In 2013-2014 we asked faculty to assess all 6 learning outcomes (doubling scope of ESLO assessment from that of 2012-2013 report) but, because some of our learning outcomes require advanced learning skills, not all learning outcomes are relevant to all classes. Our outcome evaluations are thus structured so as to reflect graded levels of learning, beginning with initial knowledge acquisition, followed by its assimilation and application in both familiar and novel settings. We requested all full time faculty members to produce Learning Outcome evaluations for each related-to-major class, and also solicited reports for other lower division classes and from non-academic senate instructors. Reports were received for 9 classes (more than doubling number of classes represented from that of 2012-2013 report) (see appendices).

The 9 classes in which assessments were provided are as follows:

GEO 001, Earth's Crust and Interior (Introductory class required by all geology majors.) ESLO 1 assessed based on answers to online quizzes, ESLO 2 via the lab final, ESLO 3 and 5 via a grading rubric associated with extended essay questions.

GEO 002, Earth's Climate Through Time (Introductory class required by all geology majors). ESLO 1 assessed based on answers to multiple choice questions.

GEO 003, Headlines in the History of Life (Introductory class in paleontology, required by all geology majors.) ESLO 1 assessed, based on answers to multiple choice questions.

GEO 012, At Home in the Universe (Introductory class in science-based views of the history of the universe and of the Earth.) ESLOs 1,3,4 assessed based on answers to both extended essay and multiple choice questions.

GEO 115, Geological Map and Landform Analysis (Introductory upper divisions class required for all geoscientists.) ESLOs 1-5, and 6? assessed based a wide variety of assessments including field notebook, student produced geological map, behavior and development of particular geological skills.

GEO 116, Structural Geology (Upper division class required for all Geology majors.) ESLOs 1-5 assessed through lecture and lab final questions problems, class presentations and project work.

GEO 118, Sedimentology and Stratigraphy (Upper division class required for all Geology majors.) ESLOs 1-6 assessed through examinations, and field group projects including measured sections.

GEO 151, Principals of Paleontology (Upper division elective class, required for Geobiology option.) ESLOs 1-4 assessed through lecture and lab final questions and problems, fieldwork tasks including proper collection and identification of specimens.

GEO 160, Global Climate Change (Upper division elective class, required for Geobiology and Climate Change options.) ESLOs 1-5 assessed through lecture and lab final questions, problem sets, and structured group discussions.

- c. What evidence was examined to assess the learning outcome(s) (e.g., student assignments, theses, tests, exams, etc.)?

Commensurate with an integrated curriculum that advances learning levels progressively, methods of assessment vary depending on individual classes. In the lower division classes achievement was evaluated largely using select sets of questions on the midterm and final examinations, but including both multiple choice and essay questions. For more advanced classes, student performance was in a wider way including assessment of student's class products, such as their individual geological maps, sections, graphic logs, or identifications, class presentations, class projects, and discussion group participation and performance. See 1b for a listing of these in relation to particular classes assessed.

- d. Please describe the method of analysis used to assess learning outcome(s) (e.g., descriptive analysis, rubric). Note: Please attach copies of relevant rubrics, assignments, or exams in the appendix.

For the reasons given above, assessment method varies widely among classes and for the different ESLO's. In each of the classes assessed, we asked the instructor responsible to produce a report, describing how the students in that class performed in categories that can be related to the learning outcomes of each major (see appendices). In particular, we compile statistics on how many students show satisfactory levels of performance, as defined by the instructor, and whether the numbers of students attaining such a level of performance is itself satisfactory.

Faculty were encouraged to use a performance level of 70% as the basis for evaluating whether the ESLO had been successfully met, in keeping with previous years. This figure has been used in different ways among faculty – in most cases it whether the average score for majors in the class exceeds 70%, but in some other cases it reflects whether 70% of the students have achieved a satisfactory standard determined by the instructor.

2. Assessment Results

- a. Please summarize in written, tabular, or graphical form the results of assessment analyses. If relevant, include any performance expectations or benchmarks. Please cite relevant evidence from student work to substantiate your results. Some questions to answer might be:

- 1) What did the department or program find?

GEO 001. For ESLO 1 geology majors scored an average of 73%, (Satisfactory), but only half of the majors achieved over 80%, which was the instructor's criterion for judging satisfactory performance. For ESLO 2 majors achieved a score of 67% but the instructor viewed this particular performance as Satisfactory. 64% of our majors achieved required performance standards for ESLOs 3 and 5 (Not Satisfactory).

GEO 002. For ESLO 1 performance of the entire class at the basic level of understanding scored 79%, (Satisfactory). For the advanced question set, the score of 59% (Not Satisfactory) and suggests that many students are challenged by the more advanced materials. Separate data for Geology/Geophysics majors was not recorded for this class.

GEO 003. For ESLO 1 average performance for all students taking the class was 70% (Satisfactory). That for majors was 84% (Satisfactory).

GEO 012. As only one Geology major took this lower division, non-required class, evaluation is presented based on all students taking the class. For ESLO 1 average performance was 59% (Not Satisfactory), for ESLO 3 average performance was 74% (Satisfactory) and for ESLO 4 average performance was 70% (Satisfactory).

GEO 115. For ESLO 1 average performance was 45% (Not Satisfactory), for ESLO 2 average performance was 77% (Satisfactory), for ESLO 3 average performance was 74% (Satisfactory), for ESLO 4 average performance was 70% (Satisfactory), for ESLO 5 average performance was 52% (Not Satisfactory), and for ESLO 6 class performance as a whole was considered Satisfactory.

GEO 116. For ESLO 1 average performance was 84% (Satisfactory), for ESLO 2 average performance was 78% (Satisfactory), for ESLO 3 average performance was 100% (Satisfactory), for ESLO 4 average performance was 92% (Satisfactory), and for ESLO 5 average performance was 100% (Satisfactory).

GEO 118. For ESLO 1 average performance was deemed Good, for ESLO 2 average performance was deemed Good, for ESLO 3 average performance was deemed Good, for ESLO 4 average performance was deemed Fair to Good, for ESLO 5 average performance was deemed Good, and for ESLO 6 average performance was deemed Good.

GEO151. For ESLO 1 average performance was 63% (Not Satisfactory), for ESLO 2 average performance was 74% (Satisfactory), for ESLO 3 average performance was 88% (Satisfactory), and for ESLO 4 average performance was 61% (Not Satisfactory).

GEO160. For ESLO 1 average performance was 88% (Satisfactory), for ESLO 2 average performance was 88% (Satisfactory), for ESLO 3 average performance was 99% (Satisfactory), for ESLO 4 average performance was 78% (Satisfactory), and for ESLO 5 average performance was 100% (Satisfactory).

- 2) Are your students meeting your program's performance expectations? What percentage of students are performing at each level of proficiency (e.g., using a rubric or course grades)?

Overall success in meeting ESLO goals, calculated on the basis of pooling the information presented above (including data for non-majors where it has not been possible to separate them from majors), are as follows:

| | | |
|---------------|------------|---------------------|
| ESLO 1 | 70% | Satisfactory |
| ESLO 2 | 77% | Satisfactory |
| ESLO 3 | 83% | Satisfactory |
| ESLO 4 | 74% | Satisfactory |
| ESLO 5 | 79% | Satisfactory |
| ESLO 6 | | Satisfactory |

Accordingly, assessing in this way it appears that students are performing to expectation, although we are cautious of this interpreting result to allow any complacency. Figures vary considerably between classes, and among individual ESLOs and are subject to problems associated with small sample size. Results point to a general concern about student's effectiveness in the acquisition and retention of core disciplinary knowledge, as attested to by the barely satisfactory overall achievement in ESLO1. Conversely, students analytical, presentation, and articulation skills are apparently somewhat better.

- 3) Are your students improving? How many and how so?

The only courses assessed in both 2012-2013 and 2013-2014 are GEO 001 and GEO 003. In 2012-2013 GEO 001 outcomes 3 and 5 majors scored an average 2.7/4 grade points for essays but in 2013-2014 the average grade point 3.2/4 was, with the latter value being within the “good” work category. With regard to GEO 003, this year only ESLO 1 was assessed, whereas last year outcomes 3 and 5 were assessed for that class. Overall, we are currently too early in our assessment career to judge whether significant progress has been made “longitudinally” in the same classes across multiple years but from this year onward we have a benchmark in place for 9 classes. For an encouraging preliminary longitudinal study of increased student achievement in one class, GEO 160, please see the appendix below.

This notwithstanding, it is possible to make a general comparison with the results of the 2012-2013 assessment. There, as again this year, results presented a mixed picture among different classes. Overall success with respect to ESLO’s 3 and 5 appear to have improved slightly. In 2012-2103 we concluded that our majors are close to, but not quite meeting, the learning outcomes that we had set. This year’s pooled results suggest we are exceeding our minimal target, but barely in some cases.

3. Recommendations

- a. What are the implications of the assessment results (e.g. course change, requirements change, etc.)? Recommend actions to improve student learning with respect to the desired learning outcomes and a timeline for implementation. Actions may fall into any of these potential categories:
- 1) instruction,
 - 2) curriculum,
 - 3) course sequencing,
 - 4) co-curricular support for student learning (e.g., tutoring, library instruction, etc.),
 - 5) communicating expectations to students.

As in 2012-21013, we conclude that the majority of our students are performing at, above, or close to the performance standards we have set for the majors. This year we have established a solid portfolio of learning outcome assessments for core classes that in future years will permit longitudinal analyses of student performance across successive years that will enable us to judge the success of modifications to individual classes. We anticipate further expanding coverage to all classes taught by academic senate faculty. It is still too early to assess the role of factors such as different definitions of success from different instructors, self-selection of students into particular classes, or different levels of performance from different student cohorts, or indeed if there are any underlying causes. As we continue to ramp-up the scope of our learning outcomes assessments in coming years, we hope to be able to differentiate between some of these factors, but we are also hampered to some extent by low numbers of majors, and the statistics of small numbers.

Some general observations follow in respect to the listed prompts:

- 1) We consider the manner of instruction in classes to be under the purview of individual faculty, but view the Learning Outcomes assessment process as of significant value from providing year-to-year cross referencing for instructional improvement.
- 2) With regard to the curriculum, a variety of factors including a swathe of new hires, pending retirements of faculty who have played key roles in our teaching program, and changing societal and scientific needs in the disciplines of Geology and Geophysics all require us to reconsider our curriculum. Initial discussions on this topic have been initiated, built around the recognition of a core set of disciplinary fundamentals common to all geoscientists. At present we feel that there are too many tracks and options within the major, with the result that it difficult to define what sets of knowledge, experience and skills defines a UCR Earth Sciences graduate. Changes to the curriculum that are currently “on the table” for discussion include:

1. Reducing the number of required lower division classes in allied sciences.
2. Introducing a new required lower division quantitative methods and numerical modeling class for all majors.
3. Expanding the set of lower division classes that qualify as gateways to the major. Existing classes, such as GEO 009 Oceanography or GEO 012 At Home in the Universe can serve as alternative gateways classes (for GEO 002 and GEO 003 respectively).
4. Defining a common core of entry level upper division classes including GEO 115 Introduction to maps and landforms (5 units), GEO 116 Structural geology (5), GEO 101 Field mapping (5), new courses Introductory mineralogy (5), Introductory petrology (5), and GEO 118 Sediments and Stratigraphy (5).
5. Permitting wide elective choice for other upper division classes.
6. Offering our own GEO 102 Summer Field Camp as a capstone experience for all Earth Sciences majors.

Our pending faculty retreat in September 2014 is dedicated to discussing these changes among the faculty at large, including the new hires.

3) Course sequencing issues will be addressed as part of the curriculum revisions. In particular, we are sensitive to the need to develop levels of learning progressively through the development of our classes – with the result that we expect the higher number ESLOs to figure more prominently in the upper division classes – something which is already evident from this year’s assessment.

4) Co-curricular support. Earth Sciences has a strong field component, and this places certain burdens on faculty, who are responsible not only for teaching but also for student welfare and safety issues in the field environment. We are grateful that CNAS has appreciated the need for extra TA support for such classes in recognition of these special circumstances and the number of faculty-student contact hours involved in field classes. This understanding encourages us as we look forward to developing a capstone GEO 102 class that will involve faculty in the field with students continuously for up to 6 weeks.

5) Improved undergraduate advising, as recognized in the response to the recent Undergraduate Review is an important component of better communication with majors. Also, our requirement of faculty to post class their course syllabi, with explicit course goals that relate to ESLOs, on a shared Google Doc page is permitting better communication of course expectations among all members of the department.

Last year we suggested we would implement the following steps:

- Require all instructors of classes in our core curriculum to submit revised learning outcomes for their classes that can be linked explicitly to learning outcomes in our major. This will greatly expedite the process of assessing success of those outcomes.

Action Completed: Google Docs set up and populated with syllabi with class goals and ESLOs explicitly outlined for most classes taught by academic senate faculty.

- Compile all curricula and syllabi from core classes, in order to better track the opportunities for learning of certain skills and knowledge, and to permit discussion between faculty members on opportunities to reinforce key skills (e.g. writing).

Action Completed: As immediately above.

- Discuss as a faculty the effectiveness of our current set of learning outcomes, and whether there is a need to revise them for greater effectiveness (e.g. ESLO 3 and 5, which currently have a lot of overlap).

Action Considered: This is becoming appropriate only now, following the widespread adoption of Learning Outcomes assessment.

- Explore the possibility of identifying more ‘longitudinal’ means of learning outcomes assessment, tracking changes in performance for individual students, e.g. through the different ‘tracks’ of the major (geology, geochemistry, paleontology, geophysics).

Action Completed: Begun with respect to yearly iterations of classes GEO 001 and 160, but the issue of class content articulation (i.e. continuity and progressive development) will be explored as part of curricular discussions.

- Explore the possibility of a introducing a capstone course that focuses on synthesis of ideas, technical writing and application of accumulated learning in personal/professional settings (ESLO 6 – an outcome that we currently do not have a good means of assessing in-house).

Action Being Considered: Discussion of capstone course GEO 102, Summer Field Mapping as capstone for all geoscience majors

- Pursue a survey of graduated students and their employers in order to judge the effectiveness of our curricula in producing effective geoscientists (this will also address ESLO 6). This could be extended to surveying leaders of summer field camps that our students attend, as an independent means of judging how our graduates ‘stack up’ in comparison to their peers from other universities.

Action Complete: First survey on-line dispersed to recent graduates in June 2014. Results pending analysis.

4. Implications of Proposed Changes

Are there any resources needed to implement the above plans for improvement? How and where might the resources be obtained?

Instituting the GEO 102 class will require investment in equipment and for running the operation, especially the hire of field vehicles and camp/class costs. Some donor support has been previously obtained for support of students when undertaking GEO 102 outside of UCR, and teaching our own class in this subject may be attractive to alumni.

5. Proposed assessment plan for academic year 2014-2015

What learning outcome(s) do you plan to assess for the next academic year? What assessment method(s) and courses will you use to assess the proposed learning outcome(s)?

We plan to again consider all ESLOs (1-6) and to expand coverage to all classes taught by academic senate faculty. We anticipate the same breadth of ways of assessing how we have met particular ESLOs as employed this year.

6. Quantitative Reasoning (WASC Core Competency)

- a. What are the expectations, if any, for majors in the department to development quantitative reasoning, or the ability to apply mathematical concepts to the interpretation and analysis of quantitative information. If your department has no such expectations, please explain.

Earth Sciences has a strong quantitative component, and quantitative skills are part of almost all classes across our curriculum. However, in formulating the ESLOs in 2010 we anticipated the recommendation of the National Science Foundation-sponsored Future of Geoscience Education workshop, and are planning to introduce a lower division core class for all Earth Science majors in numerical modeling approaches and other quantitative methods in Earth Sciences.

- b. In what ways do students acquire the experience and skills needed to develop quantitative reasoning prior to graduation? (Please list any required courses with a significant quantitative component, whether they are offered by your department or another (i.e.: math or statistics). Again, if your department has no such expectations, please explain.

Quantitative reasoning, including geometric visualization, is core to almost all classes in our program. Classes with particularly strong components include GEO 115 (Geological Maps and Landform Analysis), 116 (Structural Geology), 132 (Groundwater Geochemistry), 140 (Global Geophysics), 144 (Earthquake Seismology), 145 (Applied and Exploration Geophysics), 147 (Active Tectonics and Earthquakes) and 157 (Introduction to Geographic Information Systems). All students are required to take the MATH 009 series. Also, students are required to take STAT 100 or 155. Geophysics majors have additional requirements, including the MATH 10 and 46 series. .

- c. Are there any program-level student learning outcome(s) linked to the development of quantitative reasoning? Please list, the relevant student learning outcome(s).

Yes, ESLOs 2 (Graduates will have acquired both cutting-edge and classical skills in field, laboratory, and computer/analytical techniques in Geology/Geophysics) and 4 (Graduates will be able to apply, synthesize, and evaluate their knowledge and skills to quantitatively solve novel problems in Geology/Geophysics over a wide range of spatial and temporal scales).

- d. If the department has learning outcome(s) linked to quantitative reasoning, have they been assessed recently? What were the results? Please comment briefly here, or provide documentation from previous year's assessment report(s). If your department or program has not yet assessed quantitative reasoning, is there a plan to do so?

See sections 2.a.1 and 2.a.2 above with respect to results of ESLO 2 and 4 assessments.

7. Appendices

Please list the documents you are attaching with your report, the file name if not included in this document, and a short description of what they are. Please include rubrics, assignments, exams, and other supporting documents.

GEO 001: The Earth's Crust and Interior

Instructor: Gareth Funning

GEO 001 serves as an introductory course for both geology and geophysics majors who start their studies at UCR, along with a handful of transfer students each year. In a typical year, around 100 students complete the class, with ~10% of those being geology or geophysics majors. The class has both theoretical and lab elements, with the bulk of credit divided equally between the two categories (45% each), with the remainder coming from a series of out-of-class quizzes (10%). In this year's assessment, we consider all of the learning outcomes that pertain to the class.

Disciplinary knowledge (Earth Sciences Learning Outcome 1)

- Assessed by performance in online quizzes
- Satisfactory performance defined as a total quiz score of 80% or better
- Percentage of majors achieving satisfactory performance: 50%
- Assessment result: not satisfactory

Students' ability to learn the material covered in class, and in the textbook, is assessed throughout the quarter through a series of online quizzes. In all cases, the answers to the questions are available from the textbook. Each quiz is available for 48 hours, and the students are free to consult the textbook when answering the quiz. Typically, three factual questions are assessed in each quiz; answers to a fourth question asking for feedback on what material was hard to understand are also awarded participation credit. Performance in these quizzes is, we believe, a good test of the ability of students to develop disciplinary knowledge.

In this element of the class, geo-majors (14 out of the 106 class participants) were more successful on average than the class average (geo majors average score: 73%, class average: 69%). Only 7 of the 14 majors scored above 80% overall, the benchmark we have set for satisfactory performance; this 50% level of satisfactory performance is, however, better than the class as a whole (40% satisfactory), but lower than our stated goal of satisfactory performance from 70% of our majors. In at least two cases, poor performance by students in the major was due to a lack of participation in the quizzes.

Laboratory skills (ESLO 2)

- Assessed by performance in the lab final exam
- Satisfactory performance defined as a score of 67% or better
- Percentage of majors achieving satisfactory performance: 57%
- Assessment result: not satisfactory

The lab element of the class is designed to train students in mineral and rock identification. Eight graded laboratory exercises, focusing on skill development, e.g. in the application of diagnostic tests and the use of mineral identification keys, are undertaken in the first nine weeks of the class; students' skills are then put to the test in a lab final exam, worth 20% of the overall grade, in which a series of different mineral and rock samples (some of which have not been seen by the students before) are presented for identification. The lab final

thus serves as a summative assessment of the students' lab skills, and we use performance in that exam as the basis for our assessment.

Again, geo-majors (67% lab final average score) on average outperformed the class as a whole (56%), but performance varied widely among the cohort. For this exam, which is typically found challenging by a majority of students, we set a benchmark of 67% for satisfactory performance. This was achieved by 8 out of 14 students (57% satisfactory), a significant improvement over the class as a whole (24% satisfactory), but again lagging our target of 70% satisfactory performance from students in geoscience majors.

Writing and articulating science-based viewpoints (ESLO 3 and 5)

- Assessed by performance in essay writing exams (two midterms and final)
- Satisfactory performance defined as an average score of 3 out of 4, or better
- Percentage of majors achieving satisfactory performance: 64%
- Assessment result: not satisfactory

Unusually, perhaps, for a lower division science class, the midterms and final exam are essay-based exams, which allows us to target higher learning goals such as written presentation skills (Earth Sciences Learning Outcome 3) and ability to articulate a science-based view of Earth processes (ESLO 5). Essay prompts (an example is provided below) are written to promote synthesis and application of concepts, targeting understanding of Earth processes, rather than regurgitation of facts. Indeed, students are permitted to bring handwritten note cards into the exams, so that memorization of facts is not necessary. Students write up to five essays over the course of the quarter, and the best four scores are retained.

We have developed a grading rubric for essays in the class (see below). The scores attained by students in this scheme correspond to grade points on a four-point scale (i.e. 4.0 corresponds to an 'A'), with scores above 4 representing work that is of an upper division standard, 'above and beyond' the level required in the class. This is presented to students in a dedicated lecture on scientific writing early in the quarter. In this scheme, the defining characteristic of 'good' essay answers (a score of 3.0/grade B or higher) is their ability to explain the answer, rather than simply provide relevant and correct facts. Students are rewarded when they provide the links between observations and theory, and explain how these address the specific question(s) posed in the essay prompt. We adopt the 'good' answer as the desired level of performance, satisfying ESLO 3 and ESLO 5.

We find that the essay-writing performance of geo-majors (average score 3.18/4) is better than the class average (2.59/4), and that a greater proportion of geoscience students achieve the desired standard of an average score of 3.0 (64% versus 33% for the whole class). Again, we fall short of our target of 70% of geo-majors achieving this standard, but given the low numbers of students involved, this means we fell one student short of our self-imposed target.

GEO 001: The Earth's Crust and Interior

Final examination

- Date:** December 9th, 2013
Time: 8.00–11.00 am (No departures prior to or admittance after 8.30)
Permitted: Students' own hand-written note cards
Reminder: Write in your own words. Copying the sentences or phrasing from a book written by somebody else is plagiarism, unless accompanied by full acknowledgement and detailed page-by-page references.

Write up to two essays in the allotted time, according to these instructions:

- Select a prompt from the list below/overleaf
- Write your name and student number on the cover of your blue book
- Write the number of your chosen prompt in the top right corner of the cover of your blue book
- Write a brief outline, showing how you intend to address the prompt (you must complete this step, or your essay will not be graded)
- Write a logical, explanatory, correct and relevant essay in simple and direct English

1) Southern California has 3000 m peaks that were formed by faulting; northern California has 4000 m peaks that are stratovolcanoes. Explain the different mountain-building processes at work in terms of plate boundary settings and plate boundary geometry.

2) Discuss how the grain sizes, grain shapes and bedforms of clastic sedimentary rocks can be used to infer details about how the sediments they contain were transported and deposited. What can this tell us about past environments on Earth?

3) The solar system contains many asteroids and comets that can collide with and crater rocky planetary bodies (i.e. planets and planet-sized moons). Explain, giving examples, why most of the rocky planetary bodies in the solar system are heavily cratered, and yet some others are not.

4) Compare and contrast mid-ocean ridges and mantle hotspots in terms of their magma generation processes, the geological features they produce, the eruptive behaviors associated with them, and the compositions of the igneous rocks that they form. What styles of metamorphism may occur in those settings?

5) James Hutton, regarded by many as the father of modern geology, was contemplating geological time and geological cycles when he wrote in 1788:

“We find no vestige of a beginning, no prospect of an end.”

Explain this proposition, and explore its consequences for how we think about geology today.

6) Write, giving both practical suggestions and the reasons behind them, a guide to the precautions a southern Californian family should take in view of the existing earthquake hazard in the region, and what they should do during and immediately after a major earthquake.

7) Review how the age and composition of the lithospheric plates involved influence the form of a convergent plate boundary. What evidence can we use to infer what is occurring below the surface at such boundaries?

8) Contrast quartz and calcite in terms of their compositions, how they are bonded together, their mineral properties, resistance to weathering and roles as rock-forming minerals.


9) The Red Sea is a narrow sea with a seafloor made of young ocean crust. The Mediterranean Sea is a narrow sea with a seafloor made of old oceanic crust. Explain, defining terms where necessary, the difference in age of the seafloor of these two seas in terms of plate tectonics.

GEO 1 Earth's Crust and Interior OLMH 1208
M-W-F 10-11am

Grading rubric

| | F | D | C | B | A | A+ |
|------------------------------|---|---|---|---|---|----|
| Contains advanced ideas | | | | | | ✓ |
| Complete, with logical order | | | | | ✓ | ✓ |
| Explanatory argument | | | | ✓ | ✓ | ✓ |
| Generally correct | | | ✓ | ✓ | ✓ | ✓ |
| Mostly relevant | | ✓ | ✓ | ✓ | ✓ | ✓ |
| | 0 | 1 | 2 | 3 | 4 | 5 |

Minor errors/omissions -0.5 pt
Major errors/omissions -1 pt



Geo 2 Learning Outcomes

Our strategy has been to include basic questions on the exams that cover fundamental principles covered in the class. Students attending lectures and the labs, reading the material, and listening carefully — along with adequate preparation for the exams — should answer these correctly. The advanced questions (i.e., beyond basics) require deeper critical thinking and are designed to challenge the highest performing students in the class. Percentages are based on the ca. 300 students taking the test.

This class is designed to improve overall science literacy across diverse themes but with a specific focus on climate change and related aspects of the carbon cycle. Students learn how the ocean and atmosphere work and are given an introduction to plate tectonics (as a driver of long-term climate) and various aspects of the spatiotemporal patterns (and controls) of life on Earth. Our primary goal is provide students with a baseline of understanding on how climate varies naturally across wide-ranging timescales with the hope that they can then better understand the events of the last two centuries as overprints on the natural variation. The ultimate product should be better-informed voters, consumers, and citizens.

I am struck by how little many of the students know at the beginning of the class, such as why we have seasonal variation in weather and how a greenhouse gas works. In this regard, the class can be viewed as (1) an effort to elevate basic understanding to the level that every educated person should carry and (2) provide advanced insight that permits understanding and background for a more sophisticated view of the world around us, its history, and recent human impacts. Below is a summary of exam questions aimed at those two goals. The lab exercises and quizzes and short answer portions of the lecture exams are designed in the same way and show similar performance patterns. Because this is a large class, however, the emphasis is on assessments that are relatively easily graded. That said, I still ask my TAs to grade short written answers to test the students' abilities beyond easier recognition of the correct answer. Students consistently have a substantially harder time with this portion of the exam, often losing 30 to 40% of the total points.

What follows is a sampling of representative questions designed to assess basic and advanced understanding of important concepts. The students averaged 79% success with the basic questions and 58% for the advanced questions. A target for future classes is to elevate the former by 10% and the latter by 20% through careful reassessments of how the material is presented in the lab and lecture.

Midterm 2

Basic Questions – Percentage Correct

- 81.72%** Most of the water at Earth's surface lies within: (a) the polar ice caps, (b) lakes, **(c) the ocean**, (d) rivers, (e) none of the above.
- 71.64%** Circulation in the surface ocean: (a) moves warm water to higher latitudes, (b) moves *independent of* the Coriolis effect, (c) is driven by interactions with the prevailing winds systems, (d) a and b, **(e) a and c**.
- 74.25%** Earthquakes are: (a) uncommon along subduction zones, **(b) most common along plate boundaries**, (c) impossible away from plate boundaries, (d) rare along transform plate boundaries, (e) a and b.

71.27% Surface ocean water is less dense because of its lower temperature relative to deep water: (a) true (b) false

54.85% Both oceanic and continental crust readily subduct: (a) true (b) false.

Advanced Questions – Percentage Correct

56.34% Which of the following is *not true* about the Coriolis effect: (a) It results in clockwise oceanic circulation in the northern hemisphere, (b) It is linked to latitudinal differences in the rotational velocity of the Earth, (c) It describes particle movement on rotating spheres (d) It plays no role in upwelling, (e) a and b?

79.10% Photosynthesis is: (a) an example of heterotrophy, (b) uncommon in the surface ocean near continental margins, (c) independent on light intensity, (d) responsible for O₂ consumption, (e) important in primary production.

46.64% On geologic time scales, burial of organic matter results in O₂ release to atmosphere: (a) true (b) false.

73.13% Continents with different apparent polar wander paths for the same time interval suggests that they moved independent of each other relative to a magnetic pole that was basically fixed in position through time: (a) true (b) false.

50.00% CO₂ fertilization is an example of a positive feedback in response to increasing CO₂ content in the atmosphere: (a) true (b) false.

Midterm 3

Basic Questions – Percentage Correct

70.94% First order changes in atmospheric CO₂ (over hundreds of millions of years) are linked to: (a) sea level, (b) seafloor spreading rates, (c) supercontinent formation and breakup, (d) a and b, (e) a, b, and c.

76.98% The changing angle of tilt for Earth's axis controls the amount of energy coming from the sun rather than how it is distributed over Earth's surface: (a) true (b) false.

79.62% The albedo change during glaciation is a positive feedback that favors further growth of ice sheets: (a) true (b) false.

97.74% Population tends to grow exponentially, resulting in an increasing rate of growth over time: (a) true (b) false.

93.96% Sea level would rise approximately another ~70 m if all the glacial ice present today melted: (a) true (b) false.

Advanced Questions – Percentage Correct

64.53% The concept of panspermia argues that organic compounds are delivered: (a) by volcanoes on Earth, (b) by hydrothermal vents on Earth, (c) from space,

(d) by UPS, (e) a and d.

- 61.89%** When CO₂ and water react, the result is: (a) formation of carbonic acid, (b) formation of sulfuric acid, (c) of no consequence in the controlling rock weathering, (d) higher pH for that water, (e) c and d.
- 41.83%** The Milankovitch Theory predicts that Earth's orbit around the sun varies with a periodicity of: (a) 41,000 years, (b) 100,000 years, (c) 400,000 years, (d) a and b, (e) b and c.
- 44.15%** Chemical weathering provides a negative feedback to increases in atmospheric temperature that are a product of increasing concentration in the atmosphere: (a) true (b) false
- 50.94%** All forms of autotrophy require light: (a) true (b) false.

Final

Basic Questions – Percentage Correct

- 84.27%** Earthquakes are: (a) common along subduction zones, (b) concentrated on passive continental margins, (c) impossible away from plate boundaries, (d) rare along transform plate boundaries, (e) a and b. (Repeated from Exam #2.)
- 93.63%** Negative feedbacks tend to establish: (a) stable equilibrium states, (b) small changes in systems, (c) amplified system changes, (d) a and b, (e) a and c.
- 68.16%** The geologic times scale was initially developed based on well-constrained absolute dates for geologic materials: (a) true (b) false.
- 74.16%** Early models for the chemical origins of life require a reducing environment that lacked oxygen: (a) true (b) false.
- 91.01%** Circulation in the surface ocean: (a) moves cool water to higher latitudes, (b) moves independent of the Coriolis effect, (c) is driven by interactions with the prevailing winds systems, (d) is driven principally by thermohaline circulation, (e) a and c. (Repeated from Exam #2 for comparison.)

Advanced Questions – Percentage Correct

- 66.67%** The position of the ITCZ, the climatic equator, is fixed precisely by the position of the geographic equator: (a) true (b) false.
- 62.55%** Reversals of Earth's magnetic poles are linked to convective flow of liquid iron in Earth's inner core: (a) true (b) false.
- 61.05%** Which of the following is *not true* about a system in steady state: (a) the sum of the inputs is equal to the sum of the outputs; (b) unless perturbed, it remains in a constant state despite exchange across the system boundaries; (c) once perturbed, systems seldom return to steady state; (d) when perturbed, negative feedback processes commonly act to reestablish the steady state, (e) b and c.

67.42% The apparent surplus of energy at the equator and deficit at the poles results in: (a) a progressive warming at the low latitudes; (b) surface circulation in the oceans; (c) climate; (d) a and b; **(e) b and c.**

50.56% Ice ages (icehouse climates) occur most commonly: (a) when carbon dioxide is high in the atmosphere, (b) when the continents are concentrated near the equator, (c) about every ten million years throughout Earth history, **(d) when carbon dioxide was low in the atmosphere,** (e) a and b.

Geo-003/Bio-010: Headlines in the History of Life, Spring 2014

This course is formatted to serve as an introduction to the evolutionary history of life on Earth as seen in the fossil record. The class starts with a series of “toolbox” lectures that broadly cover topics relevant to understanding both the construction and interpretation of the fossil record. These topics included an overview of plate tectonics, principles associated with formation of sedimentary rocks, taphonomy, evolution and cladistics. Upon completion of the introductory material the students spend the rest of class “marching through time”, with lectures starting on the origin of life, followed by the Precambrian fossil record, the evolution of Metazoans, and proceeds to more specifically follow the Phanerozoic evolution of vertebrates while discussing major mass extinctions. A special emphasis is also put on 1) what science is and 2) scientific communication.

A subset of predetermined questions from the exams that either cover the bigger “take-home” topics from the class or were related to fundamentals of broader topics discussed throughout the quarter were separated from each exam and individually analyzed. Percentages of correct answers for five questions from the multiple-choice exams and final are presented for both the class as a whole and for our department majors.

To reach our goal of furthering student ability to communicate science and effectively explain scientific principles to others, students are required to complete two writing assignments. The first assignment is in the form of a blog entry, where students selected a topic from the course and wrote a couple paragraphs explaining this topic to a layperson. Students read the blog entries of fellow students and were encouraged to leave constructive comments to facilitate discussion.

The second assignment required students to select a mainstream media piece (such as a newspaper or magazine article) involving a scientific study related to the course material and to employ research methods to track down the original scientific publication described in that selected media piece. Teaching assistants and the course instructor provided guidance in topic selection and helped facilitate their research using the UCR library system. Students ultimately produced an essay describing both the media piece and the original scientific publication with an evaluation of how effectively the media piece delivered the information to a mass audience while staying true to the academic material at hand. These two written assignments served to expose students to the “art” of scientific communication in hopes of increasing scientific awareness and improved scientific communication among the undergraduate students at UCR.

Lastly, this course aims to conform to the overall departmental learning goals, including covering broad topics (Earth’s history, climate, evolution, and persistence of life), written skills, science-based views of Earth’s processes, and knowledge on climate change that will assist students in making sound economic and policy decisions in both their personal and public spheres.

Exam 1

Class Average 74.0%(n=144); Majors 84.4% (n=10);

| Multiple Choice (Class) | Multiple Choice (Majors) |
|-------------------------|--------------------------|
| 1) 96% | 1) 100% |
| 2) 84% | 2) 80% |
| 3) 90% | 3) 100% |
| 4) 85% | 4) 90% |
| 5) 89% | 5) 90% |

Exam 2

Class Average 65.8% (n=145); Majors 85.3% (n=9);

| Multiple Choice (Class) | Multiple Choice (Majors) |
|-------------------------|--------------------------|
| 1) 82% | 1) 100% |
| 2) 90% | 2) 100% |
| 3) 92% | 3) 78% |
| 4) 81% | 4) 89% |
| 5) 87% | 5) 89% |

Exam 3

Class Average 72.0% (n=138); Majors 85.6% (n=7);

| Multiple Choice (Class) | Multiple Choice (Majors) |
|-------------------------|--------------------------|
| 1) 62% | 1) 71% |
| 2) 76% | 2) 86% |
| 3) 88% | 3) 100% |
| 4) 51% | 4) 57% |
| 5) 75% | 5) 100% |

Final Exam

Class Average 68.0% (n=147); Majors 81.7% (n=10);

| Multiple Choice (Class) | Multiple Choice (Majors) |
|-------------------------|--------------------------|
| 1) 85% | 1) 80% |
| 2) 76% | 2) 80% |
| 3) 90% | 3) 70% |
| 4) 91% | 4) 100% |
| 5) 96% | 5) 100% |

Lab Summary:

Lab Activities: Class 92.2% (n=150); Majors 96.1% (n=10)

Lab Quizzes: Class Average 78.9% (n=150); Majors 98.9% (n=10)

GEO012 At Home in the Universe Learning Outcomes Assessment, 2014

1. Class goals and their relationship to Departmental Learning Outcomes

COURSE GOALS (with Dept. of Earth Sciences Learning Outcomes):

- 1. Students will understand the range of views concerning the natural history of the Universe, of Earth, and of life upon Earth offered by religion, philosophy and science (Learning outcome 1)
- 2. Students will understand the scientific method for understanding past events that cannot be observed directly (Learning outcome 1)
- 3. Students will be able to articulate how the methodology that science uses to understand natural history differs from that of religion or philosophy (Learning outcome 3)
- 4. Students will be able to articulate how humans discovered the relative sizes of Moon, Sun and Earth, and estimated the distances between these objects (Learning outcome 3)
- 5. Students will be able to integrate evidence from different fields of science to develop a consistent chronology of major events in natural history (Learning outcomes 3,4)
- 6. Students will understand Earth-Life coevolution, and the bioengineering of our planet's oceans and atmosphere (Learning outcome 1)
- 7. Students will be able to articulate empirical evidence provided by the fossil record of major evolutionary transitions (Learning outcomes 1,3)
- 8. Students will understand the role of natural history in informing arguments about current global environmental change (Learning outcomes 1,4)
- 9. Students will be able to make evidence-based arguments, and convey them in writing (Learning outcomes 3,4)

This lower division class, which is not presently part of the core curriculum, addressed only the following departmental learning outcomes: 1, 3, and 4.

2. Method of Assessment

For this lower division class achievement was evaluated on the basis of mean scores on select multiple choice questions in the midterm and final exams (goals 1-3, 6-8), and on performance in particular essay questions on the final (goals 4,5,9). Goals were assessed on the basis of several (3 or more) multiple choice questions. Class enrollment was ~170 students.

3. Results

ESLO 1: "mastery of a broad set of topics in Earth Sciences, including fundamentals of the earth's composition, history, physical state, climate, and the evolution and persistence of life". Assessed via overall average of assessments

of Class Goals 1,2,6-8 though the mean score of correct answers to 14 multiple choice questions: **Average score for assessment: 59.34%.**

ESLO 3: “mastery of written communication skills, and “ Assessed via overall average of assessments of Class Goals 3-5,7,9: **Average score for assessment: 74.43%.**

ESLO 4: “to apply, synthesize, and evaluate knowledge.” Assessed via overall average of assessments of Class Goals 5,8,9: Assessed average of all essays questions on the final. **Average score for assessment: 69.62%.**

4. Implications

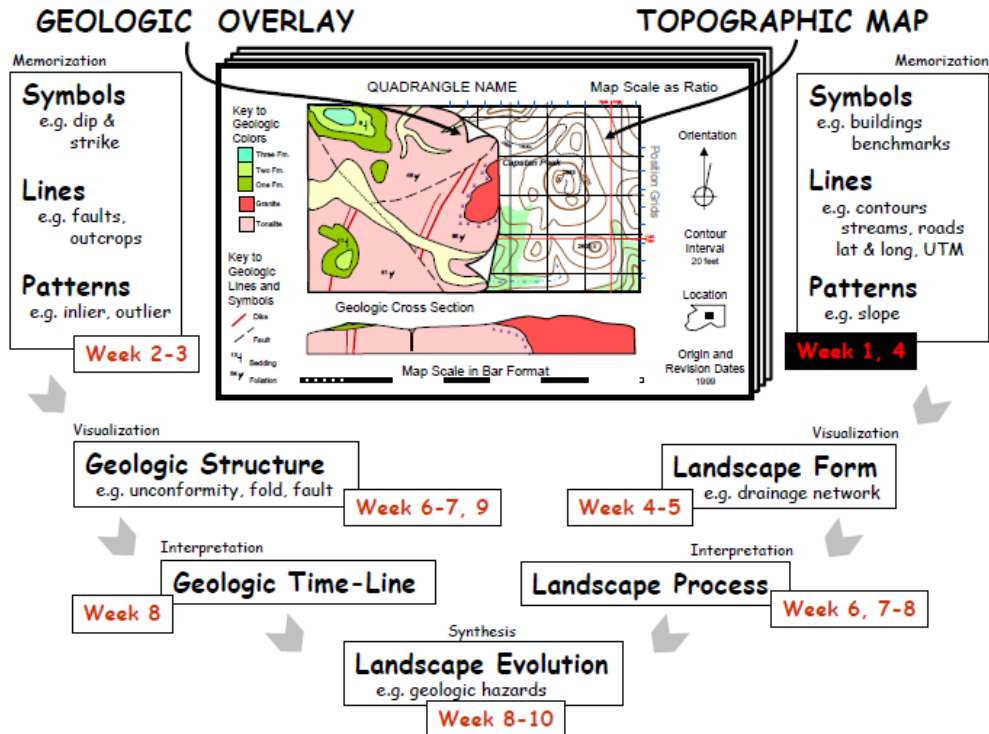
Given the departmental commitment to a 70% benchmark for evaluating success, results suggest that while overall knowledge of class material is not satisfactory, student performance in tasks that requiring communication and synthesis of knowledge is marginally satisfactory.

5. Interpretation

The better performance in meeting ESLOs 3 and 4 than for ESLO 1 may result from the fact that essay questions covered topics that are stressed repeatedly throughout the class by the teacher and TA's. In future perhaps a narrower range of topics should be presented with more opportunities for students to develop depth in these areas, but this would come at the expense of the diversity and integrative nature of this class, the purpose of which is to have students confront different ways of knowing utilized in different parts of their lives.

GEO 115 COURSE STRUCTURE and LEARNING LEVELS

Two concurrent streams, Topographical and Geological, flow from Memorization through Visualization and Interpretation to their confluence at Synthesis



Fall-2013 COURSE STATISTICS

INSTRUCTOR: Pete Sadler

TEACHING ASSISTANT: John Conrad

PARTICIPANTS:

Enrollee Head Count: 17 (Pass: 16; fail: 0; withdraw: 1 – *did not take final*)
 (Geo-majors: 14; would-be geo-majors: 2; non-majors: 1)
 (Undergraduate: 15; graduate: 2)

| | | | | |
|---------------------|-----------|---|-----------|---|
| GRADE DISTRIBUTION: | A+, A, A- | 5 | D+, D, D- | 0 |
| | B+, B, B- | 4 | F/W | 1 |
| | C+, C, C- | 7 | | |

OVER-ARCHING OUTCOME GOALS OF THE GEOSCIENCES PROGRAM

- 1) Development of disciplinary knowledge
- 2) Lab/field/computer skills
- 3) Oral/written presentation skills
- 4) Ability to apply and synthesize information
- 5) Ability to articulate science-based views of Earth processes
- 6) Ability to make critical personal/professional judgments based on scientific understanding.

GEO 115 COURSE OUTCOME GOALS and ASSESSMENTS:

Green indicates satisfactory outcome; **Red** indicates potentially troubling outcome;
 (colors assigned with regard to difficulty of task)

1. Students will be able to visualize landforms from topographic contour patterns on maps of various scales.

PROGRAM GOAL: 2 (LAB SKILL)
 ASSESSMENT VEHICLE: Final Exam Parts II and III (Fish Creek cinder cone and La Conchita coastal bluffs)

Three indicators in order of increasing challenge:

| | | | |
|----------|------------------------------------|-----------|--|
| OUTCOME: | Recognizes cinder cone.....Yes | 15 | |
| | No | 1 | |
| OUTCOME: | Recognizes incised creeks.....Most | 13 | |
| | Some | 3 | |
| | None | 0 | |
| OUTCOME: | Recognizes landslides.....Most | 7 | |
| | Some | 9 | |
| | None | 0 | |

ANALYSIS: **Recognition skills satisfactory but not exhaustively applied**
 (level of difficulty is correctly judged in assessment vehicle)

REMEDY: **Emphasize thoroughness**

2. Students will be able to determine position using maps and compasses in field settings.

PROGRAM GOAL: 2 (FIELD SKILL)
 ASSESSMENT VEHICLE: Mule Canyon Map (field mapping exercise)

| | | |
|----------|---|----------|
| OUTCOME: | Outcrop Location.....Generally Accurate | 3 |
| | Locally Slightly Inaccurate | 7 |
| | Locally Very Inaccurate | 2 |
| | Generally Slightly Inaccurate | 4 |
| | Generally Very Inaccurate | 1 |

ANALYSIS: **Satisfactory; minor inaccuracy is typical; major inaccuracy is rare**

REMEDY: **Warn about lapses of attention; show portfolio examples before exercise (a successful strategy in GEO 101)**

3. Students will be able to recognize characteristic outcrop patterns of bedrock, surficial deposits, faults and folds on geologic maps and extrapolate sub-surface structure from maps.

PROGRAM GOAL: 2 (LAB SKILL)
 ASSESSMENT VEHICLE: Final Exam, Part I (artificial geologic map)

Six indicators in order of increasing challenge:

| | | | | |
|----------|--|----------------------------|----|--|
| OUTCOME: | Recognizes pattern of vertical strata..... | Yes | 14 | |
| | | No | 2 | |
| OUTCOME: | Recognizes pattern of horizontal strata..... | Yes | 15 | |
| | | No | 1 | |
| OUTCOME: | Finds strike lines for dipping strata..... | Yes | 16 | |
| | | No | 0 | |
| OUTCOME: | Recognizes folded strata..... | Yes, correct form & plunge | 8 | |
| | | Yes, wrong plunge | 4 | |
| | | Yes, wrong form | 3 | |
| | | Yes, wrong form and plunge | 1 | |
| | | No | 0 | |
| OUTCOME: | Diagnoses overturned strata..... | Correctly | 8 | |
| | | Inconsistently | 7 | |
| | | Incorrectly | 1 | |
| OUTCOME: | Depicts Subcrop..... | Correctly | 10 | |
| | | Plausibly | 3 | |
| | | Implausibly | 2 | |
| | | No attempt | 1 | |

ANALYSIS: **Satisfactory**; handle mechanical task of finding strike lines better than recognizing the simple end members;

REMEDY: Allot more time to Geologic Time Scale and thinking in terms of cross-section view

4. Students will be able to determine dip, strike, and plunge *in field settings* and represent these by symbols on maps using a variety of common professional conventions.

PROGRAM GOAL: 2 (FIELD SKILL)
 ASSESSMENT VEHICLE: Mule Canyon Map Exercise

Three indicators of comparable difficulty and one assessment of ability to follow instructions

| | | | |
|----------|---|----|---|
| OUTCOME: | Strike Directions.....Correct | 8 | |
| | Mostly Correct | 7 | |
| | Mostly Incorrect | 0 | |
| | All Incorrect | 2 | |
| OUTCOME: | Dip Directions.....Correct | 12 | |
| | Mostly Correct | | 4 |
| | Mostly Incorrect | | 0 |
| | All Incorrect | | 1 |
| OUTCOME: | Dip Angles.....Correct | 12 | |
| | Mostly Correct | 5 | |
| | Mostly Incorrect | 0 | |
| | All Incorrect | 0 | |
| OUTCOME: | Dip-and-strike symbols.....Professional | | 6 |
| | Messy/inadequate | | 8 |
| | Unconventional | | 2 |
| | Misleading | | 1 |

ANALYSIS: **Satisfactory** measurement skills; **disappointing** neatness
 REMEDY: **Not unusual for first field map but keep showing good examples**

5. Students will be able to write professional field notes.

PROGRAM GOAL: 3 (WRITTEN PRESENTATION)
 ASSESSMENT VEHICLES: Johnson Valley Field Trip and Box Springs Lab
 (Geomorphic descriptions assessed underway and afterward)

| | | | |
|--------------|----------------------|----|----|
| OUTCOME..... | Legible | 17 | |
| | Illegible | 0 | |
| | Comprehensive | | 5 |
| | Adequate | | 10 |
| | Inadequate | | 2 |
| | Richly-Illustrated | 10 | |
| | Sparsely-Illustrated | 7 | |
| | Not-Illustrated | 0 | |

ANALYSIS: **All satisfactory** early in exercise; then **tendency to lapse**, especially in Box Springs lab, despite instructor example.
 REMEDY: **Period notebook inspections throughout day/lab?**

6. Students will be able to recognize characteristic landscape patterns of bedrock, surficial deposits, faults folds and landslides on aerial photographs and satellite images and combine this information with field and map observations.

PROGRAM GOAL: 1 (DISCIPLINARY KNOWLEDGE), 2 (LAB SKILL) AND 4 (SYNTHESIS)
 ASSESSMENT VEHICLE: Final Exam Part II (Fish Springs fault and cinder cone)

Two indicators neither difficult but both requiring synthesis:

| | | |
|----------|--|----|
| OUTCOME: | Location of basalt/granite contact.....Correct | 6 |
| | Mostly correct | 10 |
| | Mostly incorrect | 0 |
| | No attempt | 0 |
| OUTCOME: | Location of fault lines.....Correct | 9 |
| | Mostly correct | 5 |
| | Mostly incorrect | 1 |
| | No attempt | 0 |

ANALYSIS: **Satisfactory**; common error in otherwise good work is failure to distinguish dark rocks from shadows

REMEDY: **Add lab attention to relating shadows to slope aspect; i.e. better integration of topographic contours with aerial images; possibilities include Google time-of-day toy or the overlay of contours on 3-D fly-by views**

7. “Students will be able to describe landforms and interpret geologic maps and aerial images using conventional professional vocabulary.”

PROGRAM GOAL: 1 (KNOWLEDGE), 2 (LAB SKILL) AND 5 (ARTICULATE AND REASON)
 ASSESSMENT VEHICLE: Final Exam Parts II and IV: (Account of Fish Springs area, desert pavement, and mesa evolution)

| | | |
|----------|---|---|
| OUTCOME: | Evolution of basalt mesas.....Professional: | 5 |
| | (temporal series) Colloquial: | 6 |
| | Incomplete: | 4 |
| | Incorrect: | 0 |
| | No attempt: | 1 |
| OUTCOME: | Nature of Desert Pavement.....Professional: | 3 |
| | (complex cause and effect) Colloquial: | 5 |
| | Incomplete: | 7 |
| | Incorrect: | 0 |
| | No attempt: | 1 |

ANALYSIS: These indicators capture recall and vocabulary. **Unsatisfactory** mastery of vocabulary. **Satisfactory** recall/description of temporal sequence; **Barely satisfactory** recall/description of a web of causes and effects.

REMEDY: Make more explicit reference to issues of order and complexity in natural phenomena.

8. “Students will be able to infer process of formation and relative age for common landscape elements.”

PROGRAM GOAL: 4 (SYNTHESIS) AND 5 (ARTICULATE AND REASON)
 ASSESSMENT VEHICLE: Final exam Parts II and III: (Image/map interpretation)

Three indicators requiring increasing skill in synthesizing observations of landscape images, previously introduced in lecture; i.e. not purely a matter of original observing and reasoning skills, but partly a matter of listening skills (habits of mind in lecture settings):

| | | | | |
|----------|---------------------------------------|-------------|----------|-----------|
| OUTCOME: | Identifies youngest landslide..... | Correctly | 8 | |
| | | Incorrectly | 5 | |
| | | No attempt | 3 | |
| OUTCOME: | Recognizes relative age of fault..... | Correctly | | 12 |
| | and cinder cone | Incorrectly | | 4 |
| | | No attempt | | 0 |
| OUTCOME: | Discerns difference in..... | Explains | 3 | |
| | incision of channels | Describes | 7 | |
| | and understands it | Mistakes | 6 | |
| | | No attempt | | 0 |

ANALYSIS: **Satisfactory**, but with disappointing success rate on simplest task
 REMEDY: *Not sure; this is the highest skill level reached in this upper-division entry class and only close to the end; i.e. beyond noticing, naming, and describing, it requires synthesizing and reasoning. It serves to identify the “A” students. The tasks could be simplified by leading the witness. Instead of asking to interpret the cause of incision, for example, we could ask students to consider the relative depth of channel incision and then tell us which side of the fault is relatively uplifted. Some small parts of the course need to test for the highest skills*

9. “Students will learn safe field behavior.”

PROGRAM GOAL: 6? (CRITICAL JUDGMENT)
 ASSESSMENT VEHICLE: Field Exercise Behavior (Three 3-hour and two 1-day excursions)

OUTCOME: **No incidents; no accidents involving students.**
 Students self-selected responsibly for not-attempting short, strenuous, uphill hike.
 Potential problem of instructor/driver fatigue at end of long day leading exercises followed by vehicle parking/cleaning

ANALYSIS: **Satisfactory**
 REMEDY: *None needed, but don’t relax vigilance; consider option for instructor NOT to drive or for delaying vehicle cleaning until following morning.*

OVERALL OUTCOME EVALUATION

“In summary, students will have foundational skills for courses that teach geologic mapping (GEO 101 and 102) and for field sections of courses in geomorphology (GEO 162), petrology (GEO 100 and 118), and structural geology (GEO 116).”

Requires tracking performance into GEO 101, 102 and 116

ANALYSIS: **Satisfactory** *initial skill development but a greater consistency and professionalism is always desirable and professional vocabulary is weakly imprinted.*

REMEDY: *Try placing greater emphasis on professional appearance of work product but be careful not to inhibit raw enjoyment of field activities; the later GEO 101 course has 10 field days that suffice to inculcate neatness and precision.*

UNDERGRADUATE vs GRADUATE STUDENT PERFORMANCE:

*There were two **disappointing** aspects to the graduate student performance that relate to assessment of the undergraduate experience in this class. In terms of study skills and language issues, graduate students are usually, but not inevitably, good role models.*

Language Issues: Both graduate students were non-native English speakers. One did not attempt questions with narrative answers and, in spite of excellent analytical skills was not a gregarious role model. The other engaged freely with the undergraduates. Non-native English speakers among the undergraduates were not afraid of technical terms but tended to use colloquial sentence structure in written work. An encouraging trait among these undergraduates was the use of advanced non-technical vocabulary, sometimes out of the correct context, but an encouraging sign of engagement with advanced written English. As in past years, foreign graduate students and exchange students willing to converse freely add considerably to the learning environment of the undergraduates. NOTE: there is no textbook suited to the level and breadth of this course.

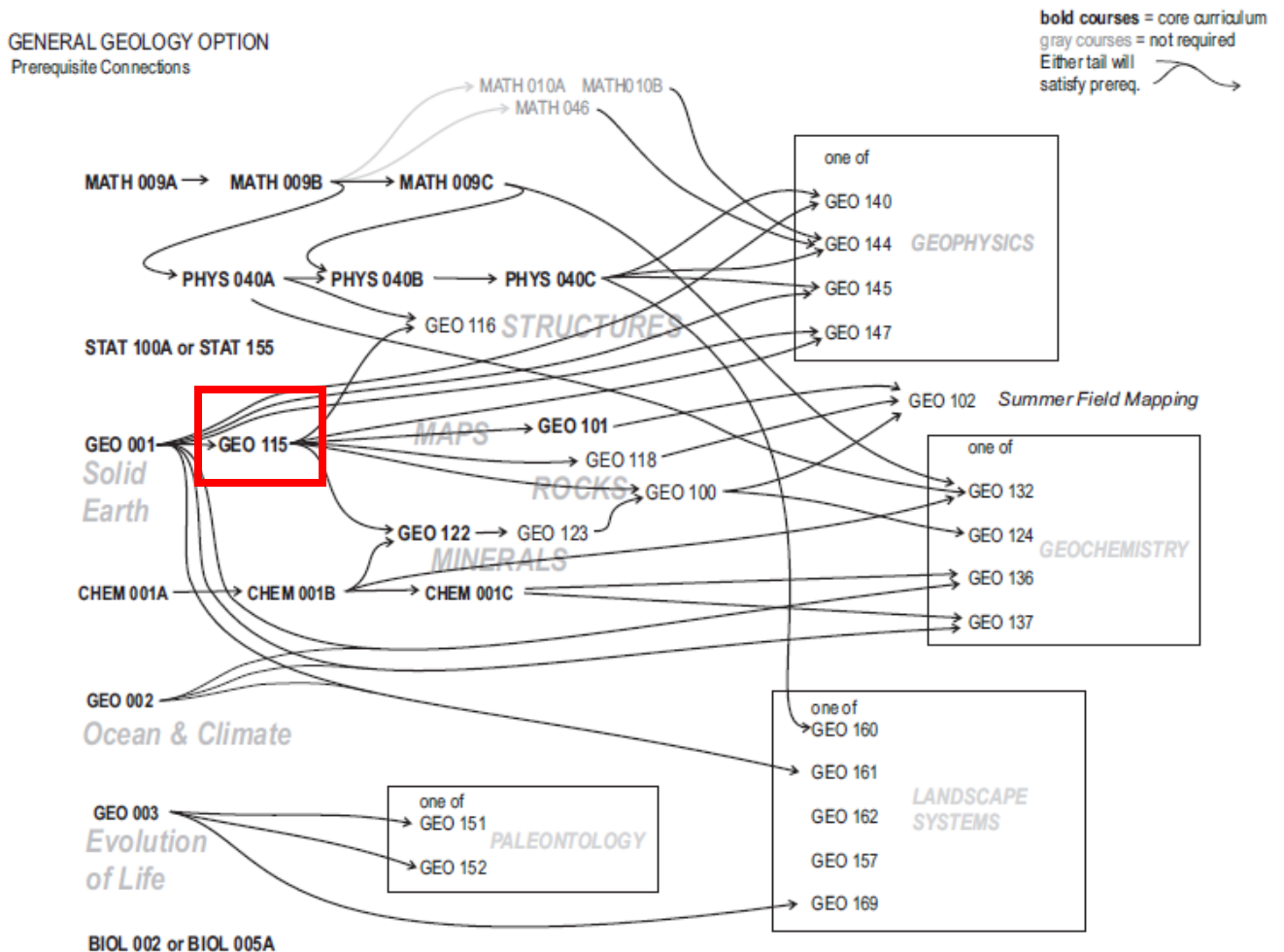
Attention Span: Only one of the graduate students had prior geoscience training beyond the level of the undergraduates in the class. The other brought MS degrees from the humanities, but no logical problem-solving skills. This potential role model had not yet shed the early undergraduate trait of not listening to instructions given prior to lab exercises. It is a general observation that, as in lower division labs, instructions issued prior to lab in this upper-division entry course quickly become a waste of time. Many students do not pay attention until immersed in lab exercises. Even there, the tendency is to go straight to the tasks/questions without reading the preamble. It was disappointing to see that advanced degrees could not be relied upon to eradicate this bad habit, regardless of discipline. Previously, graduate students in this course brought expertise in soil science and added considerably to the learning habits of the undergraduates.

PAPER REPOSITORY NOT INCLUDED

All mid-term and final exams for GEO 115 are physically retained by the instructor after debriefing students together and individually. The repository supports longitudinal performance studies and provides baselines for grading. Image and field Interpretation exercises are graded relative to general student performance rather than a “right answer.” Scanning all these pages is not time- and cost-effective.

Field notebooks are returned to students – they have purchased them and need them in other field classes. Paper field maps may be claimed after scanning/debriefing or when students enter the GEO 101 field course. All students also receive their field maps as annotated and unannotated scans. These and the field notebooks are an essential foundation for future field classes.

APPENDIX I: Position of GEO 115 in Prerequisite Structure of General Geology Degree



**APPENDIX II Position of GEO 115 as Upper Division Gateway Course within
 General Geology Sample Programs for Freshmen and Transfers**

GENERAL GEOLOGY OPTION (Plan for ~165 of 180 unit minimum⁴)

"Basic Writing and Pre-Calculus Ready"

- Eligible for pre-calculus (e.g. MATH 5, 8A) and/or
- needs courses to satisfy Entry Level Writing Requirement (e.g. ENGL 4, 5) and/or
- wants fewer units in first year and
- willing to delay some intro GEO courses to year 2.
- Benefits from easier transition to college.

| | FALL | WINTER | SPRING | SUMMER |
|----------------|---|--|---|---------------------------------|
| Year 1 (FR) | ENGL 005 MATH 005 or 008A GEO 001 12 units | ENGL 1A MATH 009A or 008B CHEM 001A and 01LA 13 units | ENGL 1B MATH 009B CHEM 001B and 01LB 13 units | |
| Year 2 (SO) | ENGL 1C MATH 009C CHEM 001C GEO 115 17 units | GEO 002 GEO 122 Breadth elective*** Breadth elective*** 16 units | GEO 003 GEO 123 Breadth elective*** 4 12 units | |
| Year 3 (JR) | PHYS 040A or 002A BIOL 002 or 005A and 005LA GEO 100 Breadth elective*** 16-17 units | PHYS 040B or 002B STAT 100A or 155 GEO 116 Major elective* 16-17 units | PHYS 040C or 002C GEO 118 GEO 101 Major elective* 16-18 units | GEO 102 14 units |
| Year 4 (SR) | Major elective* Breadth elective*** 4 8-10 units | Related elective** Breadth elective*** 4 8-10 units | Major elective* Related Elective** 4 8-10 units | |

GENERAL GEOLOGY OPTION

(Plan for ~100 units; unit target varies with total transferred units)

"Physics and Mineralogy Ready" i.e. transfer or change of major

- Has completed 1-yr college-level English composition (ENGL 001A-B-C)
- Has completed 1-yr calculus (MATH 009A-B-C)
- Has completed 1-yr chemistry (CHEM 001A-B-C)
- Has completed physical geology course with lab (GEO 001)
- Has completed all but 2-3 general education course requirements

NOTE: General Geology is the usual transfer option. To complete the other options with a comparable course load, it is necessary to transfer more lower division requirements.

| | FALL | WINTER | SPRING | SUMMER |
|----------------|--|--|--|---------------------------------|
| Year 1 (JR) | BIOL 002 or 005A and 005LA STAT 100A or 155 GEO 115 13 units | GEO 002 GEO 122 Major elective* Breadth elective*** 16-17 units | GEO 003 GEO 123 Related Elective** Breadth elective*** 16 - 17 units | |
| Year 2 (SR) | PHYS 040A or 002A GEO 100 Major elective* Related elective** 16-17 units | PHYS 040B or 002B GEO 116 Major elective* Major elective* 16 -17 units | PHYS 040C or 002C GEO 118 GEO 101 Breadth elective*** 16 units | GEO 102 14 units |
| Year 3 (?) | Qtr sometimes needed to manage schedule conflicts, repeated courses, or gaps in articulation | | | |

APPENDIX III: Portfolio of Fall 2013 Field Maps

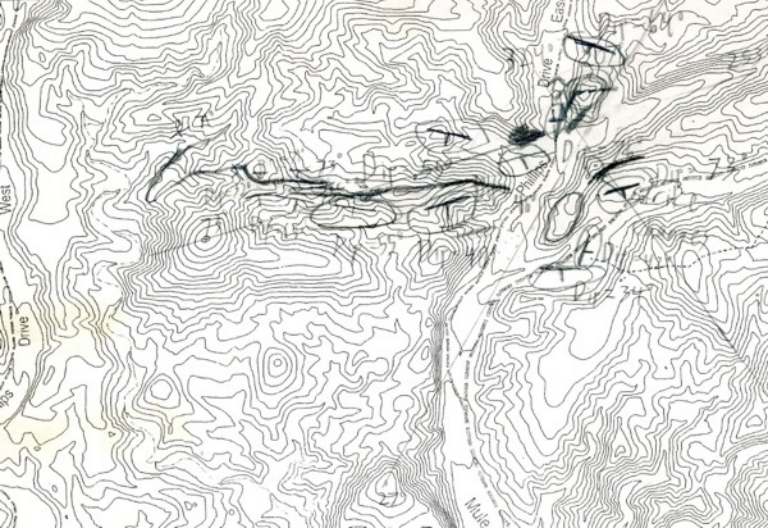
[Portfolio1_Geo115Fall2013.pdf](#)

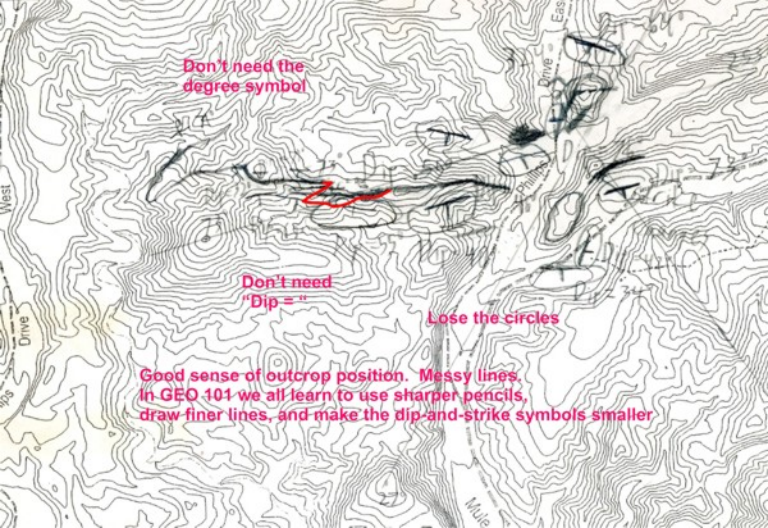
Mule Canyon field maps. Students' first attempt to trace outcrop pattern from field exposure to map with original dip-and-strike readings. Exercise was undertaken as a group with accompaniment of three instructors; i.e. NOT examination conditions in that help and discussion was freely encouraged, but students knew that the maps would be collected for grading at the end of the day.

Students could see and were frequently shown the instructors' work as examples. Instructors occasionally drew directly on student maps in the course of explanation. There was ample encouragement of professional pencil work, but no harsh enforcement; some enjoyment of mapping was fostered and the 2013 class was exceptional in the extent to which students voluntarily progressed ahead of the instructors to explore new vistas.

An instructor's field map follows, plus scanned original and critically annotated student field maps, all drawn on the same day in the field.





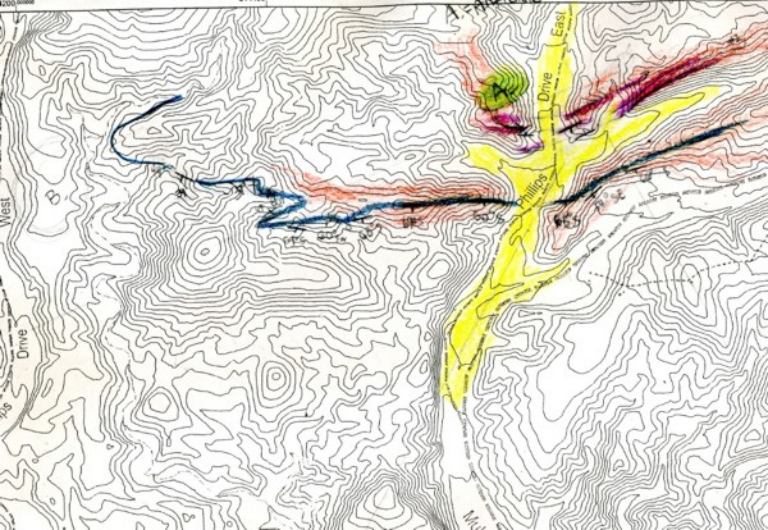
A topographic map with contour lines and several geological sketches. The sketches include a horizontal line with a red zigzag dip symbol, a circular feature with a strike-slip symbol, and a circular feature with a normal fault symbol. Annotations in red text provide feedback on the sketches.

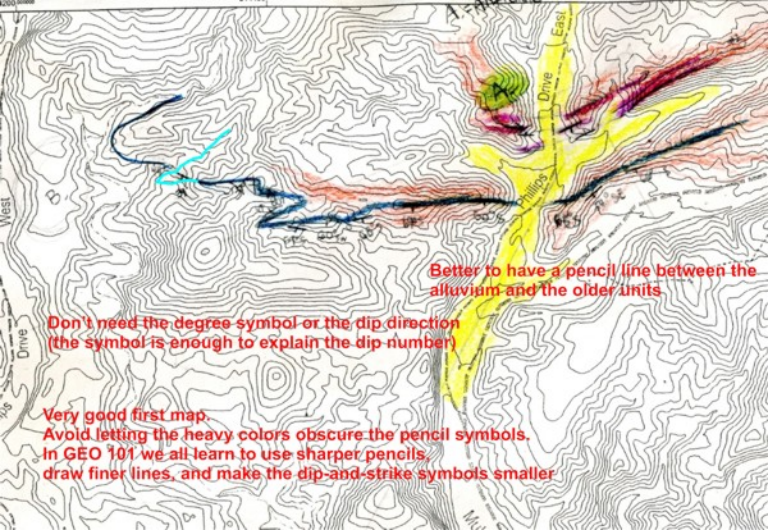
Don't need the degree symbol

Don't need "Dip = "

Lose the circles

Good sense of outcrop position. Messy lines. In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller





Better to have a pencil line between the alluvium and the older units

Don't need the degree symbol or the dip direction (the symbol is enough to explain the dip number)

Very good first map.
Avoid letting the heavy colors obscure the pencil symbols.
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller

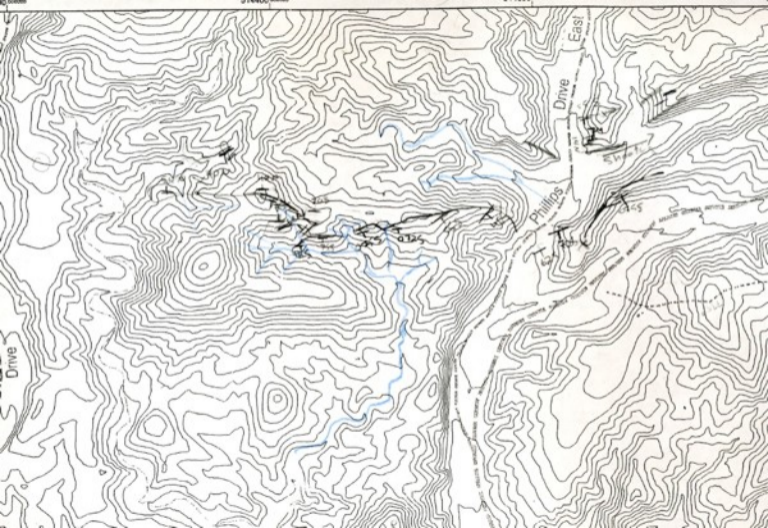


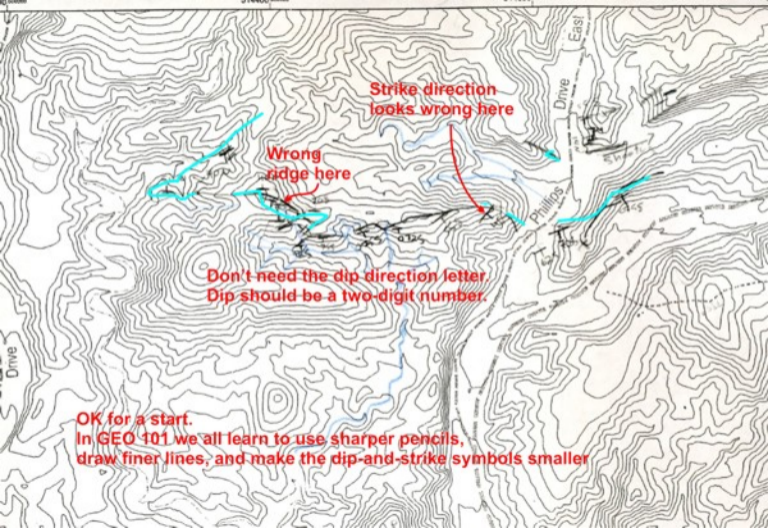
A topographic map showing contour lines and geological features. A yellow shaded area represents older units covered by alluvium on canyon floors. A red arrow points to this area. A blue line and a black line with a strike-slip symbol are also present. Text annotations in red provide instructions on how to improve the drawing.

**Don't need the strike direction numbers
or the degree symbol**

**Older units covered by alluvium
on canyon floors**

**Good start.
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller**



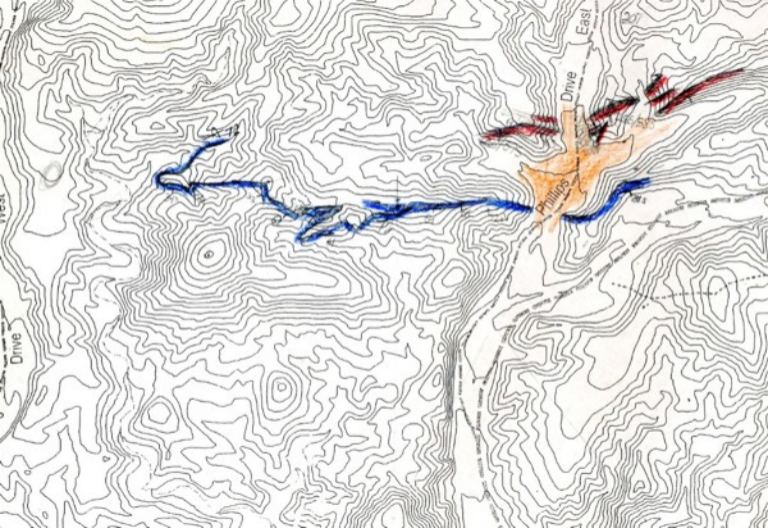


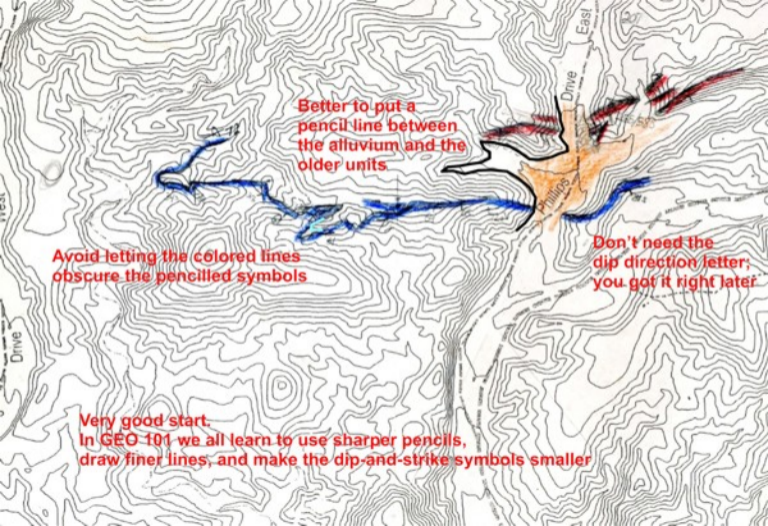
Strike direction looks wrong here

Wrong ridge here

Don't need the dip direction letter. Dip should be a two-digit number.

OK for a start. In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller





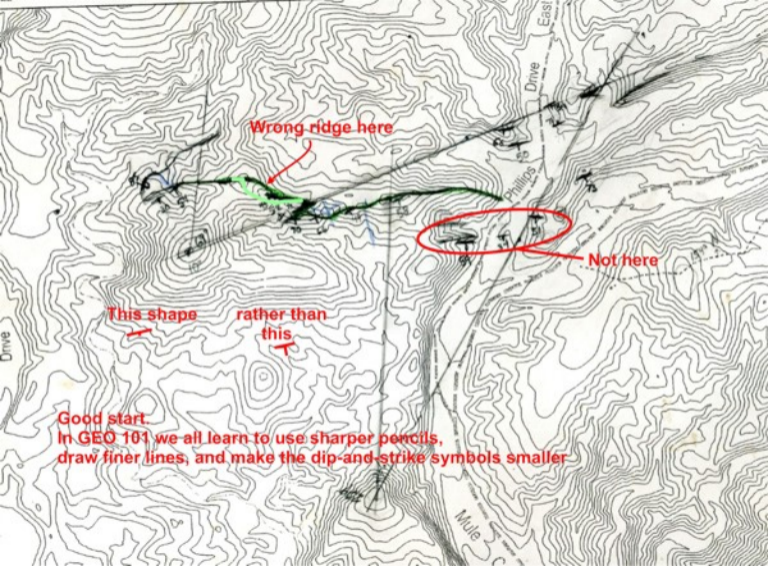
Better to put a pencil line between the alluvium and the older units

Avoid letting the colored lines obscure the pencilled symbols

Don't need the dip direction letter; you got it right later

Very good start.
In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller





Wrong ridge here

Not here

This shape rather than this

Good start.
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller



A topographic map showing contour lines and geological features. A red line traces a path across the map, with several dip-and-strike symbols drawn along it. The symbols are oriented in the direction of the red line, which is noted as incorrect. A separate symbol is shown with a right-angle between its strike and dip components. Annotations in red text provide instructions on how to improve the drawing.

It looks as though you plotted the strike symbols in the dip direction

Strike should run this way here

Dip-and-Strike symbol should make a right angle:

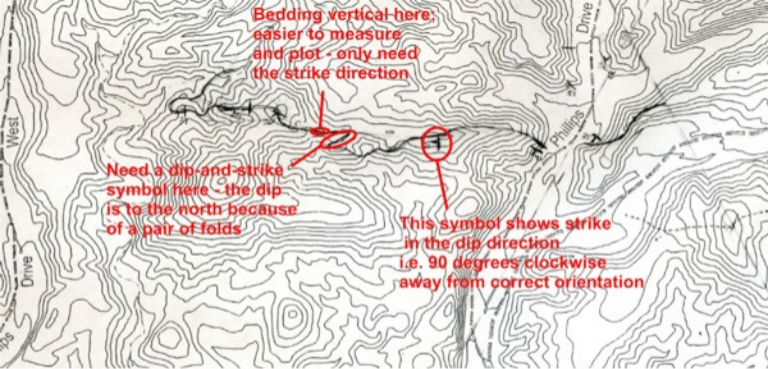
A small diagram of a dip-and-strike symbol. It consists of a horizontal line with a short vertical tick mark at its right end, forming a right angle. This represents the correct orientation for the strike and dip components of a geological feature.



Don't need the dip direction letter (S)

Outcrop line a bit simplified!
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller



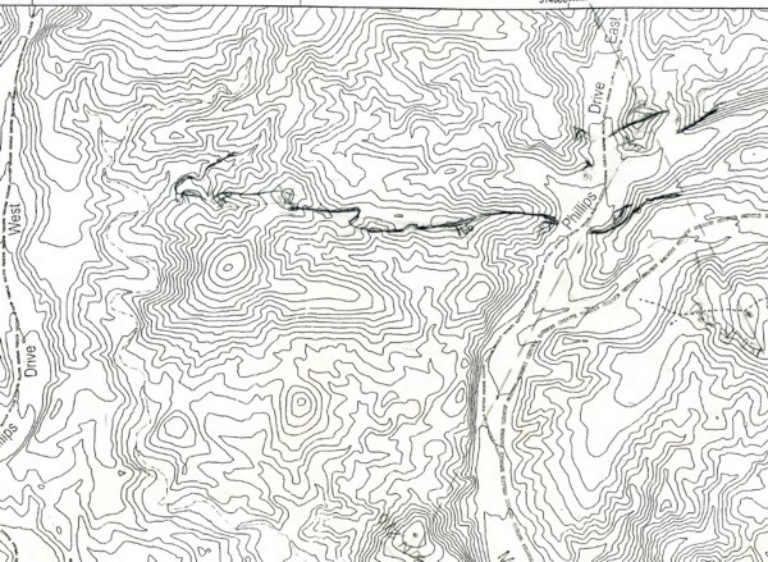


Bedding vertical here;
easier to measure
and plot - only need
the strike direction

Need a dip-and-strike
symbol here - the dip
is to the north because
of a pair of folds

This symbol shows strike
in the dip direction
i.e. 90 degrees clockwise
away from correct orientation

Very good outcrop line; not many dip-and-strike symbols;
i.e. good map-reading skills but less comfortable with compass(?)
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller

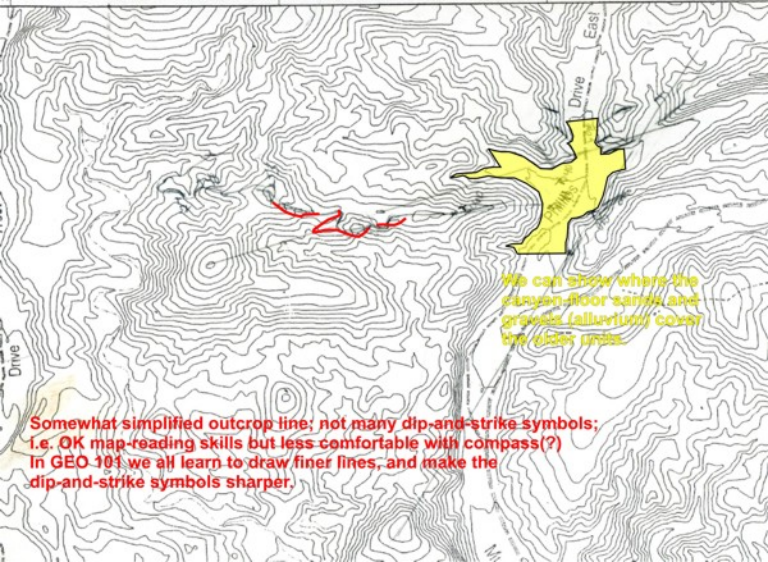


A topographic map showing contour lines and a geological outcrop line. The outcrop line is drawn in red and is annotated with a blue circle and a blue arrow pointing to it. The map includes labels for 'West Drive', 'Phillips Drive', and 'East Drive'.

Need dip-and-strike symbols here to show the two folds and the vertical beds

Good outcrop line; not many dip-and-strike symbols; i.e. good map-reading skills but less comfortable with compass(?)
In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller

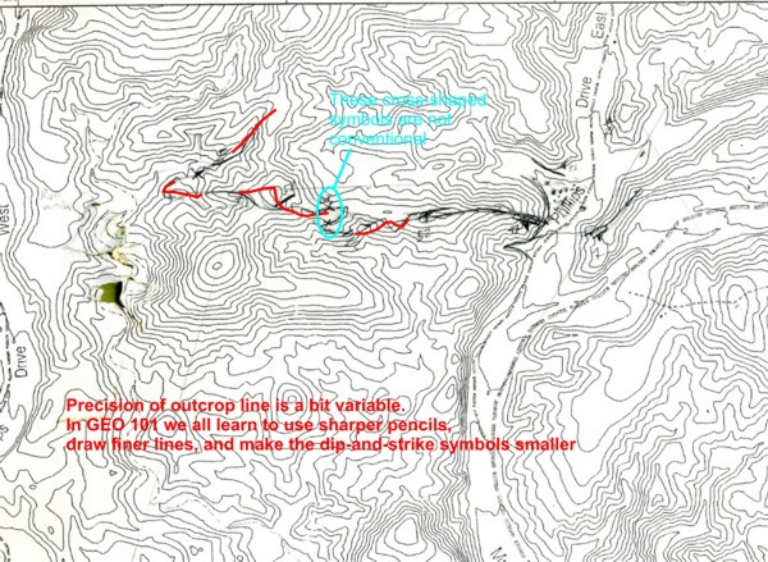




We can show where the canyon-floor sands and gravels (alluvium) cover the older units.

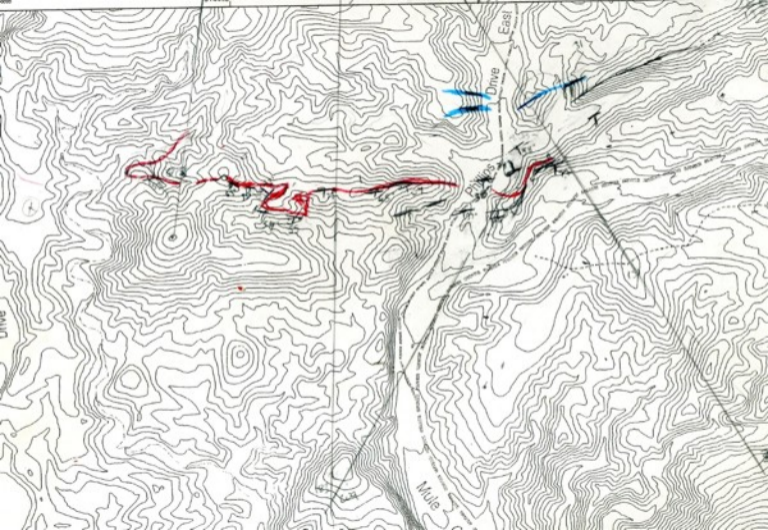
Somewhat simplified outcrop line; not many dip-and-strike symbols; i.e. OK map-reading skills but less comfortable with compass(?) In GEO 101 we all learn to draw finer lines, and make the dip-and-strike symbols sharper.

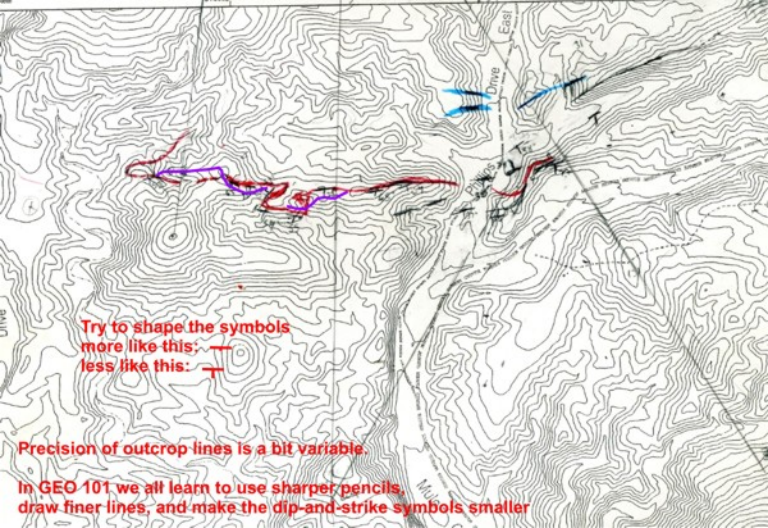




These cross shaped symbols are not conventional

Precision of outcrop line is a bit variable. In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller

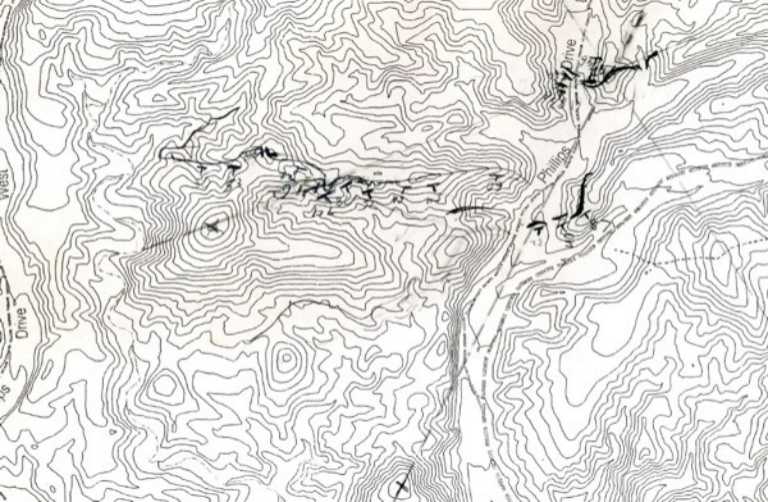




Try to shape the symbols
more like this: 
less like this: 

Precision of outcrop lines is a bit variable.

In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller



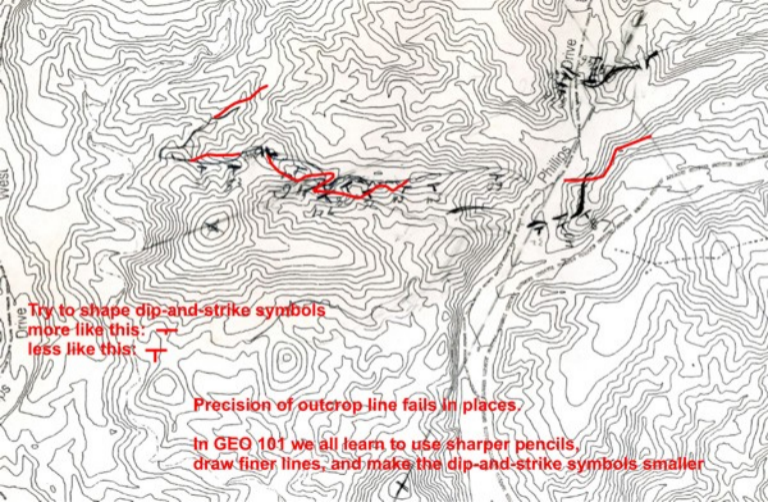
West

Drive

Phillips

Phillips Drive



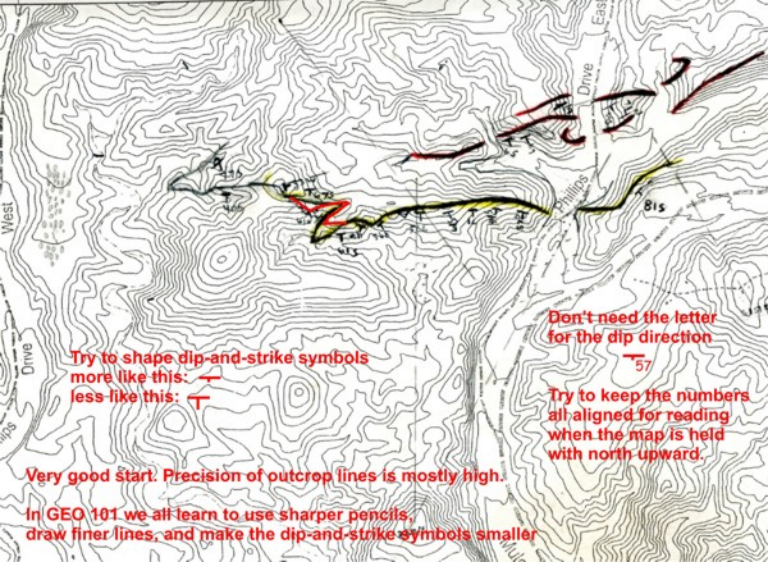


Try to shape dip-and-strike symbols
more like this: 
less like this: 

Precision of outcrop line fails in places.

In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller





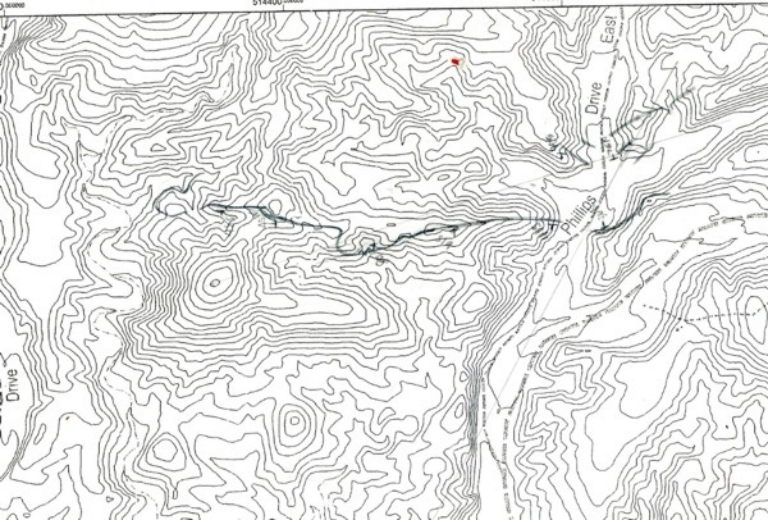
Try to shape dip-and-strike symbols more like this:  less like this: 

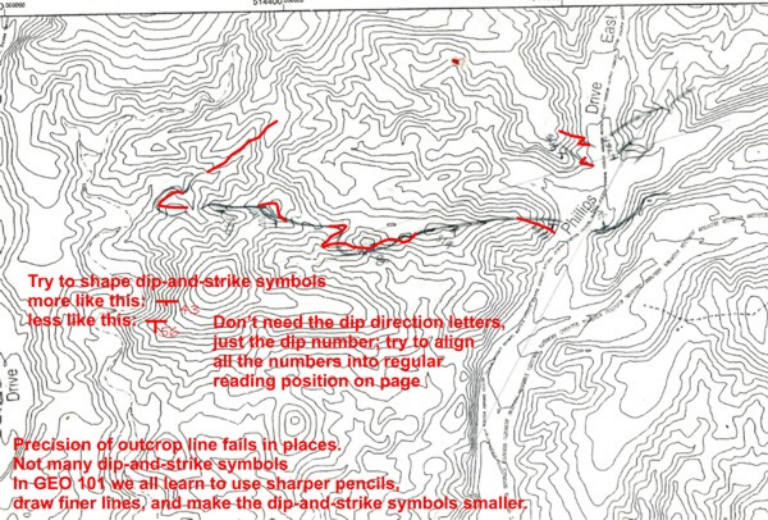
Don't need the letter for the dip direction 

Try to keep the numbers all aligned for reading when the map is held with north upward.

Very good start. Precision of outcrop lines is mostly high.

In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller

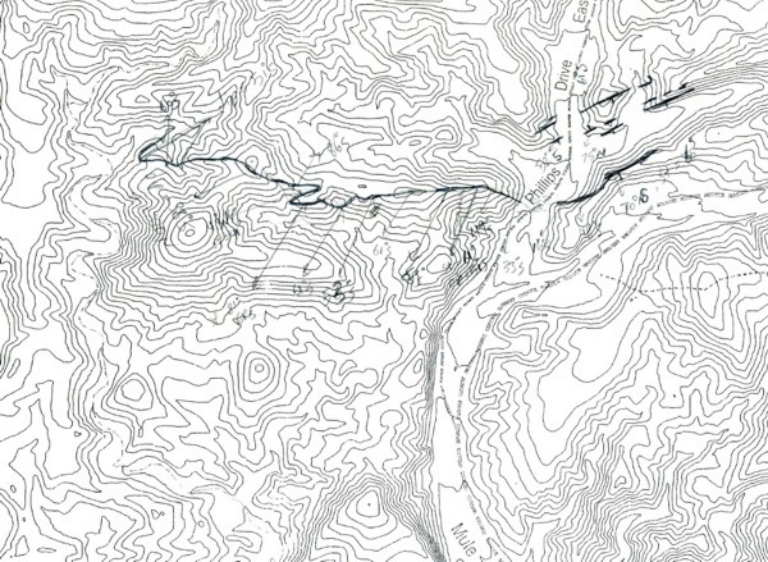




Try to shape dip-and-strike symbols
more like this: 
less like this: 

Don't need the dip direction letters,
just the dip number; try to align
all the numbers into regular
reading position on page

Precision of outcrop line fails in places.
Not many dip-and-strike symbols
In GEO 101 we all learn to use sharper pencils,
draw finer lines, and make the dip-and-strike symbols smaller.



A topographic map showing contour lines and several geological outcrop symbols. The symbols are T-shaped with a horizontal bar on top and a vertical stem. Some symbols have numbers written next to them, such as 43, 56, 63, 65, 70, 75, and 80. A road labeled 'Phillips Drive' runs vertically through the center. A dashed line labeled 'Eas' is also visible. Hand-drawn lines connect some of the symbols to the contour lines they represent. Annotations in red text provide instructions on how to draw these symbols and how to place them on the map.

Try to shape dip-and-strike symbols

more like this: 

less like this: 

Don't need the dip direction letters,
just the dip number; try to align
all the numbers into regular
reading position on page

Very good outcrop placement.

Unconventional dip-and-strike symbols

In GEO 101 we all learn to use sharper pencils,

draw finer lines, and make the dip-and-strike symbols smaller.



West

Drive

Phillips

Drive

East

Need more dip-and-strike symbols here to show the impact of the two folds that make the Z-shaped outcrop.

Try to shape dip-and-strike symbols more like this:

less like this:

Don't need the dip direction letters, just the dip number; try to align all the numbers into regular reading position on page

Good precision of outcrop placement. In GEO 101 we all learn to use sharper pencils, draw finer lines, and make the dip-and-strike symbols smaller.

GEO 116
Winter 2014
Instructor: Abhijit Ghosh
Assessment of Learning Outcomes

Course description:

This upper division undergraduate course teaches the fundamentals of structural geology. It spans a fairly broad spectrum of structural geology with the aid of quantitative, qualitative as well as field methods. The class meets twice a week. Each class has a lecture components followed by a laboratory activity. Lectures are focused on providing the fundamentals of the subject matter including theoretical concepts on which the lab activities are based. The lab activities concentrate on the application of the concepts, analysis skill and critical thinking. The course assessment is based on 14 laboratory activities, a class project, two midterms, and a final exam. Midterm and final exams are divided into two parts: one based on lectures (mainly theory) and the other based on lab activities (mainly applications).

Assessment method:

Learning outcomes (LOs) is assessed by students' performance in the class project, and representative questions and problem sets in the final exam. There are 13 students initially registered for the class. By the end of the quarter, 9 students end up completing the course with numerical grade. This assessment is based on the performance of these 9 students. If a student receives 75% or more point in a particular assessment vehicle (class project, questions or problem set), it is considered to be a "satisfactory" performance. For assessing each LO, if 7 or more out of 9 students perform satisfactorily in this scale, the LO is assessed to be achieved at level that is considered as "good". The appendix provides the details of each assessment vehicle used.

Class grade:

Out of 9 students, 5 received "A", 3 received "B" and 1 student failed.

Midterm 1 median: 82.5%

Midterm 2 median: 74.5%

Lab median: 94.3%

Class project median: 100%

Final exam median: 90%

LOs and assessments:

Below is a list of LOs for this course. Each LO is followed by the Earth Science LOs (ESLOs) it helps achieve, the assessment vehicle used, students' performance, assessment result, and planned measures when necessary.

1. Students will be able to understand and apply the concepts of stress and strain, and their mathematical and graphical representation

ESLO 1 and 4

Lab Final, problem 1

9 out of 9 students satisfactorily answer this question.

LO assessment is "good"

2. Students will be able to use Mohr circle to represent the state of stress and quantitatively solve problems related to rock failure

ESLO 1

Lecture Final, Q 3

7 out of 9 students satisfactorily answer this question.

LO assessment is "good"

3. Students will be able to identify structures in the field, field photos, diagrams, and/or sketches

ESLO 1, 2 and 4

Lecture Final, Q 9 (b)

9 out of 9 students satisfactorily answer this question.

LO assessment is "good"

4. Students will be able to use stereonet to plot different structural elements and solve problem related to structural geology

ESLO 2 and 4

Lab Final, problem 4

7 out of 9 students satisfactorily answer this question.

LO assessment is "good"

5. Given a state of stress, students will be able to predict the nature of deformation and vice versa

ESLO 1 and 4

Lecture Final, Q 4

8 out of 9 students satisfactorily answer this question.

LO assessment is "good"

6. Students will be able to understand and apply the concept of rheology and its implications on rock deformation

ESLO 1

Lecture Final, Q 6

5 out of 9 students satisfactorily answer this question.

LO assessment is below "good"

Steps planned: the lab devoted to rheology will be augmented to improve students' understanding of this specific topic

7. Student will develop the ability to understand and articulate fundamental concept, methodology, results and their implications as described in a high quality scientific article related to structural geology published in a peer-reviewed journal

ESLO 5

Class project and presentation
9 out of 9 students performed satisfactorily
LO assessment is “good”

8. Student will develop written and oral communication skills, and will be able to work effectively both individually and in groups.

ESLO 3

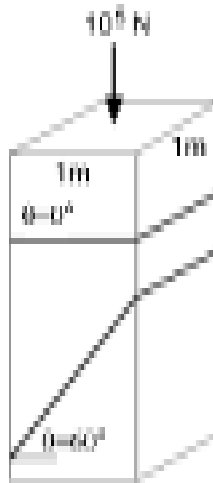
Class project and presentation
9 out of 9 students performed satisfactorily
LO assessment is “good”

Summary:

Learning outcomes are assessed via students’ performance in the class project, and questions and problem sets in the final exam. All but one learning outcomes are achieved at level that is considered to be “good” (7 or more out of 9 students perform satisfactorily). For the one (course LO # 6) that is assessed to be below the desired level (“good”), steps are planned and will be implemented to obtain better results in future.

Appendix

Lab final, problem 1:



- What are the resolved shear and normal forces (F_s , F_n) on the two surfaces?
- What are the areas of the two surfaces?
- What are the resolved shear and normal stresses that you obtain from the individually resolved forces and surface areas?

Lecture Final, Q 3:

Draw a Mohr circle and three fracture/failure criteria/envelopes we discussed in the class. Clearly mark each criterion/envelope, cohesive strength, tensile strength, and angle of internal friction.

Lecture Final, Q 9 (b):

Mark two parasitic folds in this photo (Figure 1) taken in Death Valley. What types (M, S, Z) of parasitic folds are they?



Figure 1: Folds at Death Valley.

Lab Final, problem 4:

Construct a stereonet plot based on the following data. Show the following; 1) the fault orientations, rake of the slickenlines, and slip direction, 2) the extension and shortening axes for each fault, and 3) list and show orientation of the three principal axes.

| Strike | Dip | Rake | Offset |
|--------|-----|------|--------|
| 195 | 65 | 85 | Normal |
| 358 | 62 | 84 | Normal |
| 349 | 59 | 77 | Normal |
| 355 | 76 | 75 | Normal |
| 202 | 72 | 76 | Normal |
| 346 | 60 | 85 | Normal |

| | | | |
|-----|-----|----|--------|
| 208 | 65 | 78 | Normal |
| 155 | 58E | 80 | Normal |
| 025 | 70W | 82 | Normal |
| 190 | 68 | 79 | Normal |

Lecture Final, Q 4:

Based on Anderson's classification of tectonic stress, draw diagrams of three different types of faults and corresponding orientations of principal stresses. Make sure to label them. At what kind of tectonic settings (subduction zone, mid-oceanic ridge, transform faults) would you expect to see each type of fault?

Lecture Final, Q 6:

Draw a diagram showing rheologic stratification of continental lithosphere based on a combination of the brittle friction law and the plastic flow law derived experimentally for quartz (quartzite) and feldspar (diabase). Considering the water content of the rocks are not necessary. Clearly mark and label the axes of the diagram.

Class project and presentation:

Students are asked to select a scientific article on structural geology published in a peer-reviewed journal. A broad theme and a set of articles are given by the instructor. Some papers are closely connected and often present contrasting views on similar topics. Students are encouraged to work as a group and coordinate with each other since the articles span a broad but overlapping spectrum of the given theme. Each student writes a one-page summary and makes a 15-minute class presentation based on the chosen article. Each presentation is followed by a 5-minute QA session. Students are graded based on their performance on the written summary and presentation.

Geology 118: Sedimentology and Stratigraphy
Spring 2014
Instructor: Andrey Bekker
Assessment of Learning Outcomes

In this upper-division undergraduate course, students learn basic foundations of sedimentology and stratigraphy; with laboratory exercises focused on identification of sedimentary rocks and minerals in hand samples and thin sections. The class met twice per week, on Tuesdays and Thursdays, with 50 minute-long lectures followed by almost 4 hour-long laboratory sessions. In addition, students had 1-day section-measuring exercise with Geo 101 in Calico Mountains, 1-day trip to the ocean coast (Salina Beach) to observe modern and ancient coastal settings and deposits, and 2-day fieldtrip to Death Valley focused on Neoproterozoic sedimentary successions. During the course of the quarter, students prepared term paper and made 15-min class presentations based on the topic researched. The course assessment is based on 8 laboratory activities, 1 measured section, a term paper and class presentation, one midterm, and final lab and lecture exams. Learning outcomes (Los) are assessed by students' performance on the term paper and exams. All students (9) registered for the class successfully finished with grades C+ and higher. This is a 5-credit hours course so the amount of course work corresponded to this level.

I found that the amount of time allocated to lecturing was not sufficient, whereas lab time was excessive. I used some of the lab time for lecturing, which was very efficient since the lab and lectures are scheduled back to back. Student attendance was pretty impressive; out of nine students only two students missed one field trip each. Although all lectures were posted on the Blackboard and the textbook was required, the mid-term and final exams showed that the students did not spend necessary time to study these teaching materials. The exams tested their understanding of basic concepts and independent thinking rather than memorization of specific information. I felt that teaching both sedimentology and stratigraphy in one-quarter class could be a challenge; they would have digested materials better if it was covered in two separate courses. I would be keen to split this course into process-oriented Sedimentology in the first quarter and Stratigraphy and Basin Analysis in the second quarter.

Since I was teaching this course for the first time and no institutional memory was left from teaching this class over the last 15-20 years, I had to go back to labs designed 20-25 years ago. Materials for labs were shuffled and it was a struggle to put labs together. Marilyn helped tremendously to get lab materials sorted, but I need to continue developing labs in the following years to build meaningful exercises. I expect that the number of lab will gradually increase in future, and I hope it would motivate students to read the textbook and other teaching materials. It will place higher demand for TA's time to do grading. Notably, students were mostly unfamiliar with identification of main rock-forming minerals under microscope. I will probably have to include introductory laboratory to introduce major sedimentary minerals to them at the beginning of the quarter.

Fieldtrip to Death Valley has shown that most of our majors are not aware of physical demands for doing fieldwork. I will have to explain in more detail expectations in future. One student attended in tennis shoes, another was carrying an across the shoulder bag and a jar of water in his hand. More than half of students were not able to complete rather short hike on the first day. I would like to make this fieldtrip to Death Valley in future longer, possibly 4 days long, and earlier in the quarter before heat picks up there. If we could free Fridays and Mondays from teaching classes for our majors, it would make it possible without jeopardizing their attendance in other classes. I would like to include simple exercises into this longer fieldtrip, such as a selection of stratigraphic section based on maps and outcrop, and later on logging this section in detail. It would make the trip to Calico Mountains unnecessary, but would add a practical component to the trip to Death Valley. I was not too impressed with the trip to Salina Beach; I think I will take students to other coastal area in the future. Outcrops were partially plastered in this area, making this trip less educational.

Having students presenting and writing a term paper was a useful educational exercise, but I realize now that much more instruction should be given to explain expectations for professional paper and presentation. Notably, almost all students were unfamiliar how to reference papers, to support their statements with literature sources, and to write a focused research paper. Clearly, their writing skills did not evolve beyond high school. More emphasis should be placed on teaching them drafting skills, three-dimensional visualization, and improving their handwriting. It is not only critical to make sure that an instructor can fully understand and grade their work, but it is also a part of being professional geologist: notes are taken in the field and should be readable years later.

At the end, students realized the value of practical application of this course and were enthusiastic about attending and learning. They did learn how to identify major sedimentary minerals and rocks, sedimentary structures, and stacking of lithologies into cycles. Additional course, reviewing the same foundations and taking them to a higher level, would dramatically enhance their understanding of Sedimentary Geology.

Below I assess class success in achieving the targeted Earth Sciences Learning Outcomes and criteria used in my assessment.

Knowledge

1. *Graduates will have mastered a broad set of topics in Earth Sciences, including fundamentals of the earth's composition, history, physical state, climate, and the evolution and persistence of life. ESLO 1.*

Assessments: **Good** [Assessment vehicle: midterm and final lecture exams; see several examples used in the assessment from the final exam; most students performed above 50% on these questions]

In general, evolutionary turnaround (speciation vs. extinction) was faster in marine or terrestrial realm? Why do you think it was a case? (4 points).

Fossils are widely used for biostratigraphic correlations. To be useful for this, what criteria should they satisfy? (4 points).

What geological events can be used for event stratigraphy? List them and briefly discuss their spatial extent. (4 points)

Draw profiles of carbonate platforms showing difference between rimmed and ramped carbonate platforms. Which of these two carbonate platforms has a barrier reef and an extensive lagoon? Which of them has a steeper slope? (6 points)

Skills

- 2. Graduates will have acquired both cutting-edge and classical skills in field, laboratory, and computer/analytical techniques in the Earth Sciences. EOSL 2*

Assessments: **Good** [Assessment vehicle: term paper; presentation of term paper to the class; group projects: 8 laboratory activities, measured section, field trips; midterm lecture exam, final lab and lecture exams. All students successfully performed]

- 3. Graduates will have mastered written and oral communication skills, and will be able to work effectively both individually and in groups. EOSL 3*

Assessments: **Good** [Assessment vehicle: term paper; presentation of term paper to the class; group projects: 8 laboratory activities, measured section, field trips. All students successfully performed]

Reasoning

- 4. Graduates will be able to apply, synthesize, and evaluate their knowledge and skills to solve novel problems in the Earth Sciences over a wide range of spatial and temporal scales. ESLO 4.*

Assessments: **Fair to Good** [Assessment vehicle: two questions on final exam; see below. About half of students successfully responded to them]

Where do you expect to find the carbonate compensation depth to be shallower: at low or high latitudes considering higher surface temperature at low latitudes and all other factors being equal? Explain your reasoning. (4 points).

What are geochemical tools for correlation of carbonates lacking fossils? Think about the field of chemostratigraphy. (4 points).

5. *Graduates will demonstrate the ability to understand and articulate a science-based view of Earth processes. ESLO 5.*

Assessments: **Good** [Assessment vehicle: question on final exam; see below. All students successfully responded to it]

Explain possible relationship among high $p\text{CO}_2$ level, high sea level, high chemical weathering rate, ocean anoxia, and breakup of the supercontinent. (4 points).

6. *Graduates will be able to use their knowledge and skills to make sound economic and policy decisions in both the personal and public spheres. ESLO 6.*

Assessments: **Good** [Assessment vehicle: question on final exam; see below. All students successfully responded to it]

What are mineral deposits hosted in sedimentary rocks? Name few of these major deposit types. (4 points).

GEO151 Learning Outcomes Assessment, 2013-2014. Fall 2013. Instructor: Nigel Hughes; TA: Tracy Thompson

GEO151 Specific course goals and their alignment to Department Learning outcomes

A series of course-specific goals were outlined in the syllabus that aimed to be consistent with Departmental Learning Outcomes. These included:

1. Students will be able to identify the morphological features of the common skeletonized fossil groups so as to identify them to taxonomic level of Order or below without consulting references. (Addresses Departmental Learning Outcomes 1,2, and 4).
2. Students will be able to make inferences about the stratigraphic age of the fossils based on an understanding of their taxonomic identity. (Learning Outcomes 1,2 and 4).
3. Students will be able to interpret the lifestyles of fossil organisms based on their morphological features and make reasoned inferences about the environmental conditions in which the fossils lived. (Learning Outcomes 1,2 and 4).
4. Students will be able show how fossils provide varied lines of support for evolution and for past global change. (Learning Outcome 4).
5. Students will be able to collect specimens in the field using proper protocols and write up their findings. (Learning Outcome 2).
6. Students will be able to draw logs of stratigraphic sections and record associated paleontological data. (Learning Outcomes 2 and 3).
7. Students will be able to use keys to identify fossils to species-level. (Learning Outcomes 1, 2 and 4).
8. Students will be able to make evidence-based arguments about paleontological topics, and convey them in writing. (Learning Outcome 3).

Results

Assessing success in meeting the Learning Outcomes required different methods of evaluation, as some of these related to field skills, others to those in the lab, and others still to written assignments/exams. Below I outline how each goal was

assessed and the result. Some outcomes were evaluated using more than one assessment.

1. *Students will be able to identify the morphological features of the common skeletonized fossil groups so as to identify them to taxonomic level of Order or below without consulting references. (Learning Outcomes 1,2 and 4).*

Basis of evaluation: Lab Final Question F - What does each of the bead-like structures represent in this fossil? **What kind of organism made it** and what sort of lifestyle did this organism pursue? Is this certain to be a Paleozoic fossil?

27% of the class was able to correctly identify this organism to the taxonomic level of Order.

Comment: This level of recognition is poor because the students had seen this specimen in labs during the class (albeit in the first class). The result suggests that many students are retaining rather little of the information that they have conducted exercises on in weekly lab classes.

2. *Students will be able to make inferences about the stratigraphic age of the fossils based on an understanding of their taxonomic identity. (Learning Outcomes 1,2 and 4).*

Basis of evaluation: Lab Final Question C - What are the white lines that you see on the surface of this fossil? Why are they different on the two sides of this slab? What kind of organism do they belong to, and what function did these structures provide for the animal? What does the black material between the white lines represent? **Which era is this specimen likely to have come from: Paleozoic, Mesozoic, or Cenozoic?**

57% of the class was able to correctly identify the correct stratigraphic age for this organism.

Comment: This level of recognition is also poor when it is considered that the students had seen this specimen in labs during the class. The results suggests that many students are retaining little of the information that they have conducted exercises on in weekly lab classes.

3. *Students will be able to interpret the lifestyles of fossil organisms based on their morphological features and make reasoned inferences about the environmental conditions in which the fossils lived. (Learning Outcomes 1,2 and 4).*

Basis of evaluation: Lab Final Question B - Draw a labeled sketch of these specimen, with several different views if necessary, to illustrate the key morphological features. Label these features. Key features are the mouth, the anus, the plastron, and the ambulacral plates. What kind of organism was this fossil? **What can we infer about its life habit from looking at its form?** Is this specimen likely to have lived in the Paleozoic?

63% of the class was able to correctly interpret the lifestyle of this organism.

Comment: Although of the ability to recognize the lifestyle of this animal was improved, this is an example of fossil form whose adaptive significance was discussed both in class and in the lab. Better understanding of the material was thus expected.

4. Students will be able show how fossils provide varied lines of support for evolution and for past global change. (Learning Outcome 4).

Assessment 1. Knowledge base

Basis of evaluation: Final Multiple Choice Question C –

The short-term and long-term evolutionary rates observed for morphological characters indicate that:

- a. Evolution occurs at a constant rate across all measured timescales.
- b. The fossil record often shows evidence of rapid morphological change.
- c. Evolutionary rates are random with respect to time.
- d. The fossil record is highly incomplete.
- e. Evolutionary rates decline in proportion to the interval over which they are measured.

5/22 students (22%) answered this correctly.

Comment: This question related to a topic covered in the lectures in some depth. It is conceptually demanding. There was a strong correlation between those who scored well in this question and overall grade in the class suggesting that the brighter students did grasp this concept. None-the-less, overall the result is not encouraging.

Basis of evaluation: Final Multiple Choice Question D –

The evolutionarily basal deuterostome is thought to have been:

- a. A colonial animal with a tube connecting the individuals together.
- b. A primitive echinoderm
- c. Made entirely of collagen
- d. An animal with an anterior pharynx and a segmented posterior region
- e. The first animal with a backbone

11/22 (50%) of students answered this correctly.

Comment: This question related to a topic covered in the lectures in some depth. It is conceptually relatively straight forward, and requires only modest revision with the information available on powerpoint slides. Given this, the low success rate is disappointing.

Assessment 2. Articulation of knowledge

Basis of evaluation: Final Short Answer Question 1 -

Outline the variety of ways in which your knowledge of fossils supports an evolutionary explanation for the history of life on Earth.

One of the options for essay question. 11 out of 22 students opted for this essay. Mean score of those students: 37/50 (74%). Only three students scored above 45/50 on this essay.

Comment: This essay was generally selected by weaker students in the class, who struggled with concepts such as phylogenetics. Several of the biology students chose this question, writing rambling essays that did not focus on the topic at hand, i.e. fossil evidence. There were some good essays.

Assessment 3. Articulation of reasoning

Basis of evaluation: Final Short Answer Question 1 -

How does a scientific approach to understanding the history of life on Earth differ fundamentally from non science-based alternatives? What are the fundamental principles of a science-based interpretation of the past? (10 marks)

Mean score of 7.3/10 marks (73%) for 22 students answering, with 5 students scoring 9/10, 6 scoring 8/10, 3 scoring 7/10, 6 scoring 6/10, and 5/10 or below.

Comment: This question required students to synthesize and go a little beyond what they had addressed in class. A wide range of responses ensued, some of which were very encouraging.

5. Students will be able to collect specimens in the field using proper protocols and write up their findings. (Learning Outcome 2).

Basis of evaluation: Field trip. Observations of students in field, and field report: 100% of students were able to collect and label specimens in field.

Comment: 100% of students were engaging in the field activities and put effort into it.

6. Students will be able to draw logs of stratigraphic sections and record associated paleontological data. (Learning Outcomes 2 and 3).

Basis of evaluation: Field trip. 100% of students were able to draw logs in some fashion. 18 out of 23 (78%) were able to produce logs that met minimal satisfactory standards in conveying the basic information requested.

Comment: The exercise was successful in training students in this skill.

7. Students will be able to use keys to identify fossils to species-level. (Learning Outcomes 1, 2 and 4).

Basis of evaluation: Field trip. Drawing of fossil and labeling of key diagnostic features in field report. 20 out of 23 (86%) were able to identify fossils correctly with a key provided.

Comment: The exercise was successful in training students in this skill.

8. Students will be able to make evidence-based arguments about paleontological topics, and convey them in writing. (Learning Outcome 3).

Basis of evaluation: Field trip. Field report: 10/23 students wrote an interpretive essay in field report scored 90 or over, 9 students scored between 80-89, 4 students below 79.

Comment: Most students showed competent acquisition field skills and reasonable understanding of the geological context and evolution of the locality and of the fossils within it.

Basis of evaluation: Final Multiple Choice Question A –

Describe how scientists use the phylogenetic method (also known as cladistics) to explore how organisms are related to each other.

17 out of 22 students attempted this question on the Final. The mean grade was 43.5/50 (86.7%), with 7 students scoring greater than 45/50, 8 scoring between 40-45/50, and 2 below 40.

Comment: This question related to material presented in class and for which there was a class exercise involving manual and demonstrated computer assisted analysis. The rather higher mean on this essay than that concerning the fossil record of evolution reflects both the fact that this topic was present in class a relatively discrete unit, whereas to answer the question on evolution well required a synthetic approach.

Overall Commentary on the Results

Overall the assessment suggests rather disappointing success in the meeting class goals, particularly with regard to the majority of students in the class. Nevertheless some students did exceptionally well, and the course received notably strong evaluations. This is an upper division class that in some ways

reinforces material presented in the core lower division class GEO003. It is therefore discouraging to learn that retention of information on fossil form and function is sparse, despite exposure to these topics in regular labs and in the field, with some knowledge reinforcing information and skills supposedly acquired earlier in the degree. Some of the performance in the class reflects the presence of biology undergraduates who have often had little or no familiarity with fossil material beforehand.

Suggested improvements for the future:

1. Coordination with GEO003 on what is taught in the labs in that class, and what level of expectation can be expected.
2. A more coordinated use of the textbook as required resource for lab classes.
3. Introduction of “pair-share” active learning exercises in labs and lecture.
4. Consider introduction of a term paper on fossil evidence for evolution.

GEO 160 Global Climate Change
2014 Learning Outcome Assessment
Instructor: Robert J. Allen

GEO 160 is an introduction to fundamental aspects of modern-day climate change. About 75% of the students who take the course are geology majors; the other ~25% are environmental science majors. The primary goals of the course are to develop an understanding of how and why climate is changing, and the physical basis behind that change. Additional themes including the role of humans in causing recent climate change, future rates and impacts of global warming, and climate change responses, including adaptation, mitigation, and geoengineering. The scientific assessments of climate change are also discussed, including the IPCC's Summary for Policy Makers. Students are evaluated based on weekly problem sets, weekly discussion sections and two exams.

Problem Sets

Problem sets involve a mix of question formats, including calculations, diagram/figure interpretation, and short answer. Most assignments involve the use of an on-line numerical model, allowing students to become familiar with a hierarchy of models including radiative transfer models, carbon cycle models and global climate models. Problem sets therefore address learning outcomes (LO) 1 “Mastery of Fundamental (Climate) Knowledge”, and LO2 “Development of Computer/Analytical Techniques”. To a lesser extent, problem sets also evaluate LO3 “Mastery of Written Communication Skills”. Several example problem set questions are included in Appendix A.

Overall, student performance on problem sets is very high (Table 1), with class averages in the A to B range. I was particularly pleased with the most recent group of students (Winter 2014). Much of this improvement seems to be related to motivation and proactivity—nearly all students in 2014 attended office hours on a regular basis.

Table 1. Average class scores on problem sets, exams and discussion presentation for 2012-2014.

| | 2012 | 2013 | 2014 |
|---------------------|-------------|-------------|-------------|
| # Students | 14 | 18 | 6 |
| Problem Sets | 82.2 | 89.6 | 97.5 |
| Exams | 69.3 | 66.7 | 78.0 |
| Discussion | N/A | 93.4 | 100.0 |

Exams

Exam questions emphasize critical and logical reasoning skills, in addition to mastery of standard definitions and concepts. Similar to problem sets, exams involve a mix of question formats, including multiple choice, true/false, fill-in-the-blank, calculations, diagram/figure interpretation, and short answer. Exams emphasize the aforementioned

LO1 and LO2, in addition to LO4 “Reasoning and Application of Knowledge”. Appendix B lists several example exam questions for each of these learning outcomes.

Table 1 shows that exam scores tend to be much lower than problem sets scores. This is to be expected, since students can work together on problem sets and students can meet with me to discuss problem set questions. Exams tend to be more difficult because I emphasize LO4, application and synthesis of knowledge. This is clearly a more difficult skill to master compared to definitions and concepts.

Discussion Section

During the first 3-4 weeks, discussion section focuses on the text “*The Discovery of Global Warming*”, which presents an in-depth history of the discovery of global warming. Later in the quarter, additional readings come from popular science magazines including Nature, Science, Physics Today and Scientific American. Topics include renewable energy (“*Electricity Without Carbon*”), geoengineering (“*Is This What it Takes to Save the World*”), and mitigation (“*Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*”). Discussion section also addresses more general topics, including what science is, the scientific method, and scientific consensus (“*Aliens Cause Global Warming*”) and societal reactions to scientific discoveries (“*Science Controversies Past and Present*”). Appendix C includes an example discussion section.

Discussion section assesses LO3 & LO5, including “Oral Communication Skills”, “Ability to Work in Groups”, and “Ability to Understand and Articulate Science”. In some discussion sections, students are organized into small groups. The groups discuss the paper for the first half of class, while I go from group to group and guide the conversation. The last half of class involves a general discussion of the reading by the entire class. The second format of discussion section is individual student-led. The individual leads the discussion with a prepared list of topics and discussion points, with guidance from me.

Students tend to do very well in discussion section, and we’ve had many interesting conversations in the three years I’ve taught the class. The main shortcoming is with quiet or shy individuals. But this is one of the goals of individual student-led discussions—to improve oral communication skills.

Summary

My overall assessment of learning outcomes 1-5 is positive. The main weakness is student performance on exams, particularly related to questions designed to evaluate LO4 “Reasoning and Application of Knowledge”. This is, however, one of the more difficult learning outcomes to master.

Appendix A: Example Problem Set Questions

Example Problem Set Questions Evaluating Climate Knowledge and Written Communication Skills

(Assessment of LO1 & LO3)

1. One argument you hear against mainstream climate science is that adding greenhouse gases to the atmosphere is like painting a window. Eventually, the window is opaque so that adding another coat of paint does nothing. Is this a good analogy? Is there a point where adding greenhouse gases to the atmosphere does not lead to increases in the planet's temperature?
2. Weather is predictable no more than a week in advance, while climate is predictable decades in advance. Is this a paradox? How is it resolved?
3. Your aunt asks you how we know that humans are responsible for the increase in atmospheric CO₂. Couldn't it be due to volcanoes? Or could it be coming from plants? What do you tell her?
4. Of the CO₂ humans add to the climate, approximately half is removed within a year. Where does it go? How would it affect climate if, all of the sudden, all of the CO₂ we emit stayed in the atmosphere?

Example Problem Set Question Involving the Use of a Numerical Model

(Assessment of LO2)

Water Vapor. Our theory of climate presumes that an increase in the temperature at ground level will lead to an increase in the outgoing IR energy flux at the top of the atmosphere. Go to <http://forecast.uchicago.edu/Projects/modtran.html>. The model takes CO₂ and CH₄ concentrations and other environmental variables as input, and calculates the outgoing IR light spectrum to space, similar to figures presented in lecture. The total energy flux from all IR light is listed as part of the model output.

(a) How much extra outgoing IR would you get by raising the temperature of the ground by one degree? What effect does the ground temperature have on the shape of the outgoing IR spectrum and why?

(b) More water can evaporate into warm air than cool air. By setting the model to hold the water vapor at constant relative humidity rather than constant vapor pressure (the default) calculate again the change in outgoing IR energy flux that accompanies a 1 degree temperature increase. Is it higher or lower? Does this make the earth more sensitive to CO₂ increases or less sensitive?

(c) Now see this effect in another way. Starting from a base case, record the total outgoing IR flux. Now increase $p\text{CO}_2$ by some significant amount, say 30 ppm. The IR flux goes down. Now, using the constant vapor pressure of water option, increase the Temperature Offset until you get the original IR flux back again. What is the change in T required? Now repeat the calculation but at constant relative humidity. Does the increase in CO_2 drive a bigger or smaller temperature change? This is the water vapor feedback.

Example Problem Set Questions Evaluating Quantitative Reasoning Skills

(Assessment of LO2)

1a. Hoover Dam produces 2×10^9 Watts of electricity. It is composed of 7×10^9 kg of concrete. Concrete requires 1 MJ of energy to produce per kg. How much energy did it take to produce the dam? How long is the “energy payback time” for the dam?

1b. The area of Lake Mead, formed by Hoover Dam, is 247 mi^2 . Assuming 250 W/m^2 of sunlight falls on Lake Mead, how much energy could you produce if instead of the lake you installed solar cells that were 12% efficient? How does this compare with the dam’s energy production?

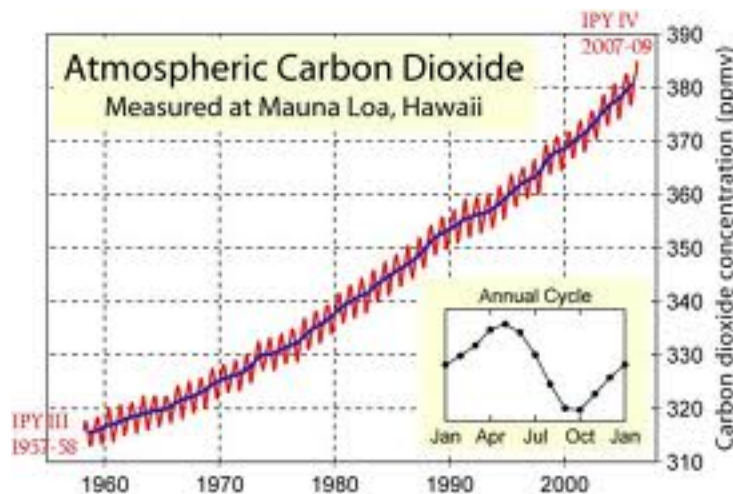
2. Assume the area of Greenland is two million square kilometers and the depth of the ice sheet is two kilometers. If this ice melted and flowed into the sea, by how much would sea level rise? Assume the surface area of the Earth’s oceans is about $2/3$ of the total surface area of the Earth.

Appendix B: Example Exam Questions

Example Exam Questions Evaluating Fundamental Knowledge

(Assessment of LO1)

1. How are isotopes used to show the increase in atmospheric CO₂ is due to fossil fuel combustion?
2. List Earth's four primary carbon reservoirs, ranking them in decreasing order of carbon storage. How have humans directly perturbed the carbon cycle?
3. With continued global warming, temperatures are not expected to rise uniformly across the globe.
 - (a) Why is there more warming at high latitudes than at low latitudes?
 - (b) Why will land warm more than ocean?
 - (c) Why do temperature contrasts (e.g., night versus day) decrease in a warmer climate?
4. The figure below shows the atmospheric concentration of CO₂ (in ppmv), measured at Mauna Loa, Hawaii, for the latter half of the 20th century.



- (a) What are the two main anthropogenic sources of CO₂ responsible for the increase shown in the figure?
- (b) In addition to the positive trend, there is a seasonal cycle. Explain what causes this.

(c) This is a very famous graph, the first to raise world attention to the possibility humans could have a significant impact on the atmosphere and climate. What is this plot called?

Example Exam Questions Evaluating Quantitative Reasoning Skills

(Assessment of LO2)

1a. Consider a planet with a one-layer atmosphere, a solar constant of 3000 W/m^2 and an albedo of 0.2. Draw the energy flow diagram and label each arrow with the value of the energy flow in W/m^2 . Derive an expression for the surface temperature of the planet.

1b. Consider a planet with a two-layer atmosphere, a solar constant of 3000 W/m^2 and an albedo of 0.2. A volcano goes off, and it makes the lower atmospheric layer absorb all visible radiation (the upper layer is unaffected). Both layers, as usual, absorb all infrared radiation. Draw the energy flow diagram below along with arrows for each energy flow, labeling each arrow with the value of the energy flow in W/m^2 . Derive an expression for the surface temperature of the planet.

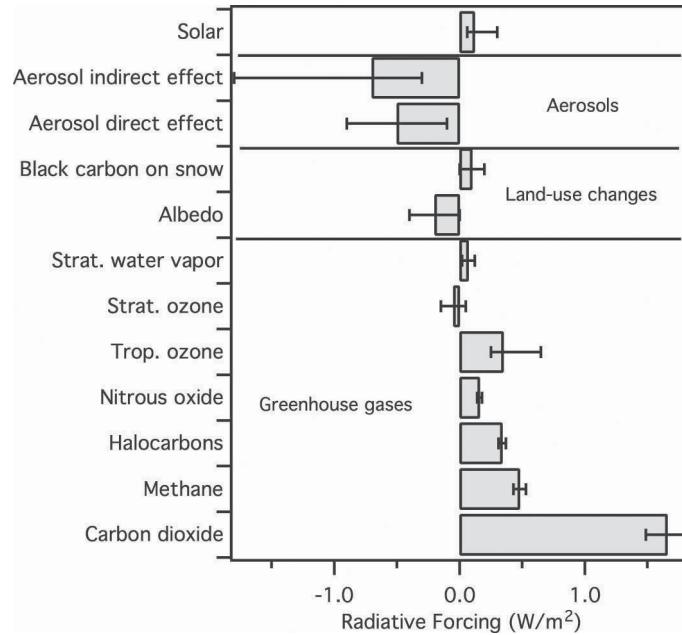
Example Exam Questions Evaluating Reasoning and Application of Knowledge

(Assessment of LO4)

1. It is often claimed that the high correlation between CO_2 and temperature in the polar ice core records proves the CO_2 theory of climate change. Critique this argument in 3-4 sentences.

2. Suppose human *emissions* of CO_2 could be instantaneously (a) frozen at current levels, (b) cut in half and then frozen, or (c) cut to zero permanently. Draw a curve of anticipated atmospheric CO_2 *concentration* vs. time, out a few thousand years, for each scenario. Show on your y-axis the position and magnitude of the current CO_2 mixing ratio and the preindustrial value. Which, if any, of these curves would become flat (no CO_2 change with time) within several thousands of years?

3. Throughout the quarter, we have discussed how aerosols have masked some of the GHG-induced global warming since pre-industrial times. Using the figure below, calculate the amount of cooling (in terms of equilibrium global average surface temperature) aerosols have caused. How much (as a percent) of the GHG-induced warming have aerosols offset? Assume a climate sensitivity $\lambda = 0.75^\circ\text{C}/\text{W}/\text{m}^2$.



Appendix C: Example Discussion Section Questions

Example Discussion Section Evaluating Oral Communication Skills, Ability to Work in Groups, and Ability to Understand and Articulate Science

(Assessment of LO3 & LO5)

Reading: “*Aliens Cause Global Warming*” by Michael Crichton

1. What is Crichton’s main point? Do you agree/disagree? Why?
2. How does second hand smoke and nuclear winter factor into Crichton’s argument? What about SETI and the Drake Equation?
3. What is meant by: A belief in Global Warming is similar to a belief in aliens?
4. Are the lines between science and policy becoming blurred? If so, what can we do to restore the lines?
5. Crichton argues: If no one believes a 12-hour weather forecast, why would we believe a 100-year climate prediction. Do you agree?
6. What does Crichton say about “scientific consensus”? Do you agree?
7. Do you think Crichton believed in Global Warming? Why or why not?



Appendix I-3: Meta-Assessment Rubric

Undergraduate Education (University of California, Riverside) Meta-Assessment of Department and Program Learning Outcomes (LOs)

Department _____

Date completed: _____

Circle or highlight the cell that is most applicable for this program.

| Element | Criteria | Emergent | Developed | Highly Developed |
|--|---|--|---|--|
| Articulation of Learning Outcomes (LOs) <input type="checkbox"/> Not Observed | LOs should be reasonable and appropriate for the degree level, and guided by disciplinary standards (if available). LOs should involve specific, active verbs with supporting details describing how students will demonstrate their learning, “analyze” or “solve”. Avoid verbs such as “know” or “understand”. | Outcomes are vague or incomplete; are not measurable or observable behaviors; are not aligned with program goals or mission. | Stated outcomes align with students’ knowledge, skills, or attitudes, as shaped by the program or academic discipline. | Outcomes are clear and well written; there are an appropriate number, are measurable, and they drive assessment for the department or program. Outcomes aligned with institutional goals or core competencies. |
| Assessment of Learning Outcomes (LOs) Using Evidence <input type="checkbox"/> Not Observed | Evidence should be aligned with LOs and discussed among faculty. Evidence collected at program-level, not at course- or student-level. Use of appropriate sampling of student work and direct evidence (e.g., theses or capstone projects), not simply grade distributions that do not align with specific LOs. | Assessment plan is not well developed, is mismatched with outcomes, or not implemented appropriately. Limited forms of evidence, poor sampling. Assessment completed by 1-2 faculty members, with minimal consultation from colleagues. Preliminary assessment of 1-2 learning outcomes. | Assessment is underway for most learning outcomes (at least 3), reviewing valid evidence from the program-level. Committee involvement and some consultation with program or department. | All of outcomes are assessed. Multiple forms of evidence collect at program-level (e.g., multiple classes, with careful sampling methodologies). Assessment plan is fully developed and implemented. Committee involvement, with regular consultation with program or department. |
| Analysis and Reporting <input type="checkbox"/> Not Observed | Reviewer(s) expectations are calibrated with LOs and program or departmental expectations. Multiple faculty involved in analyzing evidence. Results are presented clearly. Conclusions are evidence-based and align with curricular enhancement efforts. | Minimal analysis of outcomes. Evidence not systematically analyzed. Analysis completed by 1-2 faculty members, with minimal consultation from colleagues. Few evidence-based recommendations to improve departmental planning or program improvement. | Thorough analysis of quality of student work via direct evidence. Committee involvement and some consultation with program or department. Summary data are reported with evidence-based suggestions for departmental planning and curricular improvement. | Summary data are collected and carefully analyzed; analysis calibrated among reviewers. Solid recommendations for department planning or program improvement are driven by student evidence and regular assessment findings. Committee involvement, with regular consultation with program or department. |
| Multi-Year Assessment and Program Improvement <input type="checkbox"/> Not Observed | The program monitors and reports the impact of changes made from year to year, and uses these assessments to drive further improvement and planning over time. | Little discussion of prior year assessment activities. Minimal evidence that assessment data is used to drive change. Only 1-2 years of assessment completed thus far. | Analysis of recent has begun, with impact over multiple years; some committee oversight of assessment process. Multi-year assessment mapped with curriculum and program improvement. | Analysis of changes made in recent year(s) and their impact are further assessed and reported. Strong multi-year assessment plans and updated curriculum map. Broad faculty input to discuss assessment and its role in future planning and program improvement (as evidenced by department meetings and notes). |
| Addresses WASC Core Competency Quantitative Reasoning AY 2013-14 <input type="checkbox"/> Not Observed | Quantitative Reasoning definition: “Application of math skills to the analysis and interpretation of real world quantitative information.” LO(s) align WASC core competency and the logic of assessing core competencies in general. Careful review of major and general education requirements in relation to WASC core competency. Level of proficiency expected by graduation is defined by program or department. | There is no real connection or alignment, in either content or process, between LOs and WASC core competency. Minimal discussion of core competency and how it relates to discipline or graduation requirements. | There is some alignment between at least one LO and core competency. Assessment and analysis of relevant LO(s) have been conducted with some discussion, in relation to discipline and graduation requirements. For departments or programs that do not have quantitative major requirements, thoughtful discussion of how core competency is relevant to the discipline and graduation requirements. | There is clear and explicit alignment between LO(s) and WASC core competency; existing documentation could be used, essentially as is, to document assessment of WASC core competency. Thoughtful analysis and discussion, in relation to discipline and graduation requirements. |

General Education Requirements

Preparatory English and the Final Writing Course

As required by the Western Association of Schools and Colleges (WASC), UCR conducted an evaluation of general education during the last calendar year. Part of this evaluation focused on preparatory English and the English 1 series. We report here on the results of these studies.

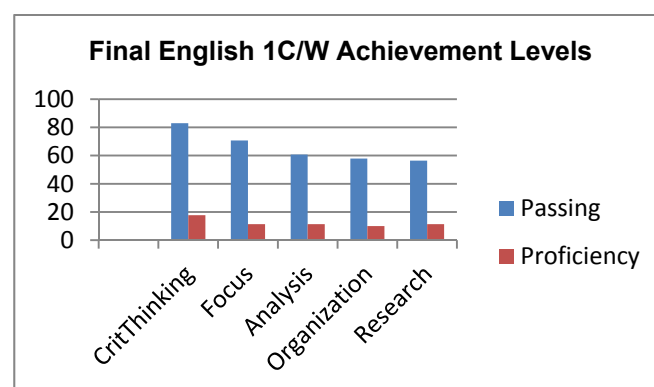
Students take an English language placement test, the Analytical Writing Placement Exam (AWPE), prior to matriculation. If they receive a failing score on the AWPE, they are placed into one of the preparatory English courses (Basic Writing 3, English 4, 5, or 1PA). About half of UCR freshmen place into preparatory English. If they receive a passing score, they are placed into the English 1 sequence (English 1A, 1B, and 1C). Three of UCR's undergraduate colleges have adopted writing-across-the-curriculum (W) courses as a substitute for English 1C.

Preparatory English Study. The preparatory English evaluation consisted of a comparison of the writing level of students prior to their enrollment in the preparatory English curriculum and at the time of their completion of their course in fall 2011. The study examined the writing of 75 randomly selected students (20 each from BSWT 3, English 4, and English 1PA, and 15 from English 5). Students scores on the placement examination were compared to their scores on final course papers using the same grading rubric developed for grading the AWPE. We trained readers on the rubric, and we found inter-rater reliability to be high. Two readers read and rated each essay, and a third rated the papers in the few cases of sizable disagreement between the first two readers.

All courses showed a significant increase in average essay scores. The average essay score in the placement exam for BSWT 3 students was 2.13 and their average score for their final exam essay was 2.81. English 4 students scored on average 3.03 on the placement test and 3.36 in their final exam essays. However, average final examination scores were still below passing (4) for all courses studies, according to the AWPE rubric. These low average scores indicate that many students

may need better preparation for passage into English 1. This evidence alone is not conclusive: it should be read together with other evidence from students' performance in preparatory English (e.g. 79.5% of students passed English 4 in fall 2012).

Final Writing Course Study. We randomly sampled 20 final papers for each English 1C and W course offered in AY 2011-12, 140 essays in all. We scored six areas: (1) critical thinking, (2) research, (3) analysis, (4) focus, (5) organization, and (6) style. Scores in each area ranged from 1 through 6. We achieved high alpha reliability scores between readers in each of the assessed areas. Again, we employed a third reader in cases of sizable disagreement between the first two readers. In the chart below, we show the percentage of students with passing levels (scores of 4 or higher) and clear proficiency levels (scores of 5 and 6) for five of the six assessed areas.



Mean scores hovered near 4 in all six measured areas. A majority of students in the study achieved satisfactory scores in critical thinking and focus. However, a majority of students did not achieve satisfactory scores in research, analysis, organization, or style. The scores of students in English 1C and W courses were not statistically distinguishable from one another. Students in some W courses performed better than English 1C students, and students in other W courses performed less well in particular scored areas. For the full report, see: http://ueeval.ucr.edu/uwp_evaluation_report_dec_12.pdf.

Appendix II-2: Report for the Senate Review of WAC

University Writing Program

December 3, 2013

TO: Ward Beyermann, Chair of the Committee on Educational Policy

FROM: John Briggs, Director of the University Writing Program
Kathleen Moore, UWP Associate Director and Coordinator of WAC

CC: Steve Brint, VPUE

RE: Senate Review of the program in Writing Across the Curriculum

We are now in the fourth full year of Writing Across the Curriculum (WAC), a pilot option for the third-quarter writing requirement approved by the UCR Academic Senate. In essence, the WAC legislation authorizes an optional track for students whose colleges permit them to substitute a Senate-approved writing-intensive “W” course for English 1C. WAC courses were to be called “W” courses once they were approved for that purpose by the Academic Senate. Students in participating colleges would have access to “W” courses once they passed English 1B with a grade of “C” or higher.

The legislation establishing the program stipulated that the Senate would commence its review of the program in the fourth year of its five-year authorization. Since the CEP has been designated by the Senate as the appropriate committee to begin that review, I am submitting this report, which supplements the materials I have already forwarded.

The implementation of WAC has necessarily entailed a number of administrative and pedagogical challenges:

- 1. The UWP faced the challenge of recruiting a substantial number of faculty, departments, and colleges interested in proposing “W” courses.**

Results: Since 2010, we have seen seventeen courses representing eleven departments (not counting cross-listings) achieve “W” status. Three of the four UCR colleges are now participating. The WAC program has grown 300% in the last three years. Although

CNAS has chosen not to participate, its executive committee has recently approved three informal WAC pilot courses, to be taught and assessed in the current academic year.

In all, seventeen faculty have worked with us and their departments to submit the requisite proposals to the Academic Senate. All but four of those courses have been offered at least once, some numerous times. We expect some of the unoffered courses to be available next year. By the end of this academic year, the WAC program will have enrolled, since 2010, approximately 8,000 students, over three thousand of them this year.

WAC courses: ANTH 1W, BUS 100W, CHN 46W, CPLT 1W, CPLT 40W, DNCE 7W, ENGL 102W, HIST 10W, HIST 20W, HIST 99W, PHIL 3W, POSC 5W, POSC 10W, RLST 7W, RLST 12W. **Syllabi for a number of these courses will be sent as attachments to a following e-mail.** As part of its assessment of WAC, the CPE might wish to speak directly with faculty who have offered “W” courses: Perry Link, Jens Giersdorf, Lynda Bell, David Biggs, Sherri Johnson, Paul Beehler, Juliette Levy, John Laursen, Kim Devlin, Andrea Denny-Brown, Farah Godrej, and in S. Burton and B. Graham, who jointly teach ENGR 180W.

CNAS Pilot Courses (writing-intensive courses along the lines of WAC but not official WAC courses): PHYS 142L, BIO 178, BIO 110

2. The UWP established a support structure for those courses:

- **advice and assistance to “W” course faculty;**

Results: The UWP has worked closely with faculty members, their departments, and their college executive committees to ensure that course proposals and syllabi followed Senate requirements. The program has also consulted extensively with participating faculty as they were preparing their courses for the upcoming quarter, and during the quarter – sometimes on a weekly basis.

- **significant supplemental financial support for “W”-course TAs;**

Results: The UWP has provided all TA support costs for 50% of the course discussion leaders when the student/TA ratio approximates 50:1.

- **assignment-based workshops for all “W” students;**

Results: At no cost to the participating department, the UWP has set up and funded assignment-based workshops for all “W” students according to arrangements with the “W”-course faculty in charge. The leaders of the

workshops are UWP-trained TAs from the writing program, who attend the lectures and consult with “W”-course discussion TAs and WAC directors every week in English 302 (03).

The workshops focuses on particular assignments in specific courses. Sign-ups for workshop groups of fifteen undergraduates each are carried out electronically, with great efficiency. 90% or more of the students attend their requisite workshops. Last year we offered approximately five hundred workshops.

- **tutorial assistance provided by well-trained peer tutors;**

Results: The UWP has recruited, trained, and supervised outstanding peer tutors, who meet with “W” course students on a drop-in basis. Sign-ups for appointments are managed electronically.

- **TA training in sections of English 302 for each “W” course’s TA discussion leaders.**

Results: The UWP has conducted mandatory course-specific weekly training sessions in various sections of English 302 for all “W”-course TAs. Last year we held over one hundred 50-minute meetings with “W”-course TAs.

3. The UWP faced the challenge of providing a rapidly growing number of WAC seats for students to accommodate student demand. The need for seats was compounded by the fact that over the last half decade the administration’s funding for English 1C has usually been limited to sections for seniors.

Results: 80-90% of student demand for “W” courses is now met before the senior year. Sophomores make up the largest cohort in those classes. Seniors who have not satisfied the requirement are accommodated in English 1C if their college does not permit them to take a “W” course for third-quarter writing credit. Appendix B at the end of this document shows the increase since Fall 2010 in WAC seats available to satisfy the third-quarter writing requirement. (For an account of how CNAS students are faring, see section 4 below.)

At the completion of the current academic year (2013-2014), WAC seat totals and the number of students eligible to take “W” courses will be close to equilibrium: the number of students who enter UCR each year in colleges that give them the “W” option will approximate the number of WAC seats. This year the growth of the number of students beginning their senior year without taking a “W” course or English 1C will level out at around 700-900 students. (See Chart #2.) Around 50% of those students are expected to take a “W” course or English 1C during the regular academic year. 35% will likely take 1C during the summer. The remaining 15% will take a “W” or 1C course in the following year when many seniors opt to take the remainder of their programs. (Despite

the fact that we leave open seats for them throughout the registration period, many seniors do not take English 1C the first few quarters they are eligible.)

4. CNAS students' access to English 1C:

Results: For the last three and a half years, CNAS students have been satisfying the third-quarter writing requirement as seniors in English 1C, or at various class levels in summer school. (CNAS students make up approximately 40% of the 1C enrollment, a percentage ten points above their proportion of the undergraduate enrollment.) If we compare this pattern to the period before the WAC program was established and the administration's limitation of funding for 1C except for seniors, we see that CNAS students are now satisfying the requirement at a later point in their academic careers. According to the UWP's projections, CNAS demand for English 1C at the end of the 2012-2013 year and (as projected) at the end of the 2013-2014 year is distributed in the following categories*:

| | <u>2012-2013</u> | <u>2013-2014</u> |
|------------|------------------|------------------|
| Freshmen | 390 | 556 |
| Sophomores | 797 | 880 |
| Juniors | 582 | 654 |
| Seniors | 104 | 240 |
| Total: | 1873 | 2330 |

*Class status at the end of the academic year

CNAS Pilots for WAC Courses

The slow but persistent float toward the senior year of many CNAS students needing English 1C might be alleviated in future years if CNAS were to open the WAC option for at least some of its students. The CNAS Executive Committee has recently approved an experiment with three pilot CNAS writing-intensive courses to be offered this year. The results of that trial will be useful in the committee's deliberation over whether to open the WAC option for CNAS students. English 1C will continue to be available to CNAS seniors.

5. **One of the goals of WAC was to encourage the development of "W" courses for majors in particular departments. It was thought that although WAC courses would be valuable for everyone, they would be of special value to students who took writing-intensive courses that challenged them to become better writers in their chosen disciplines.**

Results: Approximately one thousand seats (one third of WAC enrollment) are now available in courses required of majors and offered in their own departments: BUS 100W, ENGR 180W (for selected majors in Engineering), ENGL 102W, and HIST 99W. The other WAC seats are available to students fulfilling breadth requirements or exploring electives.

6. The UWP and the Senate, working with participating faculty, were given the responsibility to make WAC courses comparable to English 1C in terms of rigor, general expectations for writing, and results.

Amount of Writing: The Senate approval process, including the work of the Committee on Courses, is based on the WAC legislation's guidelines for "W" courses (See Appendix A below). The idea is to approximate or exceed the IGETSE norm for third-quarter writing requirement: 5,000 words of graded writing during one academic term. The University Writing Program has worked closely with faculty who draft proposals for "W" courses so that such expectations are embedded in the syllabi they send forward.

Quality of Writing: The Brint study compared a sample of students' written work in "W" courses with that of students in English 1C. The results indicated that the sample wrote at comparable levels according to a UWP-approved rubric. (See the report, which is attached to a previous message.)

For general reference, the English Department's summary of expectations for English 1C is in Appendix B. Of course, "W" courses have their own designs and goals, and assign varying numbers of assignments. In working closely with most "W" faculty over the last three years, we have found that close written analysis of texts has been an activity the "W" courses have in common with English 1C.

Writing Instruction:

Several questions regarding writing instruction have arisen over the years that WAC was in the planning stages and during its implementation:

Apart from the volume and quality of writing that they produce, are the "W" courses comparable to English 1C in terms of the writing instruction that they provide? How do the "W" courses compare in terms of such things as their expectations for writing, the tasks they set out, the ways they teach students to develop and edit their ideas in writing?

In our conversations with faculty, these questions tend to boil down to one: Can faculty and TAs who are not trained to be experts in teaching writing give adequate writing instruction? Our response regarding the WAC courses is yes.

It is important to bear in mind that all WAC students have passed English 1B with a "C" (not a "C-") or higher. They have all taken at least two composition courses. Half of

those students (those who started in ELWR) have taken three or more. They are relatively advanced students ready for sophisticated kinds of writing tasks. English 1C assumes that they are ready for such challenges; so do the “W” courses. Both focus on critical reading and the development -- through discussion and prewriting assignments -- of analysis and argument papers that respond to course readings and observations.

Another concern we hear frequently is that the “W”-course lectures and discussion classes are not dedicating as much time and focus to writing instruction as the typical 1C class does. In fact, a number of the “W” course instructors address writing in lecture, and “W” TAs do considerably more writing instruction in their discussion sections than they did in the non-“W” format. In addition, when we count WAC tutorials and the three or four additional workshop hours dedicated to writing instruction that are taught to small groups by UWP experts, the quality of writing instruction in “W” courses is comparable to the amount and quality of writing instruction in a 1C course.

The University Writing Program TAs who are WAC workshop instructors are drawn from the same TA pool as English 1C instructors. That pool receives extensive instruction in pedagogy related to English 1ABC.

7. Concluding Points

Input from TAs: The TAs who lead discussion sections in “W” courses and work with thousands of WAC students often tell us that the writing they see from their students has improved, and improved markedly over the work that was handed in when there was no “W”-course structure. A number of TAs have said they like the chance to teach and assess students on the basis of numerous and significant writing assignments, and that they usually welcome the course-specific teaching practicum (each “W” course with its own English 302 section) because it offers them the opportunity to compare student work, trade information with the UWP’s workshop leaders, and reflect upon the role of writing in the “W” course and the discipline. (TA testimony will be attached to a following e-mail.)

TA Workload: The “W” courses tend to ask TAs to do more responding to students’ work. Grading often takes longer than the grading many TAs are used to. The UWP’s English 302 meetings have been geared to help TAs find ways to make their evaluations more efficient, and their comments more productive for their students. There are many approaches that make the work more efficient and effective. Since the university’s TA contract limits their involvement to 220 hours per quarter, helping TAs manage the workload within the stipulated limit has been one of the UWP’s priorities.

Effect on TAs’ Teaching: TAs can become better teachers with regular UWP mentoring. They tend to become better teachers by working closely with their fellow TAs and

mutually-enforced standards for grading students' work. Their expectations rise for their students' writing, reading, reasoning, and comprehension.

Effect on TAs' Writing: We have often heard from TAs working on seminar papers, dissertations, and scholarly publications that the WAC program's objectification of writing conventions and strategies has given them more conscious control over their own writing.

Effect on the Climate for Writing on Campus: The WAC program has encouraged the development of writing-intensive courses in many parts of the undergraduate curriculum. It has engaged undergraduates, TAs, and faculty in developing and refining challenging writing assignments.

The WAC program has introduced and emphasized useful ways of talking about and understanding academic writing. It has introduced to the campus a shared understanding of, and language for, the conventions of, academic writing. The resulting benefits are far-reaching. For instance, "W"-course faculty have been able to develop writing assignments with greater rigor and higher expectations for student achievement because they know the discussion TAs and workshop TAs share their understanding of those expectations. Course and workshop TAs have coordinated their instruction so that students can more thoroughly address the writing assignments. Students are more likely to venture serious hypotheses, form good theses, and find and sift more pertinent evidence. They are more likely to write organized responses that are relevant to the assignments. They are more likely to pay close attention to their reading.

On a deeper level, WAC has engaged both faculty and students in a deeper exploration of course curriculum and goals. When faculty develop rigorous writing prompts to teach course concepts, they approach their course goals from a new and valuable angle, one that short-answer or multiple-choice exams do not support. Students gain a deeper understanding of course readings and lectures because the critical thinking and reading necessary for a substantial written assignment goes well beyond the memory work required of objective exams.

Effect on the Academic Resource Center: WAC-inspired innovations have influenced the approach to supplemental instruction in the Academic Resource Center, which has now, in consultation with the UWP, developed new forms of supplemental instruction focused on writing. The leader of that effort, Kevin Sitz, is a former WAC workshop leader. He has been approached by a wide range of people who are interested in strengthening writing in undergraduate and graduate education in their departments.

APPENDIX A

Checklist of Criteria for Certification and Renewal of Alternatives to English 1C

The Academic Senate will designate alternatives to English 1C on the basis of the following criteria. Appendix A should be used as a checklist.

_____ a) Writing is one major focus of the course. Writing is used as a

method of inquiry as well

as communication, for example by

- assigning written explanations of complex concepts, texts, or data sets;
- requiring writers to discover, assemble, and explain competing ideas or explanations;
- encouraging writers to weigh and evaluate competing ideas.

_____ b) The course assigns an amount of writing roughly comparable

to the amount assigned, graded, and returned to students in

composition courses, adjusting for the fact that written communication in various disciplines takes a number of forms, and that assignments and exercises preliminary to formal assignments might qualify as part of that total.¹

¹ The volume of writing in Composition courses is based on word totals required by IGETC transfer agreements with the CSU and CC systems. The amount of writing in English 1C is 5000 words: 4-6 papers (none shorter than 750 words, and at least one paper of 1250 words or more), plus a final.

_____ c) The course provides feedback to students on their writing in each assignment;

_____ d) The course responds to students' writing in terms of ideas, reasoning, development, and clarity in paragraphs and sentences as well as the assignment as a whole, in terms of

- commenting on the students' subject matter by paying close attention to fact, reasoning, development, and clarity;
- commenting on representative passages in terms of grammatical correctness, the clarity of assertions and the logic of paragraphs, and the use of evidence;
- offering advice on these matters for the sake of revision or the writing of later assignments.

_____ e) The course's TAs participate in the required UWP training course, which focuses on writing instruction -- including attention to the process of writing as well as the intensive evaluation of student writing;²

_____ f) Materials relevant to these criteria have been provided by the proposing department for UWP and COC review.

_____ g. The department offering the course commits to monitoring and evaluating the course's conformity to these requirements in cooperation with the University Writing Program.

² TA-training will take place in English 302 (meeting one hour per week) during the quarter the course is taught, or by alternative means approved by the UWP Director. TAs will remain under the charge of faculty in their home departments, and UWP training will take account of the 20-hour per week limit on TA activity. UWP instruction will focus on productive ways of responding to student writing (through, for example, conferences, drafting, comments, and evaluation that focus on methods of development and patterns of error) and effective ways of embedding writing instruction in discussion sections.

Appendix B

The English Department's Overview of Expectations in English 1C

1. ENGLISH 1C: AN OVERVIEW

English 1C introduces students to the analysis and interpretation of texts. In 1C, *reading* becomes as important as *writing*: that is, you will be trying to make your students more aware of reading as an interpretive act, requiring critical scrutiny of underlying presuppositions. Students will deepen their understanding of the shaping power of language and its conventions and become more aware of the collaborative nature of making meaning. Basic concepts of literary and/or cultural theory will be introduced. A library workshop is recommended but not required.

Writing assignments in English 1C tend to emphasize textual analysis. The concept of the thesis statement should be reinforced. Yet instructors have considerable leeway in devising assignments in this segment of the composition program, and much will depend upon the instructor's choice of main text (*Signs of Life* or *Textbook*). *Signs of Life* allows for an emphasis on semiotics and popular culture, and the "texts" to be examined will include a variety of cultural artifacts, such as Barbie, Disney World, rock music, and film, as well as more traditional literary works. *Signs of Life* is, however, primarily an essay collection rather than a handbook on writing strategies. Questions supplied at the end of each selection in *Signs of Life* will aid instructors in devising writing assignments. *Textbook*, on the other hand, allows for an emphasis on literary language and intertextuality. It is less of an essay collection and more of a handbook on writing and interpretive strategies, containing many valuable suggestions for assignments and "experiments with texts." Whichever main text you choose, you may wish to refer back to Chapters 8 ("Justifying an Evaluation") and 10 ("Interpreting Stories") from the *St. Martin's Guide* for further help in constructing assignments.

Single-Author Texts (aka "whole texts"): In addition to the main text, instructors should assign two single-author texts and plan to devote significant class time to them. An official booklist is provided and TAs and beginning lecturers are encouraged to select books from this list. However, instructors may go off-list as long as they get permission from Deborah Willis, Director of English 1ABC (deborah.willis@ucr.edu) before the quarter begins. (Your email should list the titles of the books and provide a paragraph with a rationale for your choices.) Consider using a "classic" literary text and/or a more contemporary one that engages with popular culture in some way. Or select an intertextual pair

(example: *Heart of Darkness* and *Things Fall Apart*). A full-length film may be substituted for one of the single-author texts, though using two texts plus a film is usually preferable.

A library workshop in 1C is optional, though it may be useful, especially if one of the assigned papers is a longer one involving library research. See the instructions for arranging a workshop in the overview of English 1B above.

Guidelines for Word Totals in English 1C: 4-6 papers totaling a minimum of 5000 words of formal, graded writing (none shorter than 750 words and at least one of 1500-3000 words or more), plus a final.

Survey Brief

Undergraduate Education

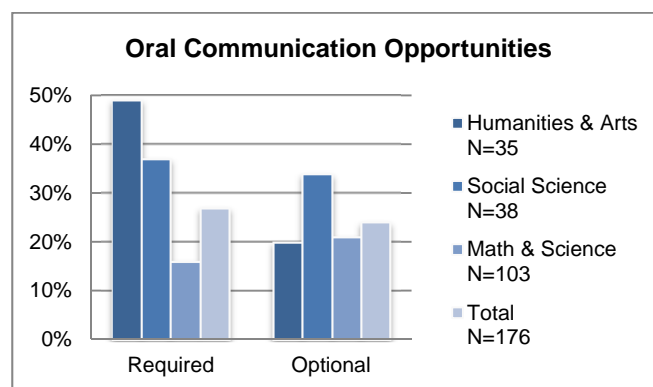
General Education Requirements Quantitative Literacy and Oral Communication

In summer 2012, a working group was brought together by the Senate Chair of Educational Policy Martin Johnson and Vice Provost Steven Brint to discuss general education assessment at UC Riverside. The group identified potential learning outcomes for the general education assessment by consulting the *Goals for an Undergraduate Education* section of the *UCR General Course Catalog*. Of the several objectives listed in this section, the committee elected to focus on quantitative literacy and oral communication.

In a society in which data collection and data analysis plays such an important role, quantitative literacy is essential not only in jobs that require it but to remain a well-informed citizen and participant in community life. Confidence in oral communication is equally important. Following graduation, many students take jobs that require the ability to communicate clearly not only in writing, but also orally.

We surveyed faculty who taught the most popular general education courses over the past three years about opportunities for quantitative literacy and oral communication in their courses. Popular general education courses surveyed for this study were lower division courses that satisfy requirements and enrolled at least 1000 students over the past three years (e.g. ENTM 010, HIST 020, PHIL 001, and SOC 001). One hundred thirty-eight faculty responded; some responded for more than one course. We received a total of 176 responses for 60 general education courses.

Findings show that 70% of courses require students to do calculations and 66% require students to use equations. Over 90% of math and science courses surveyed require students to perform calculations and/or use equations. We also found that 75% of courses required students to interpret the meaning of numbers presented in tables or the results of calculations. These findings suggest our students have ample opportunities to develop quantitative literacy through the fulfillment of general education requirements.



The findings related to oral communication are not as bright. We asked faculty to report whether oral communication opportunities were required, optional, or not offered in their courses. Oral communication opportunities, both required and optional, were most frequent in the Humanities (69%) and Social Sciences (71%). Overall, 51% of courses either required oral communication assignments (27%) or offered optional oral communication opportunities (24%) in the form of individual presentations, group presentations, video presentations, debates, or interviews.

When asked if they offered any other oral communication opportunities in their courses, faculty responded that students participate in group work, discussions, and question and answer sessions in the classroom. Other faculty members responded that course sizes prevent them from offering oral communication opportunities.

This survey suggests that students at UC Riverside are likely to take a course that will provide them with opportunities to develop their quantitative literacy skills but may not have sufficient opportunities to develop their oral communication skills as they complete their general education requirements. The general education assessment working group will meet this quarter to discuss these findings. We conducted a separate evaluation of the University Writing Program to investigate student achievement in written expression. This study will be the subject of a forthcoming Survey Brief.

Appendix III-1: Dean Childers's Email re: Assessment of Graduate Programs

From: "Joseph Childers (by way of Amanda Wong)" <graddean@ucr.edu>

Date: Tuesday, February 22, 2011 3:03 PM

Subject: WASC reaccreditation: learning outcomes for graduate programs (corrected attachments)

To: Deans, Department Chairs, Graduate Program Directors and Graduate Advisers
David Fairris, VPUE and WASC Accreditation Liaison Officer
Robert Gill, Special Assistant to the Vice Provost
Morris Maduro, Chair of the Graduate Council

Fr: Joseph Childers, Graduate Dean

Re: WASC reaccreditation: learning outcomes for graduate programs

Dear Colleagues:

In early December I wrote to you regarding plans for the campus to implement learning outcomes for graduate programs and to incorporate learning outcomes assessment into graduate program reviews before the end of the 2011-12 academic year. As a first step in this process, I am requesting that each graduate program develop learning outcomes, assessment methods, and evaluation plans for each of its degrees and **submit these to the Graduate Division before the start of Fall Quarter 2011**. The Graduate Division will review these submissions and work with each program to ensure that the campus has outcome and assessment methods in place for each of our graduate degree programs before the end of the 2011-12 academic year.

As I mentioned in my previous letter, elements of learning outcomes are already in place for graduate education at UCR. Therefore this process largely will involve formalizing and integrating these and other elements, such as performance on comprehensive and qualifying exams and on the prospectus and final defenses. This process should not require the same level of effort that was needed to establish learning outcomes for undergraduate programs, and it will afford programs greater flexibility in the definition of learning outcomes for graduate programs relative to those for undergraduate programs. However, as with undergraduate learning outcomes, programs must also establish clear assessment methods for graduate learning outcomes as well as plans for using the information generated by the assessments for regular programmatic evaluations and adjustments. Therefore it would be beneficial for graduate programs to utilize the expertise of any participating faculty members who previously helped to develop undergraduate learning outcomes.

Enclosed you will find guidance and suggested templates to assist you in developing your program's learning outcomes, assessment methods, and evaluation plans. You also will find the WASC Rubrics for Assessing the Quality of Academic Program Learning Outcomes, and several examples of learning outcomes developed for graduate programs at other institutions. If you have any questions, please contact Associate Dean Ken Baerenklau in the Graduate Division.

Best Regards,

Joe

Joseph W. Childers
Dean, Graduate Division
University of California, Riverside
Riverside, CA 92521
951 827 4302

Appendix III-2: Graduate Program Assessment Report Exemplar

UNIVERSITY OF CALIFORNIA, RIVERSIDE STUDENT LEARNING OUTCOMES ASSESSMENT REPORT 2013-2014

In compliance with WASC learning outcomes assessment and to support student success at UC Riverside, all undergraduate programs and departments are asked to submit a report of assessment of **at least one student learning outcome** for each academic major. For example, "Students completing a major in Comparative Literature should demonstrate the ability to: read critically literary and cultural texts in a range of genres and media."

Reports are due on **June 30, 2014** and can be submitted via two options:

1. Directly input results to OATS: oats.ucr.edu. Instructions may be found at <http://appsupport.ucr.edu/oats/>
2. Reports using the template below should be emailed to Gary Coyne, Interim Director of Evaluation and Assessment: assess@ucr.edu. Please include the following in the email subject line: "Assessment [Department/Program Name]."

Program/Department and Major(s): Mathematics
Chair Name and Email Address: Gerhard Gierz, Gierz@ucr.edu
College: CNAS
Author Name and Email Address (if different than Chair):

Student Learning Outcome(s) and Assessment Method(s) for 2013-2014

- a. Please list all of the student learning outcomes for the major.
 - 1.) **Learning Outcomes for Master's Degree in Mathematics Students**
 - Students should have broad knowledge and understanding of the following core areas/sequences of mathematics:
 1. Algebra
 2. Topology
 3. Real Analysis
 4. Complex Analysis
 - Students should be able to formulate and solve mathematical problems in these areas.
 - Students should be able to understand, construct and communicate proofs of mathematical theorems.
 - Students should be able to study and understand mathematical articles and communicate them verbally.
 - Students should be able to critique the effectiveness of the graduate program. Students should be able to teach mathematics effectively.
 - Professionalization will be offered through a variety of training programs, such as Math 302 (Apprentice Teaching).
 - 2.) **Learning Outcomes for Master's Degree in Applied Mathematics**

- Students should have broad knowledge and understanding of the following core areas/sequences of mathematics:
 1. Ordinary/Partial Differential Equations
 2. Real Analysis
- Students should be able to formulate and solve mathematical problems in these areas.
- Students should be able to understand, construct and communicate proofs of mathematical theorems.
- Students should be able to study and understand mathematical articles and communicate them verbally.
- Students should be able to teach mathematics effectively, and apply mathematics in the real world.
- Professionalization will be offered through presentations and workshops from outside speakers and industry professionals.

3.) Learning Outcomes for Ph.D. Program

- Students will be assessed through the performance on assignments and exams in required courses, including four of the five following core areas/sequences of mathematics:
 1. Algebra
 2. Topology
 3. Real Analysis
 4. Complex Analysis
 5. Ordinary/Partial Differential Equations
- Students should be able to formulate and solve mathematical problems in these areas.
- Students should be able to understand, construct and communicate proofs of mathematical theorems.
- Students should be able to search mathematical literature and gain comprehensive knowledge of current mathematical developments in their fields of specialization.
- Students should be able to effectively conduct and communicate mathematical research, both verbally and in writing.
- Students should be able to teach mathematics effectively, and apply mathematics in the real world.
- Professionalization will be offered through a variety of training programs, such as Math 302 (Apprentice Teaching), and presentations and workshops from outside speakers and industry professionals.

b. Please indicate the learning outcome(s) assessed in 2013-2014.

We assessed the performance in exams in the four required courses Algebra, Topology, Real Analysis and Complex Analysis. We excluded Ordinary/Partial Differential Equations, because this course is required mainly for our new program in Applied Mathematics and not many students have yet taken the course in the past few years.

c. What evidence was examined to assess the learning outcome(s) (e.g., student assignments, theses, tests, exams, etc.)?

We examined the grades in the basic graduate courses 201ABC (Algebra), 205ABC (Topology), 209ABC (Real Analysis) and 201AB (Complex Analysis) and compared them to the pass rates in the corresponding qualifying exams.

- d. Please describe the method of analysis used to assess learning outcome(s) (e.g., descriptive analysis, rubric). Note: Please attach copies of relevant rubrics, assignments, or exams in the appendix. Due to an unprecedented turnover in our staff, our Department did not have the luxury of a full-time students affairs officer dealing with our graduate students in the last two years, and we had to share such a staff person with other departments in CNAS. Among other things, this lead to a poor 2012-2013 recruitment year for graduate students and to some loss of continuity in our staff. So even a modestly rigorous statistical analysis of our grades and outcomes of qualifying exams is not possible at this time, and we have to resort to a descriptive, experience bases analysis.

2. Assessment Results

- a. Please summarize in written, tabular, or graphical form the results of assessment analyses. If relevant, include any performance expectations or benchmarks. Please cite relevant evidence from student work to substantiate your results. Some questions to answer might be:

- 1) What did the department or program find

There is a wide agreement among our faculty that a grade of A in a basic graduate course would correspond to a PhD pass in the qualifying exam on the correspond topic. Similarly, a grade of B corresponds to a Master’s pass. The following table shows the grades of the highest basic courses in an area (201C for Algebra, 205C for Topology, 209C in Real Analysis and 210B in Complex Analysis) in comparison to the results of the corresponding qualifying exams.

| Cohorts Taking Qualifier in 2012 - 2014 | | | | | |
|---|-------------------------------|---|---|--------------------------|-------------------------|
| | Grade in highest basic course | | | Passed Qualifiers at PhD | Passed Qualifiers at MS |
| | A | B | C | | |
| Algebra | 19 | 5 | 0 | 13 | 2 |
| Topology | 12 | 6 | 0 | 11 | 3 |
| Real Analysis | 19 | 9 | 0 | 12 | 2 |
| Complex Analysis | 17 | 3 | 1 | 15 | 2 |

It should be pointed out that not all students take a qualifier exam in the same year in which they take the corresponding course. So the difference in numbers cannot be attributed to fails in the qualifying exams. But as a trend, the numbers confirm our belief that A’s in graduate course correspond to PhD passes.

The attached Excel spreadsheet (2012-2014 MATH Grades for grad. Students) shows a more detailed picture: In any of the course, less then 5% of the grade where below B, showing that almost all of our students perform at least on the Master’s level. The ratio of A’s to B’s in all graduate courses is about 2:1.

- 2) Are your students meeting your program's performance expectations? What percentage of students are performing at each level of proficiency (e.g., using a rubric or course grades)?

Yes, the students are meeting our department’s expectations. As was pointed out under (1), about 2/3 of our students perform at the PhD level and the remaining students perform at Master’s level. Only 5% of the students do not meet our standards, and that roughly also corresponds to the number of students who leave our program without a degree.

- 3) Are your students improving? How many and how so?

The correspondence between grades in courses and pass rates in qualifying exams has been stable the last decades.

3. Recommendations

- a. What are the implications of the assessment results (e.g. course change, requirements change, etc.)? Recommend actions to improve student learning with respect to the desired learning outcomes and a timeline for implementation. Actions may fall into any of these potential categories:
- 1) instruction,
 - 2) curriculum,
 - 3) course sequencing,
 - 4) co-curricular support for student learning (e.g., tutoring, library instruction, etc.),
 - 5) communicating expectations to students.

While we are satisfied with the pass rates in qualifying exams, we realize that we need to improve the amount of time students spend to obtain a PhD in Mathematics. We have too many students in their 6th and 7th year of residence who are still working on their thesis, and the amount of time students need to advance to candidacy is also too long.

The grades in the courses and the pass rates in qualifying exams show that students are not overstretched by our curriculum – it simply takes them too long to pass the necessary qualifying exams. We are currently discussing to reduce the number of qualifying exams students have to pass from four to three.

Also, after the students have passed all the exams, they need easy access to an experienced advisor. This is contrasted by the reality that about 10 of our 25 ladder rank faculty member are relatively junior, which leaves only 15 experienced thesis advisors for over 80 graduate students. We need to find a way to improve this ratio.

4. Implications of Proposed Changes

Are there any resources needed to implement the above plans for improvement? How and where might the resources be obtained?

We would need no additional resources to reduce the number of qualifying exams passed.

Since almost all new hires are at the tenure track level, we need to find a way to encourage our junior faculty to take on graduate students at a very early stage in their career. Course releases are one way to achieve this, which would require additional temporary faculty members.

5. Proposed assessment plan for academic year 2014-2015

What learning outcome(s) do you plan to assess for the next academic year? What assessment method(s) and courses will you use to assess the proposed learning outcome(s)?

We need to study why it takes students so long to advance to candidacy and to complete their PhD theses. This can be addressed by a discussion of the following learning outcomes:

- Students should be able to formulate and solve mathematical problems in these areas.
- Students should be able to understand, construct and communicate proofs of mathematical theorems.
- Students should be able to search mathematical literature and gain comprehensive knowledge of current mathematical developments in their fields of specialization.

- Students should be able to effectively conduct and communicate mathematical research, both verbally and in writing.

Exit interviews are one way to assess these learning goals.

6. Quantitative Reasoning (WASC Core Competency)

- a. What are the expectations, if any, for majors in the department to develop quantitative reasoning, or the ability to apply mathematical concepts to the interpretation and analysis of quantitative information. If your department has no such expectations, please explain.
- b. In what ways do students acquire the experience and skills needed to develop quantitative reasoning prior to graduation? (Please list any required courses with a significant quantitative component, whether they are offered by your department or another (i.e.: math or statistics). Again, if your department has no such expectations, please explain.
- c. Are there any program-level student learning outcome(s) linked to the development of quantitative reasoning? Please list, the relevant student learning outcome(s).
- d. If the department has learning outcome(s) linked to quantitative reasoning, have they been assessed recently? What were the results? Please comment briefly here, or provide documentation from previous year's assessment report(s). If your department or program has not yet assessed quantitative reasoning, is there a plan to do so?

We do not believe that these questions are meant for a Department of Mathematics.

7. Appendices

Please list the documents you are attaching with your report, the file name if not included in this document, and a short description of what they are. Please include rubrics, assignments, exams, and other supporting documents.

Excel Spreadsheet "2012-2014 MATH Grades for grad. Students"
Copies of qualifying exams (8 pdf files)

Appendix IV-1:

VC Anguiano's Email re: UCR's Resource Allocation and Budget Redesign Initiative

From: Sharon Vander Veen

Sent: Wednesday, October 29, 2014 6:17 PM

To: Aman Ullah; Amir Zaki; Andrew Winer; B Glenn Stanley; Begona Echeverria; 'bir.bhanu@ucr.edu'; Christine Victorino; Daniel Ozer; Daniel R Jeske; David A Eastmond; David D Oglesby; David F Bocian; David K Herzberger; Deborah Willis; Dylan Rodriguez; Eric L Chronister; Erich H Reck; Gerhard Gierz; 'guillermo.aguilar@ucr.edu'; J Giles Waines; Jacqueline Shea Murphy; James O Sickman; Jan M Opdyke; Jane Ward; 'javier.garay@ucr.edu'; 'jay.farrell@ucr.edu'; John C Briggs; John N Medearis; Julia Bailey-Serres; Katherine A Borkovich; Katherine A Kinney; Keith M Harris; Kenneth Barish; Kevin M Esterling; Kimberly Hammond; Leah T Haimo; 'malcom.baker@ucr.edu'; 'marek.chrobak@ucr.edu'; Maritza Rodriguez; Martha Orozco-Cardenas; Mary Gauvain; Michael A McKibben; Michael Allen; Mikeal L Roose; Monica J Carson; Natasha Raikhel; 'nosang.myung@ucr.edu'; Pamela S Clute; Pashaura Singh; Paulo Chagas; Peggy A Mauk; Peter Atkinson; Peter Graham; Philip A Roberts; Phyllis A Guze; Rami Zwick; Randolph C Head; Raymond L Russell; Richard J Debus; Rick Redak; Ronald O Loveridge; Sang-hee Lee; Steven Clark; Stu Krieger; Susette L Aguiar-Possnack; Thomas F Scanlon; Thomas M Perring; Umar Mohideen

Cc: Paul D'Anieri; Maria R Anguiano; Matthew Hull; Sharon Vander Veen; Kim A Wilcox

Subject: Resource Allocation and Budget Redesign Initiative Vision Workshop on November 6th in the Alumni Visitor Center from 9:00 a.m. – 11:00 a.m.

Dear Colleagues,

While have grown tremendously over the past decade, many of our internal management processes have not kept pace. As an organization that has an annual operating budget of over \$700M, we can no longer rely on the tools and processes that got us here. Foremost amongst the processes that need an overhaul is how we intertwine strategic planning, budgeting and funding allocations. To that end, we will shortly be kicking off the " Resource Allocation and Budget Redesign Initiative.:

The fundamental goal behind this initiative is to enable better alignment between UCRs strategic priorities and funding allocation decisions. We plan to not only bring much needed transparency to this process, but to also establish a more incentive-based funding allocation model that rewards departments that strive to meet our UCR 2020 vision. Coinciding with the redesign, we will be implementing two IT tools (business intelligence reporting and a budget and planning tool) to help improve departmental financial management and the development of common performance metrics, thereby enabling more robust campus wide financial planning and analysis.

To assist us in carrying out this initiative, we have engaged Deloitte & Touche to review our existing resource allocation process, the incentives and disincentives associated with it, and facilitate discussions regarding the creation of a new future-state process.

Over the next few months, we will be holding discussions with key budget process stakeholders and owners to gather the information needed to create the most appropriate budget model for UCR. As part of that effort, we are holding a **Resource Allocation and Budget Redesign Initiative Vision Workshop on November 6th in the Alumni Visitor Center from 9:00 a.m. – 11:00 a.m.** and are requesting your attendance to participate in the discussion.

As preparation for the Vision Workshop, attached is a document prepared by the Education Advisory Board entitled “Exploring Alternative Budget Models.” This document provides a general framework around the different budget models in use in higher education.

In addition to this document, we have prepared a short survey (shouldn’t take more than 5 to 10 minutes to complete) to help in the review of our current state resource allocation and budgeting process pain points, and to start the discussions about what our future state process might look like. Please complete the survey at the link below, so that we may include your thoughts into the discussion at the upcoming Vision Workshop.

<https://deloittesurvey.deloitte.com/Community/se.ashx?s=3FC11B266B524BBF>

Survey results will be kept confidential and only reported in the aggregate. Your name will only be used to verify your participation and will not be associated with the survey responses you provide. Thank you in advance for your participation and engagement.

If you have any questions or technical issues with the survey, please contact Jacky Lam at jaclam@deloitte.com. In order for us to incorporate your feedback into the Town Hall meetings, **please complete the survey by end of day Monday, 11/3, or sooner.**

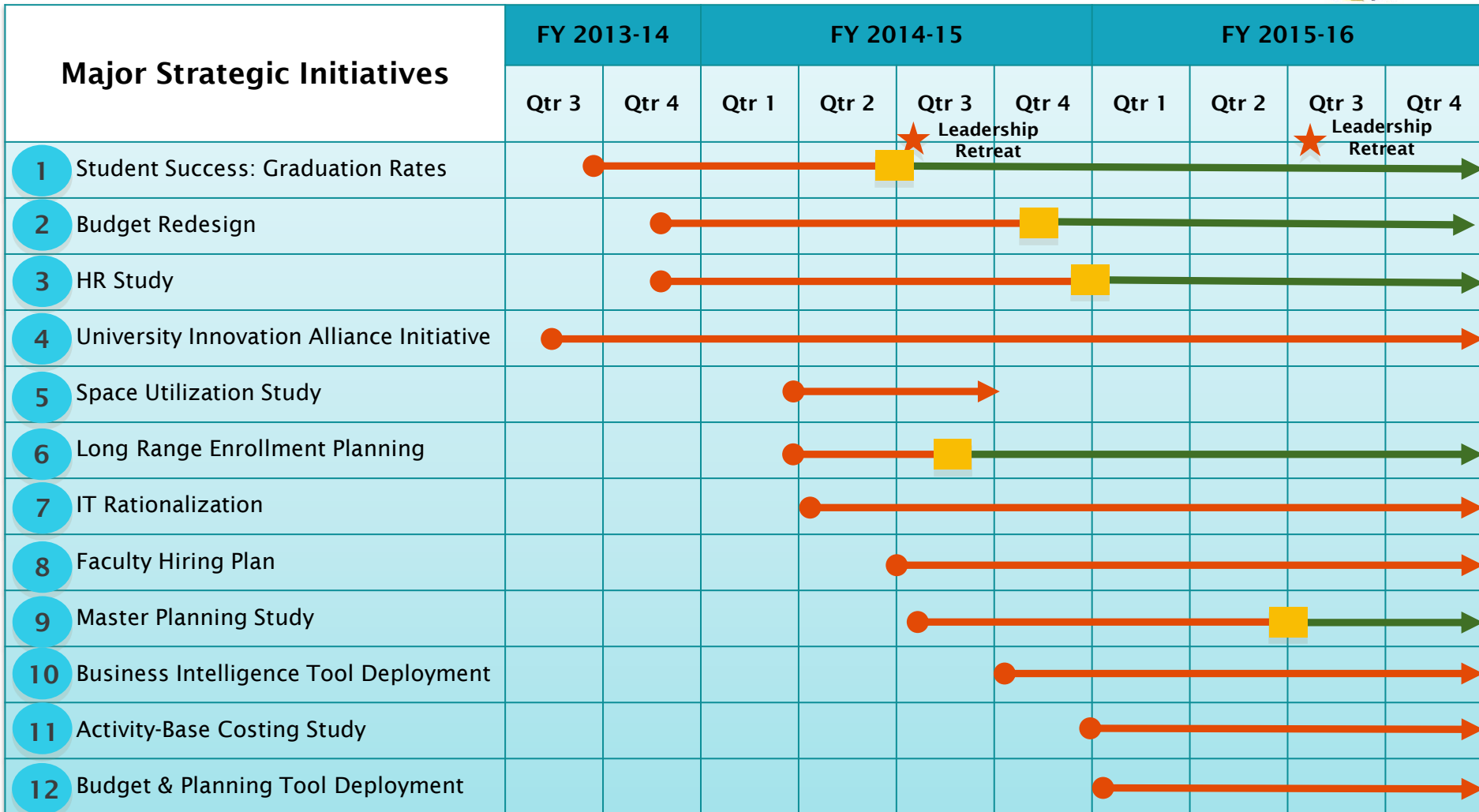
I want to thank you in advance for your participation and engagement in the upcoming months. Please feel free to reach out to me if you have any questions, comments, or concerns.

Sincerely,

Maria Anguiano
Vice Chancellor
Planning and Budget



Timeline of all UCR Initiatives



■ Report Due → Implementation Phase

Timeline of all UCR Initiatives

