Academic Program
Plan for Assessment of Student Learning Outcomes
The University of New Mexico

A. College, Department and Date

1. College: Arts and Sciences, University of New Mexico
2. Department: Earth and Planetary Sciences
3. Date: 7th May 2014

B. Academic Program of Study*

B.A., Earth and Planetary Sciences

C. Contact Person(s) for the Assessment Plan

Laura Crossey, Chair, Earth and Planetary Sciences, lcrossey@unm.edu
Joseph Galewsky, Chair, Undergraduate Committee, galewsky@unm.edu

D. Broad Program Goals & Measurable Student Learning Outcomes

1. Broad Program Learning Goals for this Degree/Certificate Program

All Earth and Planetary Science Bachelor of Science Majors shall:

A. Develop an understanding of interconnected Earth systems, with special emphasis on the physical and chemical processes that result from plate tectonics.

B. Develop an understanding of Earth materials as recorders of geological processes.

C. Develop an understanding of geologic time and Earth history.

D. Acquire geologic data in the laboratory and the field, analyze these data, and interpret their meaning through application of the scientific method.

E. Read and understand geological literature, and present geologic information (both in oral and written form) clearly and concisely.

F. Understand applications of geologic sciences to natural resource development and natural hazard assessment and mitigation.

G. Follow the principles of ethics in the conduct and application of science within the academic and professional arenas.

H. Solve problems quantitatively by applying first principles from supporting sciences.

* Academic Program of Study is defined as an approved course of study leading to a certificate or degree reflected on a UNM transcript. A graduate-level program of study typically includes a capstone experience (e.g. thesis, dissertation, professional paper or project, comprehensive exam, etc.).

2. List of Student Learning Outcomes (SLOs) for this Degree/Certificate Program

A.1. Students will compare the physical and chemical conditions that characterize different plate tectonic settings, and apply their understanding to interpret past and present Earth environments.

B.1. Students will identify and classify minerals and rocks, and interpret the origin and formation history of a given mineral or rock sample.

C.1. Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.

D.1. Students will formulate a testable hypothesis based on field and / or laboratory observations, and devise appropriate tests of their hypotheses.

E.1. Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.

F.1. Students will describe and discuss natural hazards and natural resources in terms of geologic processes and constraints.

G.1. Students will use professional ethical standards for reports and publications associated with collaboration, data collection, authorship, and citation of previous results.

H.1. Students will solve geologic problems quantitatively using mathematical, chemical, and physical equations and principles.

E. Assessment of Student Learning Three-Year Plan

All programs are expected to measure some outcomes annually and to measure all priority program outcomes at least once over two consecutive three-year review cycles. Describe below the plan for the next three years of assessment of program-level student learning outcomes.

1. Student Learning Outcomes

[Insert at least 2-5 priority learning outcomes that will be assessed by the unit over the next three years. Each unit will select which of its learning outcomes to assess.]

Relationship to UNM Student Learning Goals (insert the program SLOs and check all that apply):

University of New Mexico Student Learning Goals				
Program SLOs	Knowledge	Skills	Responsibility	Program SLO is conceptually different from university goals.
A.1. Students will compare the physical and chemical conditions that characterize different plate tectonic settings, and apply their understanding to interpret past and present Earth environments.	XX	XX		
C.1. Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.	XX	XX		

D.1. Students will formulate a testable hypothesis based on field and / or laboratory observations, and devise appropriate tests of their hypotheses.	XX	XX		
E.1. Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.	XX	XX		

Student Learning Outcome A.1.

Students will compare the physical and chemical conditions that characterize different plate tectonic settings, and apply their understanding to interpret past and present Earth environments.

2. How will learning outcomes be assessed?

A. What:

i. Students in EPS 303L (Igneous and Metamorphic Petrology) will demonstrate their understanding of the plate tectonic control of environments important to the formation of igneous and metamorphic rocks, in questions that they will be asked in exams. There are two exams during the semester, one for igneous and one for metamorphic petrology. An example of a question from an igneous petrology exam, that specifically addresses this SLO, is attached.
ii. The measure is direct.
iii. The exam question is graded according to a grading scheme that awards points for accuracy of factual content, and ability to communicate an understanding of geologic processes. We expect that at least 80% of the EPS B.A. majors will score ≥75% on exam questions of this nature.

B: Who:

Evidence will be collected in EPS 303L, a required course for all EPS B.A. majors.

3. When will learning outcomes be assessed? When and in what forum will the results of the assessment be discussed?

EPS 303L is offered each Spring semester and assessment data will be collected then. Results from the previous Spring will be discussed by the department's Undergraduate Committee and disseminated to the full department faculty in the Spring semester each year.

4. What is the unit's process to analyze/interpret assessment data and use results to improve student learning?

The gathering of evidence will be conducted by the faculty instructor in EPS 303L and presented by him/her to the department's Undergraduate Committee for discussion. The Undergraduate Committee and then the full faculty will consider and discuss the implications of assessment for changes to assessment mechanisms, to curriculum design, and to pedagogy. Recommendations will be submitted to the Chair of Earth and Planetary Sciences, in writing, each Fall Semester, no later than 1 October of each academic year.

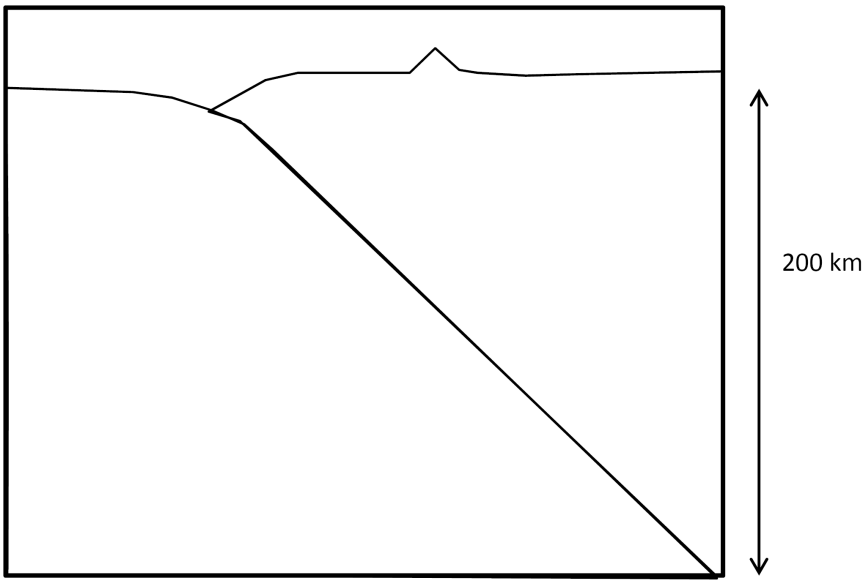
Student Learning Outcome A.1., assessment in EPS303L.

IGNEOUS PETROLOGY EXAM, SAMPLE QUESTION (15 points) – grading key

a) The diagram below shows a subduction zone at a continental margin. Add to the diagram, and label, the following:

- Oceanic crust
- Continental crust
- Lithospheric mantle
- Asthenosphere
- Trench
- Volcanic arc

1 point for correctly sketching and identifying each of the above features (6 points)



b) On the diagram, illustrate the process that results in melting of the mantle. Describe the process briefly in words:

Answer should illustrate the correct process in the correct location on the diagram.
Written answer uses appropriate terminology and describes the correct sequence of events / processes. (3 points)

c) On the diagram, illustrate two processes that could result in changes in composition of the original mantle-derived melt, before it reaches the surface. Describe the processes briefly in words:

Each process should be described accurately in words and indicated in the appropriate location on the diagram. There are several possible processes – any two that will change the composition of the melt are acceptable.
(4 points – 2 for each)

d) On the diagram, indicate where granitic rocks are formed in this plate tectonic setting. Describe briefly how granitic melt is produced:

Answer should correctly indicate where granite is formed.
Description should discuss how granitic melt is produced, using appropriate terminology. (2 points)

Student Learning Outcome C.1.

Students will interpret the geologic history of a rock, field region or map, based on an analysis of geologic structures and/or laboratory data.

2. How will learning outcomes be assessed?

A. What:

i. Students in EPS 307L (Structural Geology) will demonstrate their understanding of the geologic history, rocks, and structures of a region via a take home map and rock interpretation exercise given as part of the final exam. An example of a question from the Structural Geology final that specifically addresses this SLO is attached.

ii. The measure is direct.

iii. The exam question is graded according to a grading scheme that awards points for accuracy of interpretation structures in map, cross section, and stereonet, an ability to determine rock type and shear sense in an accompanying hand sample, and an ability to communicate an understanding of geologic history and processes portrayed on the map in a one page summary of the geologic history. We expect that at least 80% of the EPS B.A. majors will score ≥75% on exam questions of this nature.

B: Who:

Evidence will be collected in EPS 307L, a required course for all EPS B.A. majors.

3. When will learning outcomes be assessed? When and in what forum will the results of the assessment be discussed?

EPS 307L is offered each Spring semester and assessment data will be collected then. Results from the previous Spring will be discussed by the department's Undergraduate Committee and disseminated to the full department faculty in the Spring semester each year.

4. What is the unit's process to analyze/interpret assessment data and use results to improve student learning?

The gathering of evidence will be conducted by the faculty instructor in EPS 307L and presented by him/her to the department's Undergraduate Committee for discussion. The Undergraduate Committee and then the full faculty will consider and discuss the implications of assessment for changes to assessment mechanisms, to curriculum design, and to pedagogy. Recommendations will be submitted to the Chair of Earth and Planetary Sciences, in writing, each Fall Semester, no later than 1 October of each academic year.

Student Learning Outcome C.1.

Sample of take-home exam question: Structural Geology and geologic history of the Cauliflower Butte area.

This is a take home part of the final exam (also useful as study guide for Lab final) - 2 weeks to complete it, due at final exam time.

1) Lightly color and examine the map and answer the following questions as part of your qualitative map analysis (you can come back at the end and write your final answer next to your initial answer (only final answer is graded), but leave your initial answer there for my assessment purposes):

a) How many structural rock packages are present in the map (not counting the cover)

_____

b) What is the orientation of the axial plane and fold axis of any folds?

_____

c) What is the movement plane and direction of any shear zones?

_____

d) How do contacts cross topography: are beds flat lying or dipping or some of each?

_____

e) What is the dip direction and movement sense of any faults in the map area?

_____

2) Please turn in all your work and turn in all map analysis tools used:

a) steronet (s)

b) structure contour maps(s)

c) others

3) Examine the hand sample of the rock from the western part of the map area

a) what is the orientation of the shear plane _____

b) what was the slip direction on the shear zone _____

c) draw a correct symbol for the foliation and lineation in the box on the map and in the space below

d) what is the shear sense and what indicators did you use to determine it

e) what would you estimate the shear strain to be

f) what depth range in the crust did it likely form at?

g) what rock name would you give it?

h) what was the likely protolith?

4) Draw an accurate true scale cross section along the E-W line X-X'

a) hints: Bottom and top of the cross section can be at 5000 and 8000 feet respectively—lay this out landscape at the top of a page leaving room for the explanation and caption. Do an accurate topo profile first and ink it; use structure contours, trigonometric projection of fold hinge data from the stereonet, and other map relations to get accurate unit thicknesses and subsurface geometry; plot all dips accurately with a protractor. Color it lightly with the same colors as the map.

5) Below and on the same page as your cross section, make an explanation of units (use same colors as the map and cross section) that shows their relative age (oldest on bottom), use a squiggle line (on the explanation, not the cross section) to indicate any unconformities (and explain what type may be present), and list the thickness of each unit in feet (if known). Also explain all structural symbols used on the map and cross section such as: interpreted movement sense on any shear zones and faults, contact lines, etc.

6) Interpret the map by adding the following information to the map

a) fill in box "a" with the proper symbol for the foliation and lineation in the shear zone (from the hand sample analysis)

b) label the shear zone in the area of "b" on the map with arrows, letters, or symbols that show both the dip slip and strike slip components of movement

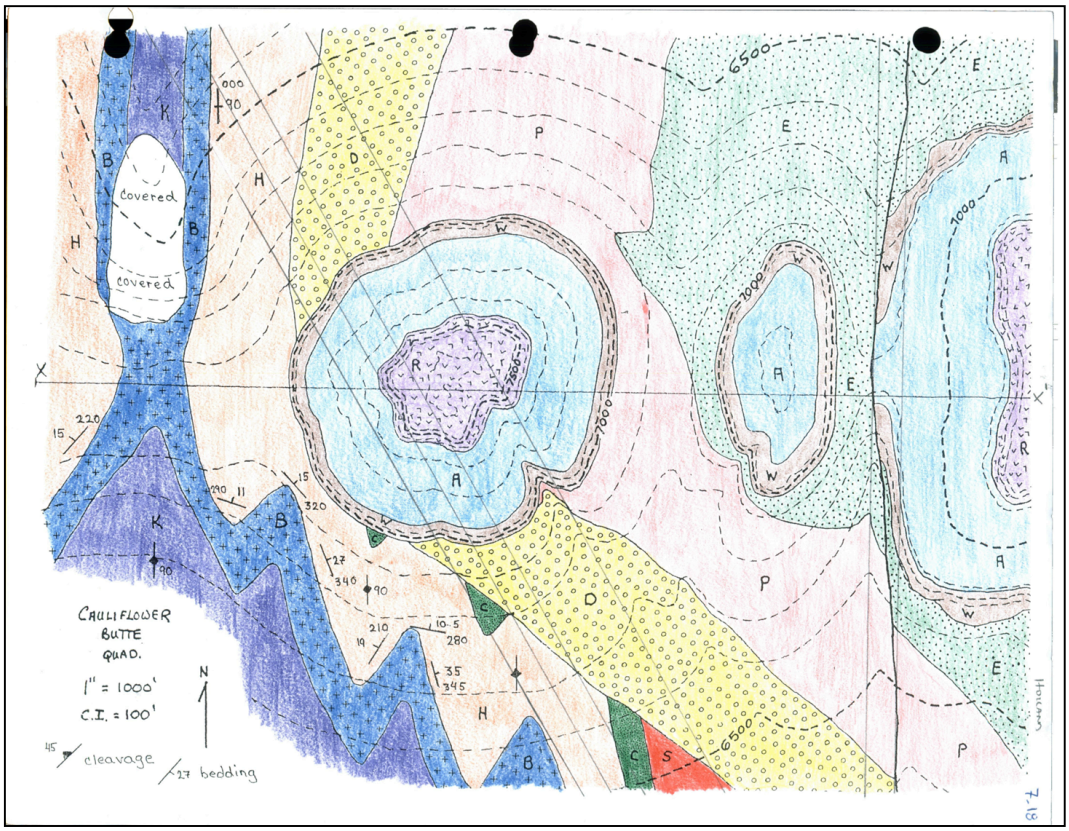
c) fill in box "c" with the proper symbol for the dip and strike of unit D

d) add the locations and proper symbols (including the plunge) for the anticlinal traces for all folds

e) show the proper symbol for any fault trace and movement sense

7) Write a < one page summary of the structural geology and geologic history of this map area. Describe geometries in detail (orientations of units, folds, shear zones, etc.) and how you know them? Describe the units and events oldest to youngest. Try to fit this (cut and paste) below the cross section —it can serve as an extended caption for the cross section.

Cauliflower Butte map



Student Learning Outcome D.1.

Students will formulate a testable hypothesis based on field and / or laboratory observations, and devise appropriate tests of their hypotheses.

2. How will learning outcomes be assessed?

A. What:

i. Over the course of the semester, students in EPS 304L (Sedimentology and Stratigraphy) write three separate reports (~5 pages) communicating the results of their own field-based stratigraphic observations and interpretations from 3 different field sites.
ii. The measure is direct.
iii. A rubric for success is distributed to students before they prepare reports – see attached example. The basic criteria for success are to communicate a) the reasons for conducting the study, b) describe methods and data utilized, c) describe in written and graphic format the results, and d) discuss hypothesis and interpretations of the results. Each of these criteria is graded based on how complete, concise, clearly communicated, and how neatly presented. By the end of the class and completion of the 3 reports, we expect that at least 80% of the EPS B.A. majors will get a ≥75% score on their final report. In addition, we will assess student progress from the first to the last report during the semester.

B: Who:

Evidence will be collected in EPS 304L, a required course for all EPS B.A. majors near the end of the core sequence of such courses.

3. When will learning outcomes be assessed? When and in what forum will the results of the assessment be discussed?

EPS 304L is offered each Fall semester and assessment data will be collected then. Results will be discussed by the department's Undergraduate Committee and disseminated to the full department faculty in the Spring semester each year.

4. What is the unit's process to analyze/interpret assessment data and use results to improve student learning?

The gathering of evidence will be conducted by the faculty instructor in EPS 304L and presented by him/her to the department's Undergraduate Committee for discussion. The Undergraduate Committee and then the full faculty will consider and discuss the implications of assessment for changes to assessment mechanisms, to curriculum design, and to pedagogy. Recommendations will be submitted to the Chair of Earth and Planetary Sciences, in writing, each Fall Semester, no later than 1 October of each academic year.

Student Learning Outcome D.1., assessment in EPS304L.

Example of grading rubric for one assignment

Grading Rubric Pt Lookout

Introduction

Fully and clearly introduce field area and purpose of study/report.

Points possible

3-fully complete and clearly communication
2- moderately complete or clear communication
1-incomplete or unclear communication

Methods

Fully and clearly communciate requirements #1-6 below.

Points possible

3- fully and completely communicated
2- moderately complete and/or clearly communicated
1- very incomplete presentation and/or unclearly communicated

1) Data collected on field trip, 3 different but temporally equivalent outcrops separated by.....
2) Described and interpreted depositional environments of units based on ....
3) Constructed stratigraphic column, obtained columns from adjacent locations and correlated units based on lithology.
4) Interpreted relative water depths using unit descriptions and environmental interpretations
5) Correlated units/rock types

Results

Fully, clearly communicated requirements #1-3 below

Points possible

6- fully, completely communicated 1-3, reasonable interpretations
4- moderately complete and/or clearly communicated 1-3, moderately reasonable interpr.
1- very incomplete presentation and/or unclearly communicated, unreasonable interpret.

1- Unit descriptions (organized and presented in table format)
2- Unit interpretations (depositional environment, depositional conditions, paleoflow direction if possible).
3- Describe correlation (or lack of correlation) between units and subunits.

Discussion of results

Fully and clearly communicate points #1-4 below.

Points possible

6- fully, completely communicated, reasonable interpretations
4- moderately complete and/or clearly communicated, moderately reasonable interpr.
1- very incomplete presentation and/or unclearly communicated, unreasonable interpret.

1- describe overall changes in sea level through time
2- describe which direction was land (or which was direction was offshore region) based on ??
3- Likely direction of storm bed transport & direction of shoreline migration and why???
4- Interpret correlation and/or lack of correlation between units/lithologies and why??

Correlation diagram

Logically and neatly correlate units/lithologies across region.

Points possible

6-complete, neat, geologically reasonable
4-moderately complete, reasonable, and/or neat
1-very incomplete and/or not neat enough to understand

Student Learning Outcome E.1.

Students will present clear and concise written and oral reviews and reports, discussing geological interpretations and problems.

2. How will learning outcomes be assessed?

A. What:

i. Over the course of the semester, students in EPS 304L (Sedimentology and Stratigraphy) read and critically evaluate 5 scientific articles pertaining to Sedimentology and Stratigraphy topics. For each paper, they evaluate and communicate in written format a) why the paper was written, b) the main data used to test the hypothesis, c) conclusions of study, and d) implications of conclusions.
ii. The measure is direct.
iii. Each of these criteria is graded based on completeness, conciseness, and clarity of communication. By the end of the class, we expect that at least 80% of the EPS B.A. majors with get a score of ≥75% score on their final paper evaluation. In addition, we will assess student progress from the first to the last report during the semester.

B. Who:

Evidence will be collected in EPS 304L, a required course for all EPS B.A. majors near the end of the core sequence of such courses.

3. When will learning outcomes be assessed? When and in what forum will the results of the assessment be discussed?

EPS 304L is offered each Fall semester and assessment data will be collected then. Results will be discussed by the department's Undergraduate Committee and disseminated to the full department faculty in the Spring semester each year.

4. What is the unit's process to analyze/interpret assessment data and use results to improve student learning?

The gathering of evidence will be conducted by the faculty instructor in EPS 304L and presented by him/her to the department's Undergraduate Committee for discussion. The Undergraduate Committee and then the full faculty will consider and discuss the implications of assessment for changes to assessment mechanisms, to curriculum design, and to pedagogy. Recommendations will be submitted to the Chair of Earth and Planetary Sciences, in writing, each Fall Semester, no later than 1 October of each academic year.