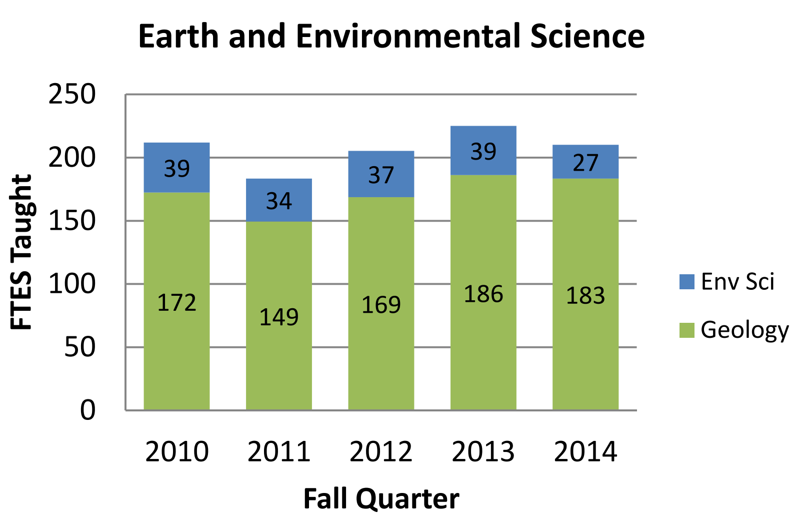
Environmental Science BS Program Annual Report 2014-15

Department of Earth and Environmental Sciences

The Department of Earth and Environmental Sciences in the College of Science offers degrees in Geology (BS, BA, MS) and Environmental Science (BS). The scope of this report is the Environmental Science BS program.

Enrollment

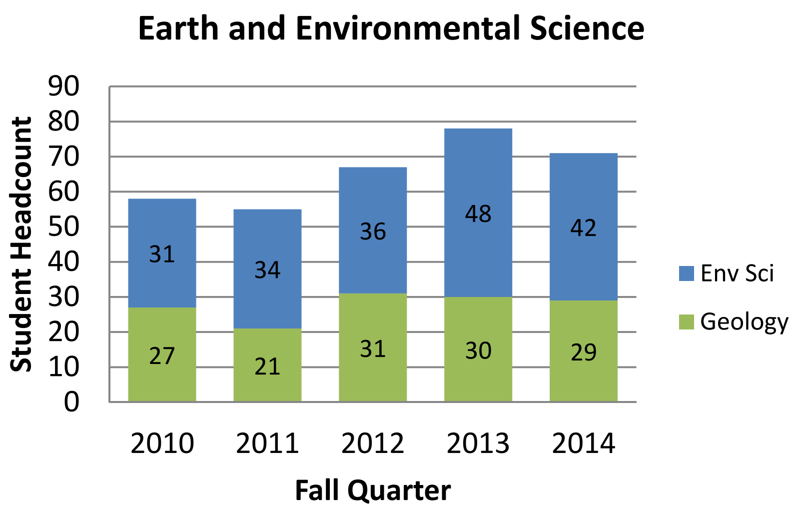
Enrollment in courses offered by the department as measured by Fall Quarter FTES was 210 for 2014 and has been relatively stable during the past two years (see figure below). The majority of the department's FTES are associated with Geology courses. A large portion of the department's enrollment is due to its participation in the General Education (GE) Program. This includes Freshman Learning Communities (clusters) and upper-division GE. The department taught in three GE clusters during AY 2014-15. Two of these included lower-division introductory Environmental Science courses; Global Environmental Problems (ENSC 2801), and Global Environmental Issues (ENSC 2802). Enrollment in Environmental Science courses have been relatively modest to date because most of the courses required for the major are taught by other departments. However, we expect enrollment to increase in the future due to an increased number of majors, a new tenure-track faculty member, and new course offerings.



FTES for courses in Geology and Environmental Science.

Number of Majors

The number of Environmental Science majors was 42 in 2014, a slight decrease from 2013 but higher than the five-year average of 38.



Number of majors in Environmental Science and Geology programs, 2008-2013. Environmental Science indicated in blue.

Student Advising

Advising for the Environmental Science program is provided by the program coordinator.

We created roadmaps for student advisement, which are provided below.

Faculty

The Department hired a new tenure-track faculty member with expertise in Environmental Science, who started in Fall 2013, and who now serves as the Environmental Science Program Coordinator. The department has five tenure-track or tenured faculty members; one Assistant Professor, two Associate Professors and two full Professors.

Due to the small number of regular faculty, we utilize ten lecturers to teach a variety of courses, including introductory courses for non-majors as well as upper-division and graduate level courses for majors. Most are part-time and have been teaching in the department for several years. All have at least an MS degree, and seven have a PhD in Geology or a related field.

Staff

The department normally has two staff members, an Administrative Support Assistant and Instructional Support Technician. The ASA provides office support and the technician prepares and maintains materials for labs. The technician position is currently vacant and a search is underway for a replacement.

Assessment

The department updated its assessment plan earlier this year to provide more details on the implementation for Environmental Science BS program for a five-year period through 2017-2018. The revised materials and assessment results for the current academic year, 2014-2015, are attached.

Department of Earth and Environmental Sciences
California State University, East Bay

ASSESSMENT REPORT 2014-15

ENVIRONMENTAL SCIENCE B.S.

28 June 2015

Department of Earth and Environmental Sciences
California State University, East Bay

Assessment Report 2014-15
Environmental Science B.S.

Contents

Department of Earth and Environmental Sciences
California State University, East Bay

Program Learning Outcomes
Environmental Science B.S.

ILO Alignment Matrix. The table below shows which Institutional Learning Outcomes (ILOs) are addressed by each of the Program Learning Outcomes (PLOs) listed above.

ILO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**
1. Thinking & Reasoning	**X**	**X**	**X**	**X**	**X**
2. Communication					X
3. Diversity	X				X
4. Collaboration				X	X
5. Sustainability				X	X
6. Specialized Education	X	X	X	X	X

Department of Earth and Environmental Sciences
California State University, East Bay

Program Learning Outcomes
Environmental Science B.S.

Students graduating with a B.S. in Environmental Science from Cal State East Bay will be able to:

1. demonstrate practical skills and theoretical knowledge of the biology, chemistry, geology, and physics relevant to the Earth system, in both laboratory and field settings; (Physical and Life Sciences)
2. collect, analyze, and interpret quantitative and qualitative data in order to characterize and address environmental issues; (Data and Analysis)
3. critically consider scientific findings within the context of the social, cultural, economic, ethical, and human dimensions of contentious environmental issues; (Socioeconomic Context)
4. synthesize knowledge of the major components of the Earth system, including physical, biological, and human systems, as well as human impacts; (Synthesis)
5. critically analyze environmental issues through the evaluation of scientific literature, and present their positions clearly and persuasively in written and oral form. (Communication)

ILO Alignment Matrix. The table below shows which Institutional Learning Outcomes (ILOs) are addressed by each of the Program Learning Outcomes (PLOs) listed above.

ILO	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**
1. Thinking & Reasoning	**X**	**X**	**X**	**X**	**X**
2. Communication			X		X
3. Diversity			X	X	X
4. Collaboration		X		X	X
5. Sustainability			X	X	X
6. Specialized Education	X	X		X	X

Curriculum Map for Program Learning Outcomes

CSU East Bay, Dept. of Earth & Environmental Sciences

Degree: Environmental Science BS

			Program Learning Outcomes				
Prefix	**Course**	**Title**	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**
ENSC	2210	Environmental Geology +		I	I	I	P
ENSC	2211	Environmental Geology Lab +			I	I	
ENSC	2400	Environmental Biology	I				
ENSC	2401	Environmental Biology Lab	P				
ENSC	2800	Environmental Problems of California	I	I	I	I	I
ENSC	2801	Global Environment Problems	I	I	I	I	I
ENSC	2802	Global Environmental Issues	I	I	I	I	I
ENSC	2900	Field Activity in Environmental Science	I	I	I	P	
ENSC	3500	Environmental Hydrology +			M	M	P
ENSC	3999	Issues in Environmental Science					P
ENSC	4140	Hazardous Waste Management +		P		M	P
ENSC	4200	Global Change					P
ENSC	4800	Seminar in Environmental Science	P	P	P	M	M
ENSC	4900	Independent Study				P	P
GEOL	2101	Physical Geology			I		
GEOL	2102	Earth and Life Through Time	I		I	I	
GEOL	2210	Environmental Geology +		I	I	I	P
GEOL	2211	Environmental Geology Lab +			I	I	P
GEOL	2600	Introduction to GIS			P	P	
GEOL	3500	Environmental Hydrology +		P	M	M	P
GEOL	4140	Hazardous Waste Management +		P		M	P
GEOL	4320	Hydrogeology			M	P	P

Notes:

See attached Program Learning Outcomes (PLOs)

\+ This course cross listed, appears under both ENSC and GEOL

Levels: I = Introduced; P = Practiced; M = Mastered

CSUEB Department of Earth and Environmental Sciences
Programs in Geology and Environmental Science - Quantitative Literacy Rubric

Quantitative Literacy (QL) is competency and comfort in working with numerical data. Individuals with strong QL skills possess the ability to reason and solve quantitative problems from a wide array of contexts and situations.

This rubric may be applied to student assignments that involve all or parts of any of the department's Program Learning Outcomes (PLOs).

	Capstone 3	**Milestone** 2	**Milestone** 1	**Milestone** 0
Interpretation *Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)*	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information.	Provides accurate explanations of information presented in mathematical forms.	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units.	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means.
Representation *Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)*	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.	Competently converts relevant information into an appropriate and desired mathematical portrayal.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.
Calculation	Calculations attempted are successful and sufficiently comprehensive to solve the problem. Calculations presented clearly and concisely.	Calculations attempted are mostly successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem.	Calculations are attempted but are both unsuccessful and are not comprehensive.
Application / Analysis *Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis*	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.
Assumptions *Ability to make and evaluate important assumptions in estimation, modeling, and data analysis*	Explicitly describes assumptions and provides compelling rationale for each. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.	Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.	Explicitly describes assumptions.	Attempts to describe assumptions.
Communication *Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)*	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support.

After American Association of Colleges and Universities, aacu.org

Environmental Science B.S. Assessment Results, 2014-2015

Overview

The Environmental Science B.S. program was assessed for quantitative literacy during 2014-2015, in accordance with the five-year assessment plan. Two courses, ENSC 2900 Field Activity in Environmental Science, and GEOL 4320 Hydrogeology, were used for assessment. Both of these courses are core courses for majors. The ENSC 2900 course consisted primarily of students who were newer to the program, while GEOL 4320 had a mixture of newer and more experienced students.

In general, students' quantitative literacy lacks the polish expected of majors in STEM fields. Students lack basic mathematical and quantitative skills coming into these majors courses, and this lack of preparation shows through in the assessments. Key areas for improvement include:

a) facility with algebra,

b) ability to read, interpret, and construct graphs, and

c) ability to use basic software such as a spreadsheet program.

"Closing the Loop"

In order to improve learning outcomes for students, and increase student quantitative literacy, the faculty of the Department of Earth and Environmental Sciences will provide additional scaffolding such as pre-assignments, and intensive quantitative problem-solving time with the instructor.

ENSC 2900 Field Activity in Environmental Science – Spring 2015

The assessment was a "mini-project" in which students collected biodiversity data in the field, and spent several weeks analyzing the data. The assignment included computations, data analysis, graphing, and interpretation, and had never been attempted before. Calculations were demonstrated in-class via a walk-through using a spreadsheet program, and students had extensive in-class opportunities for coaching and assistance. Students who did not avail themselves of these opportunities, and students who missed the day of data collection, generally performed worse on the task.

The Quantitative Literacy rubric was used to evaluate student work. Out of 18 possible, overall scores ranged from 0 to 17, with an average of 7.6 and standard deviation of 5.1. Twelve of 20 students who completed the assignment displayed at least the basic level of competency (score of 1) in all six areas of quantitative literacy; only three of 20 displayed competency at the mastery level (score of 2) in all areas. One student displayed an exemplary level (score of 3) in five of six areas of quantitative literacy.

The students in this section of ENSC 2900 are a mixture of a few experienced students (who did not have this lower-division core requirement when it was last offered) and relatively newer students. **There is little overlap with the students assessed in GEOL 4320, also included in this report.** With extensive coaching, many of the students in ENSC 2900 were able to achieve some level of competency, though generally their understanding of quantitative work was inconsistent and incomplete (with a few notable exceptions). Calculations were demonstrated in-class, and students had several hours of in-class time available for coaching and assistance.

Students' quantitative skills were generally poor, but several areas of particular note were:
a) facility with basic mathematical operations for using a supplied formula; b) ability to create and interpret graphs; c) ability to understand and relate quantities to each other; and, d) basic competency with a spreadsheet program.

Possible ways to improve learning outcomes include:

1) a pre-assignment that gives students practice with necessary algebra skills,

2) a pre-assignment to develop skills with spreadsheets and graphing, and

3) further intensive work with data in groups, with the instructor present.

A similar assignment will be used in-class and for assessment again in the future, and some or all of these recommendations will be implemented in order to improve students' quantitative literacy.

GEOL 4320 Hydrogeology – Spring 2015

The assessment focused on data analysis in a laboratory exercise that replicates Henri Darcy's famous experiment in which key parameters are measured and their relationship to groundwater discharge is surmised.

The Quantitative Literacy rubric was used to evaluate student work. Out of 15 possible, overall scores ranged from 2 to 14 (for students who turned in the assignment while credit was still possible, with an average of 4.6 and standard deviation of 4.1 (including two scores of zero). Only nine of 20 students who completed the assignment displayed at least the basic level of competency (score of 1) in all five areas of quantitative literacy; only three of 20 displayed competency at the mastery level (score of 2) in all areas. One student displayed an exemplary level (score of 3) in four of five areas of quantitative literacy. A thorough mastery of basic algebra and graphing is an expected pre-requisite for the course, but some students lack the basic preparation and others have the necessary preparation but their quantitative skills are quite rusty.

Possible ways to improve learning outcomes for this assignment are:

1) a pre-assignment that gives students practice with advanced algebra skills,

2) recommendations for math tutoring at SCAA for students who do not perform well on a math skills pre-test given on the first day of class,

3) an additional, optional, session where students work on problems with the instructor present.

In the future, similar assessment material will be assigned since a fundamental understanding of Darcy's Law is a key student learning outcome for this course.

CSUEB ENSC B.S., Program Assessment
Rubric: **Quantitative Skills**
Course: ENSC 2900 Field Activity in Environmental Science
Quarter: Spring 2015
Assignment: Mini-project

Student ID	**Interpretation**	**Representation**	**Calculation**	**Application/ Analysis**	**Assumptions**	**Communication**	**Total**
1	3	1	2	2	1	2	11
2	0	0	0	0	0	1	1
3	3	2	2	2	2	2	13
4	0	0	0	0	0	0	0
5	1	0	1	1	0	1	4
6	1	1	1	0	0	1	4
7	1	1	0	0	0	1	3
8	3	3	3	2	1	2	14
9	1	1	1	1	1	2	7
10	3	2	2	3	2	2	14
11	2	2	2	1	1	2	10
12	0	0	1	0	0	1	2
13	2	2	2	1	0	2	9
14	3	3	3	3	2	3	17
15	3	2	2	2	1	2	12
16	3	2	2	2	1	2	12
17	1	1	1	1	1	1	6
18	0	1	0	0	0	1	2
19	0	1	0	1	0	1	3
20	1	1	2	1	1	2	8
Average	1.55	1.30	1.35	1.15	0.70	1.55	7.60
Std. Dev.	1.23	0.92	0.99	0.73	0.69	0.69	5.09
Min.	0	0	0	0	0	0	0
Max.	3	3	3	3	2	3	17

CSUEB ENSC B.S., Program Assessment

Rubric: **Quantitative Skills**
Course: GEOL 4320 Hydrogeology
Quarter: Sp 15
Assignment: Lab 5: Darcy Columns

Student ID	Interpretation	Representation	Calculation	Application/ Analysis	Assumptions	Communication	Total
1	3	2	3	3	3	NA	14
2	2	2	3	2	2	NA	11
3	0	1	1	1	0	NA	3
4	2	1	2	2	2	NA	9
5	0	0	1	1	0	NA	2
6	2	2	3	3	3	NA	13
7	1	1	1	1	1	NA	5
8	2	1	2	2	1	NA	8
9	0	0	0	1	1	NA	2
10	1	1	1	1	1	NA	5
11	2	2	1	1	1	NA	7
12	0	0	0	1	1	NA	2
13	1	1	1	0	1	NA	4
14	0	1	1	0	0	NA	2
15	0	0	0	0	0	NA	0
16	1	1	1	1	0	NA	4
17	0	0	0	0	0	NA	0
18	1	1	1	1	1	NA	5
19	0	0	1	1	0	NA	2
20	0	1	0	0	1	NA	2
21	0	1	0	1	0	NA	2
22	0	0	0	0	0	NA	0
Average	0.8	0.9	1.0	1.0	0.9		**4.6**
Std. Dev.	1.0	0.7	1.0	0.9	0.9		**4.1**
Min	0	0	0	0	0		**0**
Max	3	2	3	3	3		**14**

Mini-project: Measuring, calculating, and comparing biodiversity

Ground cover surveys versus counting individuals

Last week, we spent class measuring biodiversity with quadrats, and one group took a survey of all of the trees in the riparian area near where we were counting. Our quadrat sampling protocol measured *ground cover* of the understory, which is slightly different from measuring the *total number of individuals* in an area. It would be really hard to count all of the individuals in a grassland area, so instead we sampled how much of the ground they covered. Indeed, some big plants were probably counted multiple times in our ground cover survey, since they…Cover more ground.

The data sheets for these ground cover surveys were posted online. Hopefully you have been working on entering the data, looking for patterns, and thinking about interesting questions you might be able to answer with the data! For the next ten days or so, I'd like you to work with the data to answer a question that interests you, and write up a mini-report (two to three pages, single-spaced, plus a few figures) about your findings.

The assignment grade will be assigned as follows: **20% formatting, readability, and clarity** *(Is it legible, neatly formatted, and in proper standard written English?)*; **30% completeness** *(Did you come up with and answer an interesting question? Do your plots and data analysis support your question?)*; and, **50% quality of analysis** *(How well does your analysis address your question?)*

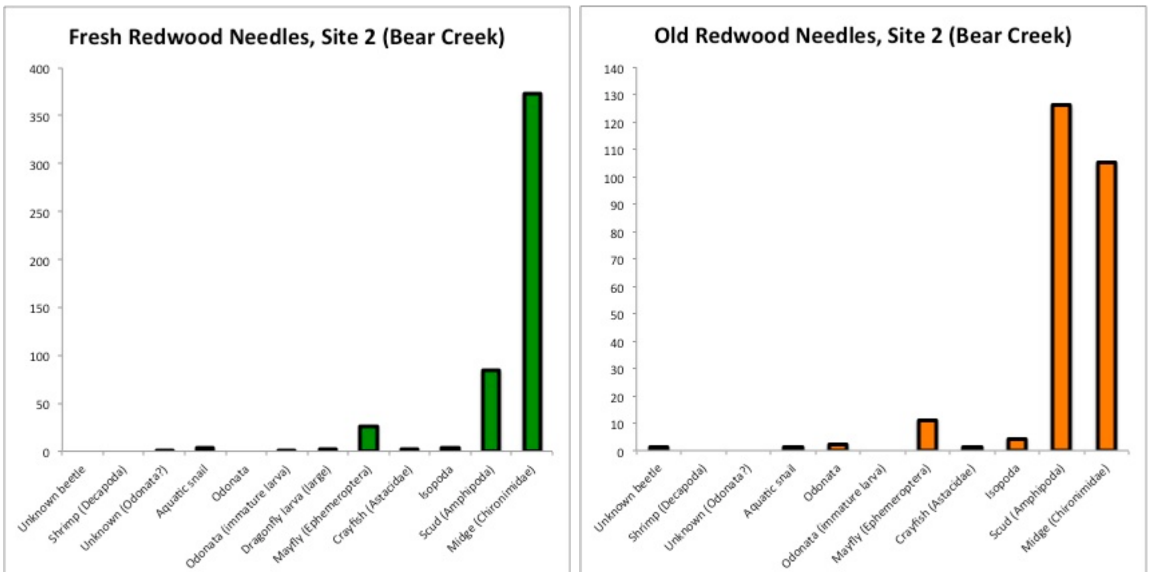
Sections of your mini-report

1) **Introduction:** outline your research question, and your reasons for wanting to address this question (~1 paragraph).
2) **Methods:** normally this would discuss both *data collection* and *data analysis* methods, but I want you to **focus on the data analysis methods for your mini-report.** Give a brief (~1 paragraph) overview of which data you used, and which comparisons/methods you used for comparing biodiversity. For example, did you use Simpson's Index? Did you use the Shannon Index?
3) **Results:** make one or two nice figures (see example) that show your data and tell a story that helps to answer your research question (from the introduction). Then write a short (~1 paragraph) section that highlights the key points of your data and figures.
4) **Discussion and Conclusions:** while in section 3 (Results) you were just *reporting* your results, this section is where you *discuss* them and draw conclusions about your research question. Aim for one paragraph of discussion, and one of conclusion.

Hints and tips

Figures

You should include a few figures in your report. Figures should tell a story, and should help you tell the main story of your findings…They are not just there to make your report look more scientific, more technical, or more official! Here's an example figure, from an experiment I did with a friend, comparing biodiversity of insects in a stream. We let the insects colonize a bag of fresh redwood needles, and a bag of dead, brown redwood needles, then we counted individuals and compared the overall biodiversity of insects. *Note that figures should include a descriptive, self-contained caption!*



Example Figure 1. Species distribution of aquatic invertebrates that colonized fresh and old redwood needles in Bear Creek near Woodside, California. The redwood litter was colonized mostly by midges (Chironomidae) and scuds (Amphipoda). Midges were far more common in fresh redwood needles, while scuds were more common in old needles. Fresh redwood needles also supported a higher total population of individuals.

Diversity indices

One diversity index you could use is called Simpson's Index, and is discussed in the optional reading on Blackboard. Another common diversity index is the Shannon Index (represented by the symbol *H'*), which is given by the formula:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

where i is species i, R is the total number of species, and p_i is the proportion of species i (for example, if species i is 90% of the individuals in the sample, p_i is 0.90).

Submitting your assignment

Your assignment (~2-3 pages, single-spaced, 12-point font, nicely formatted) should be uploaded to Blackboard in PDF format by Sunday night (May 24, 2015) at 11:59 pm.

LAB 7

DARCY'S LAW AND HYDRAULIC CONDUCTIVITY

PURPOSE: Gain an understanding of the controls on groundwater flow through porous media, using a simulation of Darcy's experiment.

OBJECTIVES: Determine the hydraulic conductivity and permeability of four sand samples.

Determine the relationship between discharge and hydraulic gradient.

Determine the relationship between discharge and hydraulic conductivity.

Determine the relationship between permeability and hydraulic conductivity.

Relate the magnitude of hydraulic conductivity to grain size and degree of sorting.

Become familiar with laboratory methods for measuring permeability, using both constant–head and falling–head permeameters.

REPORT REQUIREMENTS: A table of observational and computational data.

A summary of hydraulic conductivity, K (15.5°C), and permeability, k.

The relationship between discharge and hydraulic gradient (constant-head permeameter observations).

The relationship between discharge and hydraulic conductivity.

The relationship of hydraulic conductivity to grain size and sorting.

A note concerning any apparent departures from Darcy's law.

READING ASSIGNMENT: In addition to reading through this lab, read material on permeameters in your textbook (e.g., Fetter, 2001, pp. 90–93) and do Problem 3 (on the CD). Summarize your results from Problem 3 in Procedure 14, which follows.

PROCEDURES

Darcy's Law and Hydraulic Conductivity Using Constant-Head Permeameters

You will use these procedures to simulate Darcy's experiments, measuring flow through two different sands under several different heads. If discharge is a linear function of the hydraulic gradient, $\Delta h/\Delta l$, the constant of proportionality is hydraulic conductivity. By measuring flow as a function of head and graphing the results, the slope of a regression line through the origin will be hydraulic conductivity.

Darcy's Law and Hydraulic Conductivity Exercise

Pages 52-58 intentionally omitted

Department of Earth and Environmental Sciences, CSCI

CALIFORNIA STATE
UNIVERSITY
EAST BAY

ASSESSMENT PLAN: B.S. in Environmental Science

Updated Date: Fall 2014, by Michael Massey

PROGRAM MISSION

[CSUEB Missions, Commitments, and ILOs, 2012]

CSUEB Environmental Science Program Description

The Environmental Science program provides interdisciplinary scientific preparation for students wishing to pursue knowledge and employment in the fields of environmental research, consulting, and oversight. Additional objectives of the program include provision of sufficient preparation for graduate studies in environmental sciences and allied fields and partial satisfaction of the Single Subject Matter Preparation Program for a teaching credential in science.

The Bachelor of Science degree major in Environmental Science is an interdisciplinary program of study in the Department of Earth and Environmental Sciences with faculty participation from the Departments of Biological Sciences, Chemistry and Biochemistry, and Geography and Environmental Studies. In contrast to the B.A. degree major in Environmental Studies, the B.S. degree major in Environmental Science requires students to take a structured core of science courses from a variety of physical and life science disciplines, as well as a specialized upper division science coursework.

PROGRAM DRAFT STUDENT LEARNING OUTCOMES (PLOs)

Students graduating with a B.S. in Environmental Science will be able to:

PLO 1 *ILO 1,6*	Demonstrate practical skills and theoretical knowledge of the biology, chemistry, geology, and physics relevant to the Earth system, in both laboratory and field settings *(physical and life science)*
PLO 2 *ILO 1,2,4,6*	Collect, analyze, and interpret quantitative and qualitative data, individually and in groups, in order to characterize and address environmental issues *(data and analysis)*
PLO 3 ILO 1,3,5,6	Critically consider scientific findings within the context of the social, cultural, economic, ethical, and human dimensions of contentious environmental issues *(socioeconomic context)*
PLO 4 *ILO 1,3,4,5,6*	Synthesize knowledge of the major components of the Earth system, including physical, biological, and human systems, as well as human impacts *(synthesis)*
PLO 5 *ILO 1,2,3, 4,5,6*	Critically analyze environmental issues through the evaluation of scientific literature, and present their positions clearly and persuasively in written and oral form *(communication)*

Year 1: 2013-2014	
1. Which PLO(s) to assess	PLO 4 *(synthesis)*, PLO 5 *(communication)*
2. Assessment indicators	*Brownfield Remediation Capstone Report, Hazardous Waste Management Research Report*
3. Sample (courses/# of students)	ENSC 4800, ENSC 4140
4. Time (which quarter(s))	Winter 2014
5. Responsible person(s)	Michael Massey
6. Ways of reporting (how, to who)	The report was delivered to the Chair, and distributed to the faculty. It was also included within the department report.
7. Ways of closing the loop	Areas of improvement were discussed at faculty meetings, improvements and revisions to future courses are expected

Year 2: 2014-2015	
1. Which PLO(s) to assess	PLO2 *(data and analysis)*
2. Assessment indicators	Course assignments and projects, with department rubric
3. Sample (courses/# of students)	GEOL 4320, ENSC 2900
4. Time (which quarter(s))	Spring 2015
5. Responsible person(s)	Michael Massey, Jean Moran, affiliated faculty
6. Ways of reporting (how, to who)	Reports first to the Chair and then to the entire faculty for comment & discussion. An end-of-year meeting will be devoted to evaluating assessment results and "closing the loop."
7. Ways of closing the loop	Students' quantitative "areas for improvement" will be incorporated into modified/updated core courses for majors

Year 3: 2015-2016	
1. Which PLO(s) to assess	PLO 1 *(physical and life science),* PLO 3 *(socioeconomic context)*
2. Assessment indicators	Short assessment test given in capstone seminar, seminar paper focusing on the socioeconomic context of environmental science
3. Sample (courses/# of students)	ENSC 4800 and one of ENSC 3500, ENSC 4140, ENSC 4200, or other upper-division core
4. Time (which quarter(s))	Winter 2016
5. Responsible person(s)	Affiliated faculty (designing assessment), Michael Massey
6. Ways of reporting (how, to who)	Reports first to the Chair and then to the entire faculty for comment & discussion. An end-of-year meeting will be devoted to evaluating assessment results and "closing the loop."
7. Ways of closing the loop	Disciplinary knowledge assessment will aid with program revision concurrent with quarter-to-semester conversion.

Year 4: 2016-2017

1. Which PLO(s) to assess	PLO 2 *(data and analysis)*
2. Assessment indicators	Course assignments and projects, with department rubric
3. Sample (courses/# of students)	GEOL 4320, ENSC 2900
4. Time (which quarter(s))	Winter 2017, Spring 2017
5. Responsible person(s)	Michael Massey, Jean Moran, affiliated faculty
6. Ways of reporting (how, to who)	Reports first to the Chair and then to the entire faculty for comment & discussion. An end-of-year meeting will be devoted to evaluating assessment results and "closing the loop."
7. Ways of closing the loop	Assess progress made since 2014-2015, adjust strategies. Revise program requirements concurrently with quarter-to-semester conversion.

Year 5: 2017-2018

1. Which PLO(s) to assess	PLO 4 *(synthesis)*, PLO 5 *(communication)*
2. Assessment indicators	*Brownfield Remediation Capstone Report, Hazardous Waste Management Research Report,* or other course assignments
3. Sample (courses/# of students)	ENSC 4800, ENSC 4140, other upper-division core
4. Time (which quarter(s))	Winter 2018
5. Responsible person(s)	Michael Massey
6. Ways of reporting (how, to who)	Reports first to the Chair and then to the entire faculty for comment & discussion. An end-of-year meeting will be devoted to evaluating assessment results and "closing the loop."
7. Ways of closing the loop	Assess progress made since 2013-2014, adjust strategies.

Appendix: Current PLOs, Rationale for the Draft Revised PLOs

RATIONALE FOR PLO (PLO) REVISION, INITIATED IN 2014

The Environmental Science Program Learning Outcomes underwent a proposed revision in Spring of 2014. The draft revised learning outcomes were used in this document (since this document has a five-year scope), even though the draft revisions await the approval of affiliated faculty, before becoming official. The current learning outcomes are listed below.

The rationale for the revision is based on a desire to emphasize the quantitative and systems-focused nature of the interdisciplinary program, as well as to highlight the interconnected nature of scientific progress, science, natural systems, and society. Additionally, the revised PLOs are written with the goal of effective, holistic learning outcome assessment.

The current PLOs are heavily discipline-focused, with PLOs 1, 2, and 3 all related to specific physical and life sciences. These three PLOs were combined into one (revised PLO 1) in the revision process. The program maintains its focus on science, since this learning outcome is in the primary position. The revised PLO 2 is entirely new, and highlights the importance of data collection and analysis in science, since natural science is heavily quantitative and data-driven. The revised PLO 3 is also entirely new, and acknowledges that environmental scientists must be cognizant of social and human factors such as culture, diversity, and socioeconomic status. The revised PLO 4 highlights the importance of synthesis and systems-level thinking in an interdisciplinary field such as environmental science, and PLO 5 maintains the program’s goal of encouraging critical thinking and clear expression.

CURRENT PROGRAM/STUDENT LEARNING OUTCOMES (PLOs)

Students graduating with a B.S. in Environmental Science will be able to:

PLO 1	Apply knowledge of the principles of form, function and organization of organisms at the levels of molecules, cells, tissues, organs, organisms, populations, and communities
PLO 2	Apply knowledge of the fundamental principles of chemistry, chemical structure, bonding, equilibrium, dynamics, and reactions, as well as classes of organic compounds and reactions
PLO 3	Characterize the nature and distribution of earth materials, the processes by which the materials are formed and altered, and the nature and development of the landscape
PLO 4	Synthesize knowledge of the major components of the physical environment, including landforms, climate, vegetation, and soils
PLO 5	Critically analyze environmental issues through the evaluation of scientific literature, and present their positions clearly and persuasively in written and oral form