College Annual Assessment Reporting Form

For activity during 2011-12

College: Science and Mathematics
Submitted by: David Gray/Robert Espinoza, Associate Deans

Due: October 26, 2012

Please provide an overview of college-level assessment activities, if relevant.
Data Collection: Assessment in CSM strives to align University, College, Program, and Course learning objectives in a hierarchically nested manner. In the college, we use direct methods of assessment almost exclusively; data collection is primarily via assignments and exam questions embedded within the framework of courses at both lower and upper division levels. Data collected in this manner incentivize students to answer questions correctly, if they can, and thus provide a good reflection of student learning. Three of the five programs [Physics, Chemistry, Geology] now use nationally standardized exams or assessment exercises as a portion of their assessment efforts. Data Usage: CSM values informed decision making. Across the College, data from assessment, as well as reflection on the assessment process, have led to (1) recitation sections added to high DUF courses in both Chemistry (Organic Chemistry), Mathematics (Calculus), and Physics (majors core), (2) Peer-Learning Facilitators to support student success, (3) support for tutoring centers and SI sections, and (4) we have now implemented changes to course pre-requisites such that pre-requisites need to be passed with a grade of C or better in many areas, notably for students to transition into upper-division biology courses.

College-level assessment process:

Is there a college assessment coordinator or college assessment committee? Is this a new position or committee?

YES. The two Special Assistants to the Dean [Gray/Espinoza] act as the *de facto* assessment coordinators for the College. We have a college assessment committee (est. 2010) that meets at minimum 2 times per year, and has frequent email contact. The College has also established a shared webdrive (1) for liaisons to archive plans, reports, and data, (2) to facilitate sharing of those plans, reports, and data across programs, and (3) provide continuity of assessment as liaisons turn over.

What are their responsibilities?

Assessment in CSM is a shared responsibility of all faculty, thus the liaisons and the College committee oversee assessment, write reports, archive data, etc., but faculty within the departments are the primary contributors to departmental assessment direction, generate the data within their courses, and reflect upon those data to make programmatic improvements.

College-level learning outcomes:

Describe any college-wide learning outcomes.

College-wide learning outcomes in CSM are designed to mirror the University Fundamental Learning Competencies (FLCs) and to bridge the gap from the University level to specific program areas, as follows (also see attached SLO alignment chart):

(1) University: “Knowledge of human culture and the physical and natural world”

(1) CSM: “Knowledge of mathematics, and the physical and natural world”

(2) University: “Intellectual and practical skills”

(2) CSM: “Ability to apply appropriate techniques of scientific and mathematical inquiry, and to analyze and interpret results"

(3) University: “Communication skills”

(3) CSM: “Ability to engage the scientific and mathematical literature, and to communicate scientific and mathematical information verbally and in writing”

(4) University: “Personal and social responsibility”

(4) CSM: “Ability to apply ethical principles in coursework, learning, and research”

Were any college-wide learning outcomes assessed this year? If so, please describe the process used to assess them.

YES. 2011-2012 assessment data were collected that correspond to SLOs 1-3, Knowledge, Intellectual Skills, and Communication Skills. Learning outcome 4, Responsibility, was adopted in 2010 and as of yet has not been vertically integrated to the level of data collection. Data for SLOs 1 and 2 were extensively documented in all five programs, primarily using embedded questions in student exams. Data for SLO 3

were collected both for oral and written communication via laboratory notebooks, student presentations, and written assignments, each of which were scored with previously developed rubrics.

What evidence of student learning resulted from the study?

Based on student performance on embedded exam questions, including in some departments questions from standardized national tests, we can document student achievement for College SLO 1, Knowledge, and SLO 2, Intellectual skills. For example, Chemistry students scored at or above the national average on the standardized national ACS test sections for General Chemistry and Biochemistry. Majors in Biology show improvements in assessment scores over time from the lower division assessments (106/107) to the upper division assessments (322, 360, 380); we expect these gains to continue for two reasons: (1) peer-learning facilitators started in fall 2012, and (2) institution of C or better prerequisite requirement instituted in fall 2012. Physics students (majors as well as GE) score around the national average on the nationally standardized ETS exam; the majors in particular continue to show gains compared to the national average, but the department notes that the small sample size precludes strong conclusions. Geology students given pre- and post-tests show clear evidence of achievement. Mathematics students show demonstrated gains in success in the Calculus series when weaker students are required to take a lab class concurrent with the normal Calculus series. Data for College SLO 3, Communication, were collected in Chemistry [average students scores on their oral communication averaged in the 17-18 range (the rubric codes performance measures from 0-20 points, 20=best)], in Biology 423 as an embedded writing assignment, and in Physics 365. In each of these areas we document adequate but not extraordinary student achievement.

How will the resulting evidence be used to improve program quality?

(1) Chemistry has now added a required 1 unit recitation section to an Organic Chemistry course (333). Data from the prior assessment year (2009-2010) have been analyzed and indicated that students who had 333R concurrent with 333 (N = 85 students) earned D's and F's at a 21.2% rate whereas students who had 333 without 333R (N= 257 students) earned D's and F's at a 41.2% rate.

(2) Biology had now adopted a "pre-requisites passed with grade C or better" policy for most upper division courses. This policy went into effect fall 2012, so as of yet we do not know the effect on student retention and progression to graduation.

(3) Physics has now added a 1 unit intensive review during the first four weeks of the semester for Physics 301 and 311. If deemed successful, this model may be adopted for other upper division

courses in both Physics and in Biology.

(4) Geology made impressive methodological gains in assessment last year, and this year has a variety of specific curricular changes under consideration.

(5) Mathematics will track success rates with the new calculus series requirement of additional lab enrollment for weaker students. These data will form the basis for informed decision making regarding the success of this strategy in calculus, and its possible extension to other high DUF courses.

Fundamental Learning Competencies:

Were any Fundamental Learning Competencies (eg. critical thinking, written communication) assessed this year?

YES. As above, the University FLC related to critical thinking (Intellectual and Practical Skills) is assessed via the college SLO 2. The University FLC related to written communication (Communication skills) is assessed via the college SLO 3. Both of these SLOs were assessed as detailed above.

The only University FLC not to be assessed this past year was FLC 4, Personal and Social Responsibility. This is a relatively new FLC; the college assessment committee has adopted a parallel SLO re. ethical principles in coursework, learning, and research, and the Departments are currently working on ways to incorporate these within existing curricula (e.g. proper environmental disposal of chemical wastes in Biology and Chemistry, discussion of plagiarism in GE and majors core courses, research ethics in independent study as well as graduate core courses).

University: Fundamental Learning Competencies	**Knowledge of human culture and the physical and natural world**	**Intellectual and practical skills**	**Communication skills**	**Personal and Social Responsibility**
College of Science and Mathematics SLOs	Knowledge of mathematics, the physical and natural world	Ability to apply appropriate techniques of scientific and mathematical inquiry, and to analyze and interpret results	Ability to engage the scientific and mathematical literature, and to communicate scientific and mathematical information verbally and in writing	Ability to apply ethical principles in coursework, learning, and research
Biology Undergraduate	Students should demonstrate knowledge of a) the structure and metabolism of cells; b) the transmission and expression of genetic information; and c) the immediate and long term (evolutionary) consequences of interactions between organisms and their environment	Students should be aware of and/or capable of using new and existing methods and technologies in these disciplines	Ability to engage the biology literature and to communicate scientific information verbally and in writing.	
	Students should demonstrate specialized knowledge in one or more disciplines of biology	Students must demonstrate facility in applying the methods of scientific inquiry, including observation, hypothesis testing, data collection and analysis		
Biology Graduate	Students can demonstrate specialized knowledge in one or more disciplines of Biology	Students are aware of and/or capable of using new and existing methods and technologies	Ability to engage the biology literature and to communicate scientific information verbally and in writing.	

		Students can demonstrate facility in applying the methods of scientific inquiry, including observation, hypothesis testing, data collection, and analysis		
Chemistry Program SLOs	1. Demonstrate basic knowledge in the following areas of chemistry: analytical, biochemistry, inorganic, organic, physical	3.Effectively utilize the scientific literature, including the use of modern electronic search and retrieval methods, to research a chemistry topic or to conduct chemical research.	2. Organize and communicate scientific information clearly and concisely, both verbally and in writing.	7.Describe the impact of chemistry on our world, including the environment, the economy, and medicine.
		4.Work effectively and safely in a laboratory environment, including the ability to follow experimental chemical procedures and maintain a proper lab notebook.		8.Demonstrate an ability to determine the scientific validity of a claim that pertains to consumer products, the environment or the life sciences.
		5.Effectively utilize modern chemical instrumentation to obtain data and perform research.		
		6.Perform qualitative and quantitative chemical analysis.		

Mathematics	Students will master numbers and data, carry out arithmetic calculations, understand and use percent in context, make estimates and predictions based on data, and distinguish between reasonable and unreasonable claims based on data			
	Students will demonstrate algebraic proficiency in evaluating and interpreting algebraic expressions involving polynomials, exponents, rational expressions, and linear and quadratic equations and inequalities			
	Students will understand properties of geometric objects such as area, angles, volume, and perimeter, Pythagorean Theorem, plot points and function, and related basic information			

Geology	Demonstrate mastery in identification of rocks, minerals, fossils, and geologic structures	Demonstrate mastery in field methods, including: a) taking accurate and reliable field notes, b) constructing a geologic map, a cross section and a stratigraphic column; and c) observing the geologic relations of a field area and interpreting its geologic history based on these field observations	Communicate clearly and articulately their geologic knowledge, findings, and interpretations in oral presentations	
		Demonstrate competency in using widely used software programs to produce quality geologic illustrations and to analyze data sets and images.	Write technical reports that are well researched, well organized, well illustrated, and well written.	
		Define methods and approaches needed to solve a geological problem.		
		Apply theoretical, conceptual, and observational knowledge to the analysis and solution of geologic data and problems.		
Physics and Astronomy Undergradaute (BS)	1. Demonstrate knowledge of physical principles used to model natural phenomena.	2. Demonstrate ability to convey physical concepts with mathematical expressions, and effectively derive quantitative predictions from a model through mathematical analysis.	6. Communicate clearly and accurately physical concepts, findings, and interpretations in oral presentations.	

	5. Demonstrate special knowledge of the subprogram.	3. Demonstrate understanding of scientific methodology, including: a) data collection from observations, setting up laboratory experiments and data collection from experiments, c) analysis of data, d) testing a model or hypothesis.	7. Acquire ability to write clear, organized and illustrated technical reports with proper references to previous work in the area.	
		4. Demonstrate competency using computer tools, including: a) use of software programs for data analysis and presentation, b) numerical analysis, c) computer simulations.		
		5. Demonstrate special knowledge of the subprogram.		
Physics Graduate (MS)	1. Knowledge of physical principles used to understand and model natural phenomena.	2. Ability to convey physical concepts with mathematical expressions, and effectively derive quantitative predictions from a model through mathematical and numerical analysis.	5. Ability to communicate clearly and accurately physical concepts, findings, and interpretations in oral presentations.	

	7. a) For students selecting the Comprehensive Examination Option: Comprehensive knowledge of the graduate core curriculum in classical mechanics, classical electrodynamics, statistical physics and quantum mechanics. (b) For students completing the Thesis Option: Ability to successfully carry out a program of graduate research and thesis.	3. Understanding of scientific methodology, which may include for example: a) data collection from observations, b) setting up laboratory experiments and data collection from experiments, c) analysis of data, and d) testing a model or hypothesis.	6. Ability to write clear, organized and illustrated technical reports with proper references to previous work in the area.	
		4. Competency using computational tools, which may include for example: a) use of scientific software for data analysis and presentation, b) numerical analysis, and c) computer simulations.	7. a) For students selecting the Comprehensive Examination Option: Comprehensive knowledge of the graduate core curriculum in classical mechanics, classical electrodynamics, statistical physics and quantum mechanics. (b) For students completing the Thesis Option: Ability to successfully carry out a program of graduate research and thesis.	

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