Assessment Activities Report for the Department of Earth System Science – May 2010

Assessment Coordinator: Associate Professor J. Keith Moore

The Department of Earth System Science (ESS) has developed and implemented an assessment plan for both of our undergraduate degree programs. We offer a Bachelor of Science degree in Earth and Environmental Science and have just begun to offer a Bachelor of Arts degree in Earth and Environmental Studies. We formulated six learning outcomes for each degree program, and conducted an initial analysis of the suitability of our curriculum to help students achieve these learning outcomes. This analysis identified several potential gaps or weaknesses in the curriculum for each major. Some modifications to the curriculum have been implemented to address these issues. In addition, we have developed and begun implementation of an ongoing assessment process that will allow us to continue to evaluate and improve the curriculum and departmental activities in the future.

Our initial focus was developing the learning outcomes for both degree programs. This process was helpful in better defining the mission and goals for the new B.A. program, and for delineating and formalizing the key differences between B.A. and B.S. programs in our department. There is some overlap in the coursework and content of these programs. In general, the B.S. program is focused on studying the Earth as a coupled system and the interactions between the various components (i.e. oceans, atmosphere) over longer timescales (decades to thousands of years). The B.A. program is more focused on human interactions with the natural environment at smaller spatial scales (local to regional) and shorter temporal scales (years to decades). A key aspect of the B.A. program is human impacts on the environment through pollution and environmental policy and regulation. The six learning outcomes for each major are listed below.

Earth System Science B.S. Program Learning Outcomes

1- Apply basic sciences (physics, chemistry, mathematics, and biology) to understand the major processes and systems governing the Earth's climate, biogeochemical cycles and global change.

2- Explain the current and projected future state of the Earth system in the context of past climate change and current human activities.

3- Acquire sufficient background knowledge and experience to understand the scientific literature relevant to Earth system science.

4- Understand the methods used to collect and analyze environmental data, interpreting results in the context of underlying theory and the methods used in data collection.

5- Summarize and communicate scientific knowledge in oral and written formats.

6- Work collaboratively to understand and address complex problems related to the Earth system.

Earth System Science B.A. Program Learning Outcomes

1- Understand the scientific foundation and socio-economic factors surrounding major environmental issues (global change, sustainability, biodiversity, ecosystems…).

2- Recognize the impacts of human activities on the Earth system, and in turn the impacts of environmental change on society.

3- Understand the mechanisms by which key institutions, policies, and regulations impact ecosystems and the physical environment.

4- Critically analyze data and policy positions related to environmental issues.

5- Summarize and communicate scientific, policy, and management aspects of the environment in oral and written formats.

6- Work collaboratively to address specific environmental problems through research, analysis and application of appropriate tools.

Initial Evaluation of ESS Curriculum in Light of the Learning Outcomes

We conducted an analysis of the core courses in the curriculum for each major in regards to student achievement of these learning outcomes. This was more difficult for the B.A. major, since many of the new courses for this major are being taught for the first time this school year. Several weaknesses were identified that generally applied to both programs. One was the limited opportunities in our core curriculum for accessing, synthesizing, and communicating information from the primary scientific literature. Secondly, collaborative student work on projects was included in only one of our core courses. Finally, it was recognized that we had no required senior-level, capstone courses that could both help address these weaknesses and allow for assessment of our students shortly before graduation.

Both majors include the ability to summarize and communicate scientific information in both oral and written formats as learning objective 5. The B.S. major objectives also have student ability to access the primary scientific literature. The core course series did not seem to provide students with sufficient practice and experience in surveying and summarizing information from the primary scientific literature. In response to this analysis, a term paper based on review of scientific articles from the primary literature was added in both ESS 53 and ESS 55 (core courses in the B.S. program) and we are looking for ways to add similar experience in the B.A. curriculum. The second identified weakness was that the curriculum of both degree programs included little opportunity for collaborative projects by groups of students (learning outcome 6). We are considering ways of incorporating more collaborative activities into the core coursework. In addition, will re-visit the idea of a adding new, senior capstone course requirement in future years. This would seem helpful to our students and the assessment process, but must be considered in light of campus-wide efforts to limit the number of required courses. Below is the matrix that matches our core, required courses in each major with the respective learning objectives. Multiple courses are relevant for each of the learning outcomes, except for learning objective 6, which focuses on working collaboratively.

ESS Outcomes - BS Program	**1**	**2**	**3**	**4**	**5**	**6**
<u>Required Courses - BS Program</u>						
ESS 25 Intro ESS	**X**	**X**	**X**			
ESS 51 Land Interactions	**X**	**X**	**X**	**X**	**X**	
ESS 53 Ocean Biogeochemistry	**X**	**X**	**X**	**X**	**X**	
ESS 55 Earth's Atmosphere	**X**	**X**	**X**	**X**	**X**	
ESS 114 Field Methods	**X**		**X**	**X**		**X**
ESS 116 Data Analysis	**X**		**X**	**X**		
ESS 191 Intro Research ESS			**X**	**X**		

ESS Outcomes - BA Program	1	2	3	4	5	6
Required Courses - BA Program						
ESS 25 Intro ESS	X	X	X			
ESS 60A Env. Studies I	X	X	X		X	
ESS 60B Env. Studies II	X	X	X		X	
ESS 60C Env. Studies III	X	X	X		X	
ESS 114 Field Methods	X		X	X		X
ESS 180 Global Sustainability I	X	X	X	X	X	
ESS 182 Global Sustainability II	X	X	X	X	X	
ESS 190ABC* or ESS 199/198(H)	X	X	X	X	X	

***ESS190ABC Senior Seminar on Global Sustainability I(2), II(2), III(4) Students write a senior research paper.**

Assessment Plan for the Department of Earth System Science

The department has implemented a two component assessment plan for our degree programs that consists of an exit survey for graduating seniors and a review of final exams from core sophomore level courses. The exit survey polls graduating ESS students to provide direct feedback on the ESS degree programs, strengths and weaknesses of the curriculum, and on how they view their preparation for achieving each of the learning outcomes. Final exams will be reviewed from one sophomore level core course in each degree program (ESS 53 for the B.S. program, and ESS 60C for the B.A. program). There will be a one-page essay question on each exam that will be the basis of this assessment. The essay will respond to a multi-part question, where the questions asked will be designed to tie to specific learning objectives for the program. These exam questions will be included and evaluated during the 2009-2010 school year for the first time. Students responses will be rated in regards to specific learning objectives (as poor, good, or excellent).

The senior survey was initiated in the spring of 2009, but received only a limited response (7 out of 33 students). One problem was that not all students actually graduated spring quarter, but may have finished in winter or fall. In the future, students will be surveyed in the quarter they actually graduate and complete classes. We are considering other options and incentives to increase survey response as well. The seven students who did respond were generally very positive about the department, the curriculum, and their overall experience at UCI. On a scale of 1-5 the average rating of faculty involvement in their education was 4.3, and on the attention given to undergraduates an average of 3.7. Scoring somewhat lower was whether ESS had an adequate number of departmental events (average 3.4). Several students suggested more informal, social interactions between faculty and students. We will analyze these responses from last year as well as those from this year's students as we plan for the 2010-2011 school year. In the future, administration of the senior survey will be conducted by department staff, while the analysis of the responses and development of action items for faculty will be the responsibility of the Vice-Chair for Undergraduate Affairs. The Vice-Chair will also be responsible for reviewing the final exams from the sophomore level courses and for reporting on assessment activities.

Assessment programs typically fall somewhere along a continuum between two paradigms that can be thought of as "assessment for improvement" and "assessment for accountability" (Ewell, 2009). The accountability paradigm is often focused on testing whether students are able to achieve certain learning outcomes mandated by government agencies or national accreditation boards. Its focus is on documenting "success" in achieving the set standards. The improvement paradigm is more focused on finding weaknesses in the program or curriculum, and searching for ways to address these weaknesses. Our activities to date in the department of Earth System Science lean strongly towards the improvement paradigm for assessment. In part, this reflects the interests of our faculty in identifying weaknesses and improving our programs, particularly in regards to the only recently defined learning outcomes. Another factor though is the relative newness of programs in the environmental sciences, and the lack of any agreed upon national standards. The focus in our department on Earth System Science is almost unique, with similar programs at only a handful of other Universities. Thus, there was little guidance for us in terms of national standards, or accreditation tests that cover an agreed upon body of knowledge and skill sets. As the field continues to mature, the emphasis on assessment for accountability could increase in the future.