October 24, 2008

CHAIR PADGETT, Committee on Educational Policy
Academic Senate Office

Re: Physical and Biological Sciences Division Feedback on General Education Reform

Dear Jaye:

I offer the following responses to your August 22, 2008 request for feedback on elements of the general education reform proposal. Due a pre-planned divisional retreat for department chairs and research directors, we were not able to hold this discussion until October 22. We had a lively discussion where various points of view were expressed, mostly centered on the challenges of mounting a sufficient general science curriculum that employs quantitative techniques. Many students lack sufficient preparation (both familiarity with thinking like a scientist and with math course work), and course support costs are increasing as enrollments go up and per-student resources for undergraduate education are declining.

Let me also clarify that this is essentially the dean's answer to these questions. The answers were presented as a draft and discussed with department chairs in attendance at the meeting but were not fully vetted with faculty in the division. Curricular decisions are the purview of the faculty rather than the administration, so I look forward to the opportunity for faculty at large to discuss directly the important questions around general education reform at the upcoming Senate-sponsored forum.

Response to Specific Questions

1. Please propose a description of a SA breadth requirement in the area of Natural Sciences (and Engineering). Descriptions can be short, of the sort seen for Ways of Learning.

Science courses teach students about the essential role of observation, experimentation and measurement and relate them to life outside the classroom. Knowledge of the scientific world and the process of scientific inquiry can impart facts, information, and ideas that provide exposure to modern empirical thinking and are essential to understanding the ethical dimension of many issues and decisions that students face now and will face after college.

2. Also provide explicit educational objectives for the requirement.

To teach key concepts, facts, and theories relevant to living systems and the physical universe and to teach the value of scientific thinking in relation to issues of societal importance.

3. Describe at least 3 courses that in your view would make good candidates for having the Natural Sciences (and Engineering) designation. If they are existing courses, provide their catalogue course descriptions. Just as important, please give examples of courses in the area of Natural Sciences (and Engineering) that are NOT suitable and say why they are not suitable.

Examples of courses that would be suitable for the Natural Sciences designation include (excerpts from the *General Catalog*):

ASTR 2. Overview of the Universe. F,W,S
An overview of the main ideas in our current view of the universe, and how they originated. Galaxies, quasars, stars, pulsars, and planets. Intended primarily for nonscience majors interested in a one-quarter survey of classical and modern astronomy. (General Education Code(s): IN, Q.) S. Vogt, P. Guha Thakurta, A. Steinacker, R. Bernstein

EART 5. California Geology. F
An introduction to physical geology emphasizing the minerals, rocks, volcanoes, mountains, faults, and earthquakes of California. In-class field trips to study the caves, rocks, and landforms of the campus and the

Monterey Bay area. Discussion: 1 hour. Concurrent enrollment in 5L required for majors and minors. (General Education Code(s): IN.) E. Knittle

BIOL 20A. Cell and Molecular Biology. F,W,S
Introduction to molecular biology, cell physiology, and genetics. Students cannot receive credit for this course and course 21A. Prerequisite(s): CHEM 1B; completion of biology placement exam recommended, http://biosci.ucsc.edu/bioplacex.html; enrollment restricted to first-year students, sophomores, and juniors. (General Education Code(s): IN.) The Staff

BIOE 20C. Ecology and Evolution. F,W,S
Introduction to ecology and evolution covering principles of evolution at the molecular, organismal, and population levels. Evolutionary topics include genetic and phenotypic variation, natural selection, adaptation, speciation, and macroevolution. Also covers behavioral, population, and community ecology including applied ecological issues. Completion of biology placement exam recommended, http://biosci.ucsc.edu/bioplacex.html. (Formerly Biology 20C.) The Staff

OCEA 1. The Oceans. F,W,S
An interdisciplinary introduction to oceanography focusing on biological, chemical, geological, and physical processes. Covers topics such as origins and structure of planet Earth and its oceans, co-evolution of Earth and life, plate tectonics, liquid water and the hydrologic and hydrothermal cycles, salinity and elemental cycles, ocean circulation, primary production and nutrient cycles, plankton and nekton, life on the sea floor, near shore and estuarine communities, future environmental problems our oceans face. Students may also enroll in and receive credit for Earth Sciences 1. (Note: General Education credit will not be granted for this course and Biology 80D.) (General Education Code(s): IN, Q.)The Staff, K. Bruland, C. Edwards, M. McCarthy

Examples of courses that would be less suitable for the Natural Sciences designation include the introductory General Chemistry series (CHEM 1A, 1B, 1C and their concurrent labs) and the Introduction to Physics series (PHYS 5A, 5B, 5C and PHYS 6A, 6B, 6C and their concurrent labs) due to the technical nature of these courses and their intent to teach core competencies at the introductory level. Also less suitable for the Natural Sciences designation would be entry-level Math, though this should be regarded as a necessary core competency required for all UC graduates.

For the following 2 questions, please understand "Natural Sciences" and "Engineering" in terms of educational goals, not divisional affiliation. In other words, do not rule out that "Natural Sciences" courses might be offered within the Engineering division and vice versa.

4. Should there be an Engineering general education SA Breadth category distinct from Natural Sciences, reflecting distinct educational objectives? Or should there be one Natural Sciences & Engineering category? Why? If you advocate for a distinction, your answer to "why" needs to help future course approval committees decide whether a proposed course is best classified as "Natural Sciences" or "Engineering."

The combination of Engineering and Natural Science into a single general education category is a historical artifact without obvious intellectual justification. Engineering is a different discipline and as such most engineering courses are not interchangeable in their goals with natural sciences courses. However, we believe that certain Social Sciences Division courses (ANTH 1, ENVS 23 and 24, for example) are similar in goals with natural sciences courses and would be acceptable courses to meet a Natural Sciences breadth requirement. Certainly there are potential courses that might be offered in Engineering (particularly in Biomolecular Engineering, and possibly in other areas) that would also be comparable.

5. If you advocate for separate categories, do you think that there should be an equal number of required courses in Natural Sciences and Engineering? Why or why not? Whether or not your answer is influenced by divisional resource or territorial considerations, please also address the educational rationale.

We believe all students should demonstrate core competencies in basic mathematics, which could include a course in statistics, calculus, or possibly certain courses in programming or in other areas. We also believe

that all students should have meaningful exposure to the natural sciences. Ideally, this should include two courses, at least one of which includes application of quantitative reasoning to a substantive problem domain (the current Q requirement). We offer no opinion on the desirability of requiring exposure to engineering for all students, however, we note that it would be very reasonable to allow students to satisfy the Q through courses in Engineering, Social Sciences, or elsewhere.

6. Should we have separate requirements in life science and physical students (students would have to take a course in each area)?

We disagree with this suggestion; it is a particular strength of the UC Santa Cruz campus that we do not draw an artificial boundary between "life" and "physical" sciences, and many of the most important questions and problems involve interaction between these domains. However, if two courses are required, we believe they should be taken in two different departments.

Please feel free to contact me if you have questions about these responses.

Sincerely,

Stephen E. Thorsett
Dean