Recommendations for Undergraduate Departments and Programs

Session Report: 8:30-10:15 AM, Wednesday, February 22, 2006

The recommended steps below are ordered in order based on the presumed ease of implementation, with easiest at the top. As you go down the list, the complexity of the issues and the additional constituencies increase the will likely increase the difficulty of implementing the change.

- Infuse quantitative skills into undergraduate research experiences/senior theses. This is something that can be done by individual faculty and focuses effort on students that continue to graduate school. It is a good mechanism for increasing ownership of skills by students. Appropriate support structures are needed to ensure successful experiences for students with time to reflect on data quantitatively: structure for experiences, technical support, rewards/time for faculty mentors.
- Communication/coordination with math and physics departments.
    - Provide relevant geoscience examples they can use in their classes.
    - Geoscience and Bioscience now require a broader spectrum and more quantitative skills than in the past. Work with math and physics to coordinate and revise curricula in order to introduce a wider range of quantitative concepts early in the curriculum to support the needs of STEM students (i.e. move away from three terms of Calculus in a row).
    - Coordinate the introduction of quantitative tools such as Excel, Matlab, and computer programming.
    - Introduce computational math in the lower level courses.

  This will require cooperation with biology and leadership at the dean/college level.
- Infuse quantitative competencies across the department curriculum. This will lead to a comfort with skills and their application. This may require redesigning the curriculum but could also be done through discussions between faculty with a matrix describing what is being done. Engage in a conversation that links research tools and problems that are exciting with what is in courses (this has value beyond just the quantitative skills component).
    - Complete a quantitative skills matrix.
    - Redesign the curriculum to spread quantitative skills throughout.
    - Encourage departments to compile a list of their Pillar Skills. Collect these compilations and post on the SERC website.
    - Use the same tools in multiple courses.
- Develop a list of skills (quantitative and other) expected and used in classes and share it with students. Link to examples of how these skills are used in the discipline and in the classes. This would provide information about why these skills are considered central. Set the expectation that students will develop comfort and expertise over the course of the four years.
- Place quantitative skills in context of other pillar skills (e.g. writing, speaking). This is needed to establish their role in the curriculum for both faculty buy-in and

student demand. Develop opportunities for students and faculty to see the range among departments in these skills.

- Use capstone courses, sophomore courses, shadow/paired courses (geoscience/math) to repeatedly introduce new math topics and integrate their use in geoscience problems. This could include seminars or courses focused on solving problem sets or designing mini-research projects – ideally, these would include student-driven content and be quantitative. This could be a course that addresses students needs, assists in reading the quantitative aspects of papers, and/or increases their ability to learn math independently. Geoscience courses could also be focused on introducing tools like Matlab and Excel.
- Advising and Mentoring on skills
    - Provide sufficient contact with faculty in the mentoring and advising process
    - Ensure uniformity across advising faculty population
    - Provide a reward structure for faculty
    - Provide written guidance in addition to oral advising
    - Make a distinction between advising (course recommendations) and mentoring (write letters of recommendation)

  Examples of how advising is done could be shared
- Recommend outside classes for students going to graduate school at appropriate time in curriculum.
    - calculus
    - calculus-based physics
    - chemistry
    - statistics
    - programming
    - linear algebra

  Working with the departments offering these courses is key to condensing time commitments.
- Generate a department culture that emphasizes continual practice and use of quantitative skills.
- Participate in efforts to infuse quantitative skills across the curriculum.