

A Focus on the Undergraduate Curriculum & Student Experience: Fall 2015
Polymer Science and Engineering Response
November 20, 2015

The Polymer Science and Engineering Department (PSE), which confers no undergraduate degree, nevertheless does address the circulated issues/questions with respect to undergraduate curriculum and experience. This document will outline the nature of PSE contributions to undergraduate curriculum and experience, adding comments about possible ways to alter these contributions so as to make PSE efforts more efficient and impactful.

Part I. PSE Undergraduate Curricular Contributions:

Description. PSE offers just one regular topical undergraduate-oriented course, PSE501 *Introduction to Polymer Science and Engineering*, an elective for juniors/seniors in science and engineering majors, with about 50% of enrollment from the Chemical Engineering Department and most of the rest from CNS departments. With UMass well-known world-wide for polymers, UMass undergraduates are frequently recruited by industry into polymer-oriented jobs; in one recent year, over 50% of Chemical Engineering majors entered the workforce with jobs focused on polymers. PSE501 is the chief polymer training for most of these students, and several have reported back to PSE about the importance of this course to their careers. PSE assigns its best instructors to the course and envisages enrollment expanding from about 70 to about 100 in the next few years; even larger enrollments are possible. The course lecture content, split roughly 50:50 between synthesis and materials aspects of polymers, is regularly updated, and the course has enough of a reputation to serve as a model for other universities starting undergraduate polymer overview courses. This course is taught every year over the spring semester, and this timing appears to satisfy current student need and fit into the undergraduate curriculum of target departments.

PSE faculty members regularly teach 3-4 freshman seminars each year, mostly on issues associated with the societal impacts of polymers. Freshman response has mostly been positive.

Advanced undergraduates can enroll with instructor permission in first-year PSE graduate courses, with just a handful (or less) of such students enrolling each year. Outcomes are mixed, with many of the students struggling to fit the PSE course load into their undergraduate course load.

Although not a direct curricular contribution, each year about 30 UMass undergraduates do independent study projects in PSE, many as Capstone project within the Honors College, with some of these endeavors turning into paid Research Experience for Undergraduates summer jobs here on campus. Several polymer peer-reviewed papers are published each year with undergraduate co-author(s), and after graduation, many of the impacted students subsequently enroll elsewhere in polymer-oriented graduate programs. In general, the sophistication and safety

aspects of polymer research limit these opportunities to juniors and seniors, although options can be made available for particularly advanced freshman and sophomores. Typically, an appointed graduate student guides all such students in the lab, adding little or no cost.

Analysis. Current PSE contributions make effective use of faculty time and provide profound, positive impacts on undergraduate learning and experience. There is some capacity to expand these opportunities, and in particular, to add one or two more undergraduate-oriented courses and increase the number of undergraduates participating in PSE labs. The former would require better communication with associated departments (principally, Chemistry, Physics, Food Science, and Chemical Engineering) to design appropriate course that fit other curricular constraints for the relevant degree program(s) (advanced polymer synthetic chemistry and advanced polymer materials properties are possible generic course titles). PSE has the teaching capacity to serve such courses, each estimated to enroll about 20 undergraduates per year. PSE faculty have reached a consensus that undergraduate students enrolled in regular PSE graduate courses should remain highly limited, with most undergraduate student requests denied; experience shows these courses are too difficult for most high achieving UMass undergrads. New undergraduate PSE courses would expand job opportunities after graduation as well as enhance graduate school attractiveness. PSE labs could accommodate 10-20 additional undergraduate lab researchers each year; space and safety are the primary constraints, with most PIs willing to absorb some of the additional costs from their own budgets. Lab opportunities could be both better publicized and better organized to help interested undergraduates find an appropriate slot.

Part Two. Goals for Student Learning and the Student Experience

PSE does not support an undergraduate student group for which PSE would define goals for learning and experience. PSE expects undergraduates completing PSE501 to have a broad polymer perspective that emphasizes the intellectual connections between polymer synthesis, structure, and processing. The course goal is to exceed the standards of the usual undergraduate polymer survey course, reaching the level of expectations for a first-year graduate course (thus, the 500-level course number). In their research lab experiences, undergraduates are expected to be more than a “pair of hands”, with each student understanding and pursuing an independent research project for which they are primarily responsible. Difficulties are mostly encountered when students are too overburdened with regular courses to make the desired time commitment to make progress on their lab projects. Projects of greater than one year seem to work best, as students frequently can progress rapidly over an intervening summer.

The PSE workplace is diverse, with major initiatives associated with the overcoming of traditional obstacles for women and minority group members in STEM disciplines. These initiatives involve invited speakers, special mentoring programs on campus, and alliances with outside organizations such as National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE).

The polymer discipline is highly international, and exchanges and employment overseas are readily found. The people in PSE are themselves highly international in background, and graduate students and faculty members often travel to collaborate with overseas investigators, and likewise, many such investigators travel to UMass. However, no special programs for undergraduate internationalization have been proposed.

Part Three. Curricular Revision Action Plan

Response 3a. Specific Actions within existing resources. As discussed in Part One, there are several steps PSE could take to bolster undergraduate curriculum and experience. None of these steps, admittedly small, can be undertaken alone, and so initiative(s) would have to be co-coordinated with academic units that support their own undergraduate programs. Within existing resources, the major impediments to curricular revision are communication/coordination between these units and PSE, with the course action plans from such units necessarily developed in concert with PSE. The major steps are (i) development of advanced undergraduate courses and (ii) increase involvement of senior undergraduates in PSE lab projects. The latter is the simpler action, which would involve only better communication and coordination with other units, possibly implemented in the less-than-a-year timescale. Undergraduates would formally be encouraged to apply rather than just be accepted to participate after making their own inquiries. Development of advanced courses would take 2-3 years after a plan for such courses emerged from joint unit discussions. A particular target for course initiatives might be the proposed Materials Science and Engineering Program in COE, but at present, to our knowledge this program does not contemplate an undergraduate curricular component.

Response 3b. Actions requiring new resources. None of the proposed actions would require significant new resources. If the number of added courses stretched beyond the 2 contemplated, or the number of additional undergraduates participating in PSE lab research exceeded 10-20, then new resources would be necessary in proportion to number of added courses or students.