Departmental Responsibilities in Curricular Reform

Mathematics, technology, and pedagogy are all elements of the dynamically changing environment in which we teach. Regular curricular review and renewal are therefore essential to good departmental management. Departments should respond thoughtfully and deliberately to change. The need to consider a department’s curriculum can be precipitated by program review, by accreditation requirements, or by internal factors: results of an assessment, students’ need for an expanded major or minor, rising or falling enrollments, and the like.

Curriculum review and subsequent change can be especially difficult in mathematics because of the hierarchical nature of mathematics curricula. Changing one course often forces corresponding changes in prerequisites or in following courses. The leader in the process is normally the chair of the department, though individual faculty may initiate changes. In any case, all faculty in a department should be invited to participate, because most changes affect the program as a whole. Ideally, the department chair fosters an atmosphere in which change is seen as vital to healthy growth.

CUPM recommends that all departments review their curricula regularly. The principles presented in this Guide’s Overview are intended to inform this process. Successful curricular review requires both introspection and looking outward to the department’s mission within the institution and to its place in the larger mathematical landscape.

Building an excellent program entails several responsibilities of mathematical sciences departments.

- **Provide a welcoming community to attract and retain a diverse student and faculty community.** Programs thrive when students and faculty enjoy a collegial working environment. Beyond explicit efforts to recruit and retain students (as elaborated in the section Recruitment and Retention), departments should ensure that faculty are readily available to students for visits, questions, and informal discussion of careers and mathematical interests. Faculty should feel free—and encouraged—to suggest new curricular approaches, new pedagogical techniques, or new uses of technology they believe will improve undergraduates’ experience in mathematics. Thoughtful experiments by faculty should be encouraged, supported, and assessed with an open mind.

- **Be aware of changing national standards and recommendations.** The times they are a-changin’—rapidly. Department chairs and leaders should follow recommendations from national accreditation bodies and professional organizations. The MAA is one among many organizations that regularly announce new curricular recommendations. Every department of mathematical sciences should monitor reports from the MAA, the National Academies, CBMS, and our sibling organizations, including ASA, AMS, AMATYC, SIAM, and NCTM. Schools with actuarial programs should adhere to the advice coming
from the Society of Actuaries and the Casualty Actuarial Society. The accreditation of education programs, formerly under NCATE or NCTM, is now merged under the Council of Accreditation of Educator Programs (CAEP). Encouraging faculty to attend national and regional meetings, to participate in professional organizations, and to report back to departments will contribute to a department’s awareness and vitality.

- **Collect data and evidence to inform decisions.** Departments are unique. National statistics may not reflect a given institution’s student demographics, pressures to provide service courses, number and nature of faculty appointments, and resource constraints. Departments need reliable and comprehensive local data to facilitate preparation of reports and to inform departmental decisions. Important information includes the mathematical preparation of incoming students, retention rates, numbers of majors in each “track”, whether and where students continue to graduate study, and graduates’ typical career paths. Tracking how students fare after introduction of new placement exams, course content changes, or pedagogy experiments can also improve decision-making. Departmental staff or institutional research offices might gather such data, but faculty should interpret the results. Periodic alumni surveys can also help identify valuable academic experiences and suggest new ones. The Assessment section has more details.

- **Hold regular discussions about curriculum.** Departments should spend time as a whole or in special committees to evaluate the effectiveness of their curricula. The departmental discussion should start with an examination of enrollments and demand. Are placement methods, prerequisites, and programs working well for their students? Are the courses aligned with national guidelines? Are grades reasonably distributed? Are textbooks well-aligned with departmental goals for content and cognitive outcomes? Do upper-level courses lead to cognitive development that matches departmental goals? Should new courses or “tracks” be introduced? The departmental database, feedback from students, and speaking with stakeholders inside and outside academia can inform the discussion. Entire departments or subgroups in the department may find it helpful to dedicate a period of time, perhaps a retreat, to discuss these matters in a deliberate and concentrated way. Department chairs should schedule such a retreat periodically and structure the agenda to focus discussion on areas needing attention. Occasionally, an outside facilitator can help a department define its mission and address problematic issues.

- **Hold regular discussions about pedagogy.** Ongoing studies of teaching and learning in college-level mathematics suggest that changes in our pedagogical methods improve our students’ learning and retention. Attention to evidence-based improvements in pedagogy should be part of the department’s regular conversation. Research in mathematics instruction at the lower levels (K-12) shows that when teachers feel free to observe their
colleagues and feel empowered to speak regularly with them about effective methods in the classroom, the quality of teaching improves. Such practices can improve teaching at the college level as well. Departments should encourage regular sharing of teaching experiences and ideas.

- **Schedule frequent conversations with partner disciplines within the institution.** Given the ubiquity of mathematics in the social, biological, and physical sciences, mathematics departments should schedule frequent and regular dialogue with other departments. These interdisciplinary conversations can benefit everyone and build good will for the mathematics department. Collaboration can be formal or informal, but it should be built into the system of governance of the mathematics department so that regular reports are made to the mathematics faculty. Comparing textbooks used in mathematics and in partner disciplines can be revealing for all parties. Such interdisciplinary meetings should also involve the education faculty, if the institution offers education degrees. Close cooperation requires scheduling meetings regularly, at least once a semester.

- **Build and maintain working relationships with mathematics departments in feeder (and receiver) schools to ensure smooth articulation.** The experience of students who move from high school to college, from two-year to four-year programs, and from undergraduate to graduate programs should be made as smooth as possible. In some large public institutions the fraction of two-year college transfers may be around 50%, and articulation may be mandated by the state. In any case, it is crucial that colleges and universities collaborate on an equal footing with their feeder secondary schools and community colleges. Such dialogue is especially important in times of significant change, such as adoption of the Common Core State Standards.

In some states, including Maryland, an informal network, including mathematical specialists in the public school system and delegates from mathematics departments in public and private two- and four-year colleges and research institutions, meets at least once a semester to discuss issues of common concern. An atmosphere of mutual respect and shared interest has fostered excellent relationships and useful collaborations. As a result, many fully articulated programs have been negotiated between individual two-year and four-year schools. This means that students getting an Associate’s degree in mathematics from the two-year school have a very high probability of graduating with a Bachelor’s in mathematics from the four-year program in just two additional years. The group is co-chaired by two mathematicians: one from the flagship university and one from a community college.

There are many examples across the states. The Illinois Articulation Initiative requires that changes in general education and transfer courses be coordinated jointly by the Illinois Mathematics Association of Community Colleges (IMACC) and
the Illinois Section of the Mathematics Association of America (ISMAA). Visiting the Illinois Section page shows that such approvals appear on the agenda and are discussed at regular section meetings. See the 2013 Section meeting agenda. (For more information, see the section on Articulation in this Guide.)

- *Stay abreast of new technologies and review their place in the department’s offerings.* Technology is evolving rapidly, and it raises complex pedagogical, mathematical, and resource-related questions. CUPM recommends that departments consult the section in this Guide on Technology and the Undergraduate Mathematics Curriculum.

- *Encourage faculty to engage undergraduates in mathematical research.* We recommend reading the chapter in this Guide on Undergraduate Research in Mathematics as a way to begin departmental discussion of its place in the curriculum. Faculty members who supervise undergraduate research should receive professional credit for doing so. Students seek out such experiences, and graduate schools and employers increasingly look for evidence of such activity. Although all programs should offer research experiences to undergraduates, their variety and extent will naturally depend on locally available resources.

- *Align the faculty reward structure with educational goals.* Faculty who want to experiment with curriculum or pedagogy often complain that such work is both time-consuming and unrewarded in the promotion, tenure, and merit processes. Failing to align rewards with department needs for renewal and reform leads to stagnation. A department that values faculty involvement in undergraduate research, interdisciplinary courses, experimental coursework, and new pedagogy should assure that suitable credit is awarded in annual reviews. Deans, department chairs, and colleagues should recognize that colleagues who risk doing innovative work deserve both encouragement and support in the planning and execution stages of projects and appropriate rewards when they come up for periodic review.

- *Observe a regular schedule of external reviews.* Many departments are required to undergo external reviews every 5-7 years. Since accreditation agencies and other outside reviewers ask for a lot of information when they visit, departments are compelled to do systematic self-studies. Such studies are a lot of work, but departments should approach reviews as chances to evaluate, renew, and re-energize their curricula. A continual process (perhaps yearly) of internal review should ease the burden of the external process. Two documents from the MAA Committee on Department Review, *Guidelines for Undertaking a Self Study in the Mathematical Sciences* and *Guidelines for Serving as a Consultant in the Mathematical Sciences* offer valuable guidance to departments engaged in review and renewal. The MAA Committee on the Profession publishes
Guidelines for Departments in the Mathematical Sciences every ten or fifteen years. Those and the CUPM Curriculum Guide are frequently used to measure the success of undergraduate programs.

- Work to integrate adjuncts, full-time contractual, and part-time faculty into the department, providing professional development and further training. In many mathematics departments over half of all student-credit hours are generated by adjunct, part-time, and full-time contractual faculty, as well as teaching assistants. The most recent (2010) CBMS study shows that the percentage of undergraduate sections in mathematics departments of four-year colleges and universities taught by tenured, tenure-eligible or permanent faculty increased slightly between fall 2005 and fall 2010 from 48% to 49%, and from 47% to 49% in statistics departments. But this is still under 50%. In public two-year colleges, the percentage of mathematics and statistics sections taught by full-time faculty declined from 56% in fall 2005 to 54% in fall 2010. Section D of the Summary in the CBMS study gives more extensive data. Since the sections taught by the non-tenured or tenure-track (NTT) faculty are generally lower-level courses with larger enrollments, a significant number of undergraduates taking courses in mathematics are taught by this workforce.

Innovative ideas come from many sources, and many grant-funded experiments are worth replicating. Nationally-funded, innovative ideas to improve the undergraduate curriculum are numerous. Nevertheless, few of them are scaled up enough to have a national impact. Moreover, much of this innovation focuses on the first two years of the curriculum. The large number of NTT faculty teaching these courses makes it important that there be an entirely new professional development effort directed toward them.

Departments with many NTT faculty should work systematically to integrate this workforce into the department in a way that compensates them for their time in professional development and promotes dialogue with regular faculty about the course content, technology, and pedagogical methods they are being asked to employ. CUPM encourages departments to modernize their curricula in tandem with the professional development of the NTT teaching corps.

MAA has offered NSF-supported Professional Enhancement Programs (PREP) (funded at least through summer 2015) for regular faculty for many years. CUPM recommends that departments consider supporting several NTT instructors in PREP offerings. A recent grant to the MAA will provide a program of professional development to those who are responsible for helping new teaching assistants succeed in the classroom. CUPM urges a greater national effort to improve and support professional development.
• Department chairs should participate in professional meetings and workshops specifically designed for chairs. CUPM encourages department chairs and undergraduate coordinators to attend national meetings and PREP workshops, where meetings of chairs and coordinators are devoted to sharing information and providing support for the management of the full range of departmental responsibilities. Networks for mentoring new chairs should be facilitated through the professional societies. CUPM recommends that MAA initiate a kind of “Project Chairs” to include chairs of two-year schools as well as colleges and universities.

Departments have the primary responsibility to set the curriculum, to help other departments select appropriate mathematics courses for their own students, and to develop major programs that are thoughtfully and intentionally designed to prepare their students for success in subsequent courses and for careers in the mathematical sciences. The department chair should provide leadership that encourages collegiality, cooperation, and innovation in assessment of these programs and in their continual renewal.