Natural Sciences and Mathematics in the Liberal Arts: A Renewed Spirit of Collaboration and Innovation

April 15, 2009

A report submitted by:
Matt Côté (co-chair)
Pallavi Jayawant
Hong Lin (co-chair)
Rebecca Sommer

Section I: Background and Overview

The team tasked in October 2009 with heading the President's initiative entitled "the Natural Sciences and Mathematics in the Liberal Arts" began by asking itself what the phrase "science and mathematics in the liberal arts" could and should mean when considered in different contexts. During preliminary explorations of the question it was helpful to separate—admittedly rather coarsely—the student body into two camps: those who major in science or mathematics, and those who tend to minimize their course work in those fields. Despite the fact that this separation ignores very real gradations in students' interests and course taking patterns, it was a fruitful starting point. It led us to the fairly obvious question of what role science and mathematics should play in the education of a liberal arts college student if the student's primary focus of study lies in fields far removed from science or math. It also prompted us to ask whether and how the education of science and math majors at a liberal arts college ought to differ from that of their peers at other types of institutions. How should the science and math faculty at liberal arts colleges adapt their approaches to research and teaching to their institutional context? How should a liberal arts institution structure itself so that mathematics and the natural sciences contribute maximally to the college's mission and adhere most closely to its core principles?

The President's initiative entitled "the Natural Sciences and Mathematics in the Liberal Arts" is timely and propitious in several ways. It takes place in a period when it is widely acknowledged throughout the scientific community that the boundaries that once clearly separated fields have become porous and even poorly defined. These changes have important ramifications for the teaching of students who choose to focus their studies on one of the natural sciences or mathematics and also for students whose primary educational focus lies elsewhere. They also highlight and magnify the need to encourage and support collaborations—whether planned and formal, or spontaneous and informal—between faculty whose expertise and training lie in different fields.
The initiative is opportune also because it comes while the College is halfway through the transition from a general education program that structured much of its curriculum for nearly thirty years, to a new program that seeks to stimulate both faculty and students to think differently about the educational process. The new program includes rationales with its requirements, so that the educational goals are clear; it explicitly includes components of a Bates education that previously went unacknowledged, such as courses taught in interdisciplinary programs, extracurricular activities, and community service; and it encourages faculty and students to think of a student’s work within their major and in other areas as mutually supporting components of their education rather than siloed activities. While broad discussions of the goals of a Bates education played a major part in the development of the new program, it is fitting that the College should use this transition period to examine on a finer scale what we seek to achieve as teachers and scholars. An examination of the question of what it means to study the natural sciences and mathematics in a liberal arts college is therefore appropriate.

As further evidence of the timeliness of the science and math initiative, we point to the unusual opportunity to hire several new tenure track faculty within the division. The retirement of some senior science and mathematics faculty has led to several tenure track searches in the natural sciences and mathematics occurring within a brief period. Three of those have taken place in the last two years—two in physics and one in mathematics. In each case the College was able to hire the search committee’s first choice. Two more hires are planned in biology over the next two years. Overall, this will lead to the infusion of fresh new ideas and new energy into the division. It also highlights the importance of collectively defining our goals as we prepare to move forward.

**Opportunities for Collaboration**

For many years faculty in the division of natural sciences and mathematics have been active in the areas of curricular innovation and scholarly research, yet the College has the opportunity to benefit more from our efforts. The success of our students after graduating from Bates demonstrates that they have benefited greatly from opportunities to work closely with faculty in research and teaching labs, offices, and classrooms. In fact, it could be argued that the close working relationship between students and faculty is one of the key features that characterize students’ experiences in the Division of Natural Sciences and Mathematics at Bates. This intimate working relationship is most obvious in the context of faculty supervised senior theses and other capstone experiences. However, it is also evident in the full range of faculty-student interactions that students experience during their four years at Bates.

Based on anecdotal evidence accumulated over many years, there is at Bates a widely held belief that while many highly selective liberal arts colleges tout close faculty-student interactions as a feature of the education they provide, Bates is unusual in the frequency and depth of those relationships and the quality of the resulting student work. Some of this evidence is in the form of testimonials from
Honors thesis examiners, who have said of our best student thesis work "this would Masters degree level work at my institution." In the sciences, student-faculty collaborative research is so deeply embedded that it has become a defining characteristic of the division's culture. It shapes not only the senior capstone experiences, including theses, but also trickles down into one-on-one independent study research projects, and strongly influences the way in which courses are designed and taught.

Faculty efforts to maintain strong research programs and provide strong senior thesis and other capstone experiences have spun off benefits throughout our curricula. Motivated to ensure that students will be poised to take full advantage of senior capstone experiences, departments have designed courses and adopted pedagogical approaches that prepare students for highly successful culminating senior experiences. Starting in introductory courses, students are introduced to the scientific approach to gaining new knowledge as well as to intellectual and hands-on techniques that are then refined and extended in later courses. The complementary goals of instilling a sense of the open-ended exploration that characterizes research, as well as teaching important standard techniques, have found their way into our intermediate and introductory courses. The fact that examples of these efforts are found throughout our division suggests an underlying common goal: taking students beyond the role of passive absorber of established information to active participant in a creative intellectual process whose outcome is not defined at the outset.

While this common goal is discernible in the individual efforts of faculty, it has not yet been actively and collectively given voice by the science and math faculty. In fact, one of the main goals we have identified as a result of the work on the science and math initiative this year is to organize the efforts and creative activity of individual faculty and departments so that we can work more coherently as a division to further a set of shared and well defined goals for our teaching and our scholarship.

Evidence for the opportunity to better connect the work of faculty in different departments within (and beyond) the science and math division is ubiquitous. The majority of students enrolled in a particular introductory math or science course will not major in the field to which that course is meant to be an introduction. Instead, most of the enrolled students will major in one of the other sciences, or perhaps in a field outside the science and math division. Nonetheless, interdepartmental discussions of the content of introductory service courses have historically been infrequent at best.

Similarly, there is considerable overlap between the content of introductory chemistry and physics, for example, but that overlap is haphazard rather than purposeful. It might be beneficial for students to see the same material more than once and in different contexts, but those redundancies should occur by design rather than as a result of a lack of communication between the faculty and departments offering the courses.
By passing the new general education legislation in 2006, faculty demonstrated that they are convinced of the need to define some minimum exposure to science and mathematics. However, many faculty also expressed a desire to find ways to deepen and broaden the science and mathematics education of our students beyond what would be achieved by simply taking three courses that are designated as S, L, and Q. It was hoped that through the newly developed vehicle of general education concentrations (GECs), which consist of a coherent set of courses with a shared theme or focus, we might find ways to present students with a broader, more engaging, and more coherent exposure to science and mathematics. The President’s science and math initiative has served as an impetus to rekindle these interests in using the GEC structure as a way to enhance science and math education at Bates.

Before delving into the details of projects and discussions we have embarked upon this year, we would like to pause to note a thread which has emerged from our discussions of what we seek for our students in math and science courses, from our efforts to develop an assessment program for our teaching of quantitative reasoning, and which we believe could also be found in other facets of a liberal arts education. We seek not only to convey knowledge and teach skills to our students, but also to cultivate a particular intellectual disposition. By engaging students with problems for which there are no preordained answers, and for which there may be no clear moment of resolution and closure, we encourage students to take risks and to be willing to take on challenges even when they do not initially know how to tackle them. We want them to see underlying connections and to proactively make use of whatever tools can be beneficially applied to a problem rather than unnecessarily limiting themselves to established approaches or perspectives. In short, we want our students, while at Bates and after they graduate, to be active and creative contributors to the world of ideas.

Section II: Activities this Year

Facilitating Discussions
The team has facilitated discussions among science and math faculty by holding two division meetings and many small group discussions. The first division meeting, held last November, was a brainstorming session during which ideas, projects, and issues that might be included as part of the initiative were identified and organized into three categories: science and math curriculum innovation, faculty-student scholarship, and facilities. It is not surprising that many of the identified topics spanned two or more of the categories given the strong coupling between curricular and scholarly work among science and math faculty at Bates. In fact, this is noted as one of the division’s defining characteristics and one of its strongest features. There was wide agreement among those who attended the meeting that we should begin by focusing on the curriculum in its broadest sense: the goals we have for our students, the courses and associated laboratory components we teach, and the student research experiences we provide during the academic year and the summer. One of the ideas that emerged from the meeting was to develop a four-course sequence that truly integrates introductory science and math content. This idea attracted strong interest of roughly ten faculty members drawn from departments
throughout the division and led to a series of group discussions. Over a period of about two months faculty from biology, chemistry, mathematics, and physics met regularly to identify opportunities to improve our degree of collaboration on curricular design and implementation. Participants began by educating each other about the content and structure of their current introductory courses, and goals for their students. The discussions were very constructive and provide a model for further interdepartmental collaborations within the division and beyond. The following core principles emerged from these discussions and led to the submission of a $1.4 million grant proposal which is described in the next section.

1. Student learning will be significantly enhanced if the presentation of topics is orchestrated to maximize students’ awareness of the interdependence of topics they normally see in separate courses. Highlighting those connections will minimize students’ tendency to “pigeon hole” topics as lying strictly within a particular field.

2. Many core topics covered in traditional introductory science and math courses are duplicated in courses taught by different departments but this duplication is not done purposefully and with coordination between instructors. This is not only an inefficient use of teaching resources, it is poor pedagogy.

3. Most first and second year college students will take advantage of the connections between fields and topics only if the exposition of those connections is explicitly designed into the courses.

4. Student interest and understanding will be enhanced if introductory courses are designed to emphasize the depth and quality of coverage rather than to maximize the number of topics covered.

5. Enhancing students’ scientific reasoning skills, and teaching them to apply those skills, are as important as covering scientific facts. It is becoming widely acknowledged that hands-on experiences are particularly effective tools for teaching scientific reasoning, whereas presenting facts in prepackaged form is largely ineffective.

6. Students whose background leaves them at risk of underperforming in traditional introductory science and math courses will be better served by courses that include the teaching of foundation skills and concepts than by courses that assume that all students have the same background.

7. Faculty whose own science and math educations were compartmentalized and rather narrow will need faculty development support and release time to learn from faculty in other fields in order to teach effectively in more integrated courses.

8. Tomorrow’s scientists and mathematicians will find it increasingly necessary to cross traditional disciplinary boundaries as they do their work, so today’s science and math students should have college level exposure to key ideas in each of the STEM disciplines. Even those whose studies focus in fields outside science and mathematics
should have a firm foundation in the nature of scientific reasoning and the foundational ideas in each field.

The second division meeting was held on April 8. Prior to the division meeting, the team met with Kelly Kerner and Erin Martin in the Advancement Office and invited them to attend the division meeting and have conversations with science and math faculty. At the division meeting, Kelly Kerner and Erin Martin introduced the process of college fund raising. The faculty attendees talked about various needs in faculty-student scholarship and curriculum. Many expressed enthusiasm about the opportunity to assist the Advancement office in fund raising by giving presentations to Bates alumni and other potential donors. It was very useful for the division to hear about how fund raising priorities are set within the College and how faculty can contribute to the process. We believe that this conversation will probably foster future collaboration between the science and math faculty and the Advancement office. Another topic of the second division meeting was collecting ideas that might be topics for a workshop on curriculum innovation. Many ideas were proposed, among which enhancing computational skills in the curriculum was echoed by faculty from several different departments and programs. The planning for the workshop will be continued during the Short Term. The workshop will be funded by a grant which is described in the next section.

The team also reached beyond the division by inviting a dozen faculty from fields outside the natural sciences and mathematics to a lunch discussion. The invited faculty included both junior and senior faculty, from humanity (philosophy, religion, music), social science (anthropology, economics), environmental studies, and Harvard Center for Community Partnerships. The team asked the group for their perspectives on the role of science and math in liberal arts education. There was a wide agreement in the group that all Bates students should graduate with quantitative reasoning skills and significant experience with math and science at the college level. During the wide ranging discussion the following points arose and garnered support:

1) Hands-on experience and application are important ways of learning.

2) While teaching scientific and mathematical content, it would be useful to view the topic from historical and social perspectives.

3) Collaborative, multidisciplinary, or interdisciplinary teaching is good in many ways, but requires significant time for both curriculum and faculty development.

4) Consider questioning the standard coverage model in order to make courses more interesting and useful to students who will not major in the subject.
Seeking funds for curriculum development
The team has worked actively to seek external and internal grants to support curriculum innovation efforts in the division.

NSF PRISM Grant Proposal for Integrated Math and Science Curriculum
As described above, many faculty members have taken part in the discussions on an integrated science and math course sequence. Working with a looming deadline, the group ultimately put together a $1.4 million grant proposal which was submitted to the National Science Foundation in February. The proposal was submitted to the NSF's Proactive Recruitment in Introductory Science and Mathematics (PRISM) program, which was brought to the division's attention last fall by Peter Wong. Five faculty members (including the four members of the team) are PI and co-PI's of the proposal.

The proposal aims to attract and retain students, particularly underrepresented minorities, who arrive at college with an innate interest in mathematics and science, but who often lose interest in those fields when they take traditional introductory science and mathematics courses. We believe that one of the primary reasons that these students ultimately choose to focus on other fields stems from the fact that the introductory courses we now offer in each of the sciences and mathematics are taught in isolation from each other, with essentially no coordination. In addition, the content of the courses, and the manner of its presentation, is often geared toward future majors in each field in spite of the fact that in most introductory math, chemistry, and physics courses, the majority of students enrolled in each course will not ultimately major in the corresponding field. The result of this is that students who might greatly enjoy future study of the STEM fields can be turned off and perceive themselves as not being among those who were “meant” to be science or math majors. In addition, the disconnected and isolated nature of the courses encourages students to compartmentalize their knowledge of each field and miss opportunities to apply what they have learned in one discipline to what they are studying in another. Because some students take chemistry before physics, for example, while others follow the reverse order, and many take courses in only one of the fields, the connections between the fields go unappreciated and underutilized by students. This compromises the education of students who choose to major in STEM fields, and discourages those who might have gained much from—and contributed a great deal to—the fields of mathematics and science had they had a more enticing introductory experience.

Based on the core principles described in the previous section, the grant proposes to design a four-course sequence that integrates selected core ideas drawn from introductory mathematics and science curricula. Its design and implementation will take advantage of Bates College’s new general education concentration structure; its five-week Short Term; its ongoing programs to recruit, retain, and support students—particularly those at risk of underperforming in traditional introductory science courses; and its liberal arts context which is ideally suited to the development of novel pedagogical approaches.
To take advantage of Bates’ newly implemented general education concentrations the plan proposed in the grant is to develop a four-course sequence, aimed primarily at first and second year students, and called Integrated Mathematics and Science I-IV (IMS I-IV), that purposely and strategically embeds the teaching of mathematics into the teaching of science. The scientific content will be drawn from physics, chemistry, biology, and geology, with the first two semesters of the sequence presenting an integrated treatment of chemistry and physics, introducing and highlighting mathematical ideas in natural contexts as they arise. The third and four semesters of the sequence will continue the theme of weaving mathematics into the teaching of biology and geology, but those two sciences are likely to be presented in two separate one-semester courses rather than integrated together as in the case of chemistry and physics. The key point is that in each case the material from each field would be fully integrated with an eye toward emphasizing conceptual connections rather than leaving students with the idea that "we are now studying physics" and "next we will study chemistry."

The goal of the project is to increase the ability and disposition of Bates students, irrespective of their major, to apply scientific and quantitative reasoning; increase the number and percent of underrepresented minorities who graduate with a degree in the natural sciences, particularly chemistry, mathematics and physics; increase the number and percent of underrepresented minorities who take courses in the natural sciences, particularly chemistry, mathematics and physics by offering courses that are attractive to those who are put off by more traditional introductory offerings; and develop a curriculum that may serve as a model for other similar institutions. In addition to course-release funds for faculty curriculum development, the PRISM proposal requests support for research for first year students and sophomores, stipends for faculty to supervise this research, and stipends for upper class students to assist the students in this research. Given the competitive nature of national funding we do not know if the proposal will be funded after the first try, and we will not hear from the NSF until late this year. In the meantime we plan to include the integrated mathematics and science project as one of several curriculum innovation ideas to be discussed in the workshops described in the next paragraph.

**Intramural Mellon Grant Proposal for Curriculum Innovation Workshops**

To keep the momentum of discussion about science and math curriculum in liberal arts education, the science initiative team received a grant of $30 K from the College’s Mellon Faculty Innovation Fund for curriculum innovations in natural sciences and mathematics. The grant supports two workshops, one in early June and the second in early fall, to further the goals of this initiative. In the first workshop, we will convene interested faculty in science and math to discuss a variety of novel curriculum ideas and projects, defined broadly enough to include student/faculty research. Faculty interested in each project will participate in its development over the summer. A second workshop will provide a venue for the presentation, discussion, and further development of each project. Speakers with pertinent expertise will be invited to Bates to augment the discussions among Bates faculty. We expect these workshops to spawn projects that will be the basis for grant
proposals, will be integrated into the Bates curriculum, and will serve as models for other institutions. As discussed in the previous section the planning for the first workshop began at the second division meeting held on April 8. This will continue with more discussions during the short term.

Teagle Proposal for Quantitative Reasoning Assessment
Bates and Bowdoin Colleges have requested a grant of $148,780 from the Teagle Foundation’s Systematic Improvement in Student Learning initiative for a three-year collaborative project that addresses the acquisition of quantitative reasoning skills among our students. The proposed project uses a faculty workshop model to identify and assess the set of understandings, skills, abilities and dispositions that are necessary if our students are to have confidence in their application of quantitative reasoning. Based on faculty’s enhanced understanding of what students need, they will then introduce improvements to curricula and pedagogical techniques that ultimately will lead to an enhancement of student learning on both campuses.

This project will extend and deepen our understanding of how best to implement the quantitative reasoning components in our respective general education curricula, develop synergies with our existing collaboration in the Teagle-supported NECASL project, and reinforce our shared goal of fostering ongoing conversations about quantitative learning outcomes for our students among our faculty. The proposed project will also provide opportunities for participating faculty and administrators to share results with wider national audiences in higher education and public policy arenas.

This past fall, faculty from Bates and Bowdoin participated in the Project Kaleidoscope workshop on “Quantifying Quantitative Reasoning in Undergraduate Education: Alternative Strategies for the Assessment of Quantitative Reasoning” at Carleton College. A crucial feature of the workshop was the creation of an action plan that delineated the next steps for achieving the groups’ goals, allowing faculty to translate their ideas into action upon their return to campus. The action plans of both Bates and Bowdoin, who were working separately at the time, recognized that recently instituted general education programs included quantitative reasoning requirements, but lacked fully developed assessment programs and support for the teaching and learning of quantitative reasoning across the curriculum. As participants in this workshop, which included 24 institutions, our faculties were exposed to a broad range of thinking in the academy about the need to look at Quantitative Reasoning as part of a well-rounded liberal arts education. Discussions of QR assessment and program design were led by a team of 15 facilitators with extensive expertise in the area. The workshop was held at Carleton College because they have done substantive work on the importance of developing quantitative reasoning ability. Carleton’s Quantitative Inquiry, Reasoning & Knowledge (QuIRK) program is a model that the two colleges are reviewing. Carleton faculty look at writing samples as part of their evaluation of QR, and Bowdoin is interested in
piloting an assessment project with a similar design using student writing samples collected as part of the NECASL project.

This proposal represents the efforts of our two institutions to work together to take the next steps to create an assessment-driven approach to this important component of general education.

For this project we propose to use the results of three stages of assessment to improve our teaching of quantitative reasoning at Bates and Bowdoin colleges. We will achieve systematic improvement through a set of nested cycles of assessment and intervention, operating on different timescales. The three modes of assessment we plan to employ are as follows. 

The experience we have gained on our campuses as a result of our increasingly detailed and ambitious assessment efforts will serve us well as we address the complexities of this project. We will assess the quantitative reasoning of our students at three points in our students' academic careers: upon their arrival as first-year students, near the completion of their first quantitative reasoning course, and just prior to their graduation. At each stage we will use a combination of quantitative and qualitative assessment techniques to assess students’ quantitative skills and their ability and inclination to apply those skills when reasoning from evidence. This approach has been devised with the following goals in mind:

1. Identify in the quantitative skills of incoming students any weaknesses that would prevent first-year students from benefiting fully from the quantitative reasoning components of their first-year courses.
2. Establish the baseline quantitative reasoning performance of incoming students so that changes in their performance while at college can be measured.
3. Assess both the absolute quantitative reasoning performance achieved by our students as they near graduation, and the changes in that performance since their arrival as first-year students.
4. Determine the extent to which improvements in students’ quantitative reasoning can be attributed to individual courses with quantitative reasoning components versus four years of maturation and education without a specific focus on quantitative reasoning.
5. Assess students’ disposition to seek and use quantitative evidence when it would augment an argument.

Section III: Findings and Recommendations

The main outcome of this initiative is a renewed spirit of collaboration and innovation within the Division of Natural Sciences and Mathematics at Bates College. Within the larger context of an increasingly cross-disciplinary culture within science and math, a number of events at Bates, including the adoption of new general
education requirements, the hiring of several new faculty members within the Division of Natural Sciences and Mathematics, and the President’s announcement of this initiative, have come together to form an extraordinary opportunity for Bates College to become a national leader in the teaching and practice of natural sciences and mathematics in the liberal arts. This goal can be achieved by tapping into existing faculty and student potential but will require significant, yet feasible, institutional and external support.

The Need for New Facilities
We have excellent faculty and students in the Division of Natural Sciences and Mathematics, many of whom are doing exceptional work, but the numerous demands on our time plus the fact that our facilities are scattered and outdated are impeding our ability to reach our full potential. Recent momentum gained in curricular design and faculty-student research could be enhanced by well-designed new facilities. Buildings shape our interactions and influence how we teach and do research. For example, new facilities could be designed to promote collaboration by housing faculty, not based on departments, but by “affinity suites” that place faculty with overlapping research and teaching interests near one another. New facilities could also have classroom spaces that allow an ease of movement between lecture, small group discussion and computer or laboratory exercises to allow for pedagogical strategies that have been shown to work well for all of our students. We think it vital that the discussion and planning process for a new natural sciences and mathematics building continues and moves forward as quickly as possible.

Recommendation I. We ask that the seeking of funds for the construction of a new science and mathematics facility be made a high priority by the College, and that the resulting fund raising and financial commitments be continued to be discussed and planned for by Advancement and Financial Offices.

Recommendation II. We urge that the College take advantage of the willingness of science and math faculty to participate in the fund raising process.

Recommendation III. We recommend that three to four faculty members from the Natural Sciences and Mathematics Division be asked to make a commitment to learning about the extensive facilities-planning experiences of Project Kaleidoscope (PKAL) and to apply the lesson learned to our particular institutional goals and principles. In addition, some faculty members should visit peer-institutions to learn about their new buildings, curricular innovations, and the coupling between them, in order to better inform the choices we will need to make at Bates.

Supporting Student and Faculty Research
All students majoring within the Division of Natural Sciences and Mathematics are required to complete a thesis or capstone experience. The only way for the thesis or capstone experiences to be truly meaningful is for the students to be academically
and technically prepared for the project and for the faculty to offer high quality research opportunities at Bates. This can only take place when faculty members have time and resources to dedicate to their scholarship. Much of the research done today in the natural sciences and mathematics requires expensive computers and instrumentation, making it necessary for faculty members to obtain external funds to support their work. We would like to encourage and support faculty efforts to have active scholarly research programs.

Recommendation I.
Recently, Howard Hughes Medical Institute (HHMI) funds ended. These funds had made it possible for many natural science and mathematics majors to stay on campus during the summer to collaborate on faculty research projects. Currently a small number of internal funds exist, but they provide nowhere near the level of student research funds that had been available. We recommend that Bates establish a significant endowed fund to support student research.

Recommendation II.
We urge that the College take advantage of the willingness of science and math faculty to participate in the fund raising process by providing examples of their exciting projects and by giving presentations to potential donors.

Recommendation III.
We request the establishment of an annual, internal funding process for which faculty can compete for a single substantial amount of “seed money” ($5,000-50,000) to be able to initiate new areas of research and position faculty members to compete for external grants.

Recommendation IV.
We recommend that the College seeks ways to embed Bates student-faculty summer research activities into the curriculum. Specifically, we would welcome a structure that allows summer student research activities be part of the participating faculty’s teaching load.

Recommendation V.
We seek data to determine how faculty-student research experiences compare to those at other peer institutions in terms of quality of experience, quantity of experiences, and outcomes. This might take the form of quantifying some aspect of the faculty-student interactions that captures what is unique to Bates (number of co-authored papers in journals, number of students with research experiences at the time of graduation), or comparing Bates student outcomes (such as which graduate schools our students attend) to those of other schools. This would necessitate a database of our students’ post graduation activities. One idea is for Bates to establish a social networking web page for alums that includes a pull-down menu in which they can update their current career and educational activities. This information would be useful as the College tries to convey “the Bates experience” in the sciences to prospective students, potential donors, and funding agencies.
Supporting Curriculum Innovation

There is a strong desire to improve our curriculum as a whole in the Natural Sciences and Mathematics Division to better serve all of our students. Significant steps to achieving this have occurred this year. First, to better coordinate the efforts and creative activities of individual faculty members and departments the division has agreed to put in place a set of shared and well defined goals for our teaching and scholarship. We’ve planned a set of Mellon Foundation-sponsored “Curriculum Innovations in Natural Sciences and Mathematics” workshops that will open with a discussion of our shared goals and will task the participants to similarly articulate the goals of their own departments and programs. The discussions will explicitly seek to address how the educational and student outcome goals fit for all students of the College (i.e., first-year students, students typically underrepresented in the natural sciences and mathematics, majors in other divisions of the College, and majors within the Natural Sciences and Mathematics Division). Second, several faculty members have worked this year to develop specific curriculum innovations (a four-course sequence of integrated mathematics and science, and pedagogical methods to increase quantitative reasoning skills) and have written two external grant applications asking for substantial funds to (1) replace faculty members from some existing courses so they have time to execute the new curricular innovations; (2) hire additional laboratory support staff; and (3) support assessment activities.

Recommendation I. To better understand our current situation, to be able to compare whether our new innovations are working, and to have more complete data for funding agencies, we need to have on-going institutional support to assess our curriculum. Specifically, we would like to determine annually how many students take science and math courses for (1) general education science (S), laboratory (L) or quantitative (Q) requirements; (2) general education concentration requirements; or (3) major requirements. We also want to assess student and faculty attitudes and responses to the science and mathematics curriculum.

Recommendation II.
We recommend that the College seek funds to support faculty development to enable collaborative cross-disciplinary teaching and scholarly work.

Recommendation III.
Develop a set of recommendations for categories of general education science and math courses which would help students satisfy the requirements by selecting sets of courses more coherently.