

COLLEGE OF NATURAL SCIENCES

Curriculum review / Action plan 2016

College-wide, the goal of this exercise has been to examine the curricula with an emphasis on improving the student experience. This takes many forms including meeting the campus objective for smaller classes in the junior and senior years. It also takes the form minimizing the number of classes with enrollments smaller than twelve students. It is imperative that we continually upgrade our curricula and our pedagogies and that we maintain a diverse set of curricula within science and mathematics that is appropriate for a major, public research university. A deep reading of the individual departmental curriculum reviews indicates that departments have taken an active approach to revising and enhancing their respective curricula.

The major challenge for maintaining the appropriate set of curricula is the explosive growth in both majors and demand for student credit hours across the sciences.

COLLEGE WIDE ACTIONS

1. Resource neutral

Explore a college-wide requirement or requirements that expose students to the use of computational science, statistics, and modeling in science today.

Form a subcommittee of the Life Science Steering Committee to look for efficiencies in teaching across the life sciences.

Form a comparable subcommittee for the physical sciences.

Increase the availability of on-line courses for students attempting to catch up with their degree program or attempting to complete their program early.

2. Require resources

Significantly increase the number of teaching assistants available for laboratory and large lecture courses. (The college will move approximately \$700,000 from other uses to support assistantships. The distribution of these funds will be tied to enrollments in lecture and laboratory classes.)

Support the departments in creating student focused web sites.

BIOLOGY ACTIONS

1. Resource neutral

Below is a list of action items we propose that, if implemented, would likely result in increased cohesion of the Biology curriculum and increased student access and progression through the major. Each of these items could be implemented with existing departmental resources. A projected time for implementation follows each action item.

1. In order to improve access to courses and progression through the major we propose to:
 - 1) Redesign the core requirements for the Biology major by reducing the number of required 200 level courses. (*Need Department and Faculty Senate approval 6-9months*)
 - 2) Renumber our courses to provide a clear course order. (*Need Department and Faculty Senate approval 6-9months*)
2. Feedback from our students revealed that the scheduling of our courses creates course conflicts and limits course access. We will assess our scheduling of courses in order to eliminate or reduce this impediment to class access. (*Will identify and address by Spring enrollment; 4 months*)
3. Biology majors are currently required to earn a C rather than a C- in each of the courses required for the Biology major; this includes courses in Chemistry, Physics, and Math Departments. This requirement is impeding the progression of a small subset of our majors through the curriculum and creates lack of curricular cohesion between the 8 life science majors on campus. We propose to substitute a C- as the minimum grade for Biology majors in required courses in Chemistry, Physics and Math. (*Need Department and Faculty Senate approval 6-9months*)
4. In order to improve communication with our students, we propose to:
 - 1) Develop and make available online an 'Advising Frequently Asked Questions' (FAQ) sheet for Biology majors. (*Available for Fall 2016*)
 - 2) Develop and make available online an 'Advising FAQ' sheet for Honors (CHC) Biology majors. (*Available for Fall 2016*)
5. We will discuss the pros and cons of increasing the capacity of Biology 285 Cellular and Molecular Biology and Biology 288 Introductory Physiology. If enacted, this will result in a gain of two instructors to teach two upper level courses and will help to decrease the class sizes for our upper level Biology majors. (*Decision by 2016 Spring enrollment*)

period)

6. To address the inadequate supply of upper level Biology courses and their large class sizes for upper level Biology majors, we propose to work with the CNS Life Science community (Life Science Steering Committee, Life Science Curriculum Taskforce and life science departments) to integrate instructors from life science departments into the teaching of the introductory biology sequence (Biology 151 and 152). This will make current Biology instructors available to teach other courses thereby increasing the offerings and reducing the class sizes of upper level Biology courses. *(12-24 months)*
7. To address the limited capacity of Biology 283 General Genetics, we propose to work with the CNS Life Science community to increase access to a core genetics course by developing a shared genetics curriculum for the 4 undergraduate core genetics courses currently being taught in CNS and to evenly distribute the students and instructional resources among them. *(12 months)*
8. We will consider Biology's investment in teaching BS general education courses. A reduction in the number of general education courses we teach would allow reassignment of some faculty to teach smaller upper level Biology courses and better direct our resources toward serving our Biology majors. *(3-6 months)*
9. We will identify and discuss mechanisms to incorporate diversity into our biology curriculum through units in Biology 283 General Genetics, Biology 280 Evolution, and Biology 312 Writing in Biology. *(Target date: Fall 2016 or Spring 2017)*
10. We will identify and discuss mechanisms (with Biology faculty and students) to ensure that our major is compatible with study abroad opportunities. *(6 months)*

2. Require resources

Below is a list of action items that, if implemented, would likely result in increased cohesion of the Biology curriculum and increased student access and progression through the major. Each of these items requires investment of additional resources for implementation. A projected time for implementation follows each action item.

1. We propose that we redesign the Biology 153 laboratory course into a modern research experience that uses techniques and approaches appropriate for the 21st century. This will require renovation of the introductory laboratory suite (Morrill 301, 302, 303, and 304). With time, the new laboratory fee structure should provide the equipment and supplies needed for this modernized course. *(Full implementation is dependent on the availability of renovation funds;*

some new equipment and new lab unit will be in place in Spring 2016)

2. We propose a new 200 level Genetics and Evolution Laboratory course (Biology 284) for Biology majors. Progress has been made on this Strategic Plan goal; an instructor has been identified, a curriculum is being developed, and the course will be as a small pilot section in Spring 2016. *(In place for Spring 2016)*
3. Our ability to effectively deliver a coherent Biology curriculum to our majors is limited by the size of our major relative to the size of our instructional faculty. We must bring more instructional resources to bear in order to offer the sufficient number and sized courses to resolve our problems of student access, student satisfaction, and curricular cohesion. This can be accomplished with the hiring of new faculty who will participate in the delivery of the Biology curriculum. Alternatively, reassignment of current life science faculty or assignment of the hires resulting from current life science IALS searches to teach courses serving Biology majors is a less expensive means to this goal. *(Undetermined time line)*
4. We propose to introduce three concentrations within the Biology major in an effort to provide curricular cohesion and streamline the progression of students through the major. To make these concentrations functional and successful at meeting our goals, we must ensure that each concentration meets our departmental learning goals and that students have access to the courses in the concentrations. Given the identified needs for new courses and the imbalance in student interest and current course offerings across the proposed concentrations, investment in instructional resources is required, including an increase in faculty, teaching assistants, and equipment, supplies, and instructional support for new lab courses. *(Undetermined time line)*
5. We will assess the design and capabilities of *Appointment Plus* software to determine if it will provide our students with easier access to scheduling and a better matching of students to the right advisor. Given the size of our major, the number of advising appointments/month, and the number of advising calendars, the estimated annual fee for the software is from \$800-\$1,200. *(A decision in 6 months)*
6. We propose to redesign the Biology Department website so that it becomes the “go-to” place for information for our majors. Funds will be needed to achieve this goal. *(Time line dependent of availability of funds)*

BIOCHEMISTRY AND MOLECULAR BIOLOGY ACTIONS

1. Resource neutral

Reorganize the BMB IE course from a 3-credit stand alone course that currently uses one full time lecturer and one graduate student TA in the fall and 1/3 time of two TT faculty in the spring to modules that can be distributed more broadly throughout the BMB curriculum. In particular, we interpret senior exit surveys as a call to incorporate career prep (currently in the IE course) earlier into our curriculum. The IE requirement is an unfunded mandate that drains limited departmental resources and adds to the already very high demand for limited classroom space. Furthermore, the rationale for this requirement is not supported by rigorous assessment or evidence as to its value in the undergraduate curriculum. There are elements of the BMB IE course that we value and that are well-received, but that could be retooled as components of other required major's courses, thereby freeing up one lecturer and one graduate student in the fall and two tenure system faculty in the spring.

Work with transfer admissions staff to identify and redirect junior transfer students who do not meet BMB requirements for junior status within the major. Junior transfer students who have not taken all of the pre-reqs for junior level courses routinely have to stay an extra semester, which is costly and frustrating for them.

Develop course-based research so that more of our majors who want to participate in research have the opportunity to do so. We will need to work with CHC on the requirements for Departmental Honors since it currently requires a research thesis project.

2. Require resources

BMB has seen the departure or retirement of four senior TT faculty and one lecturer within the past two and a half years. Combined with a four year doubling rate of BMB majors, a 6 year doubling in SCH and a decrease in our instructional support allocation, the department is experiencing significant enrollment stress. The balance between TT faculty research activity and classroom teaching is precarious. More tenure system faculty (from the current 13) would stabilize this balance by bringing the student to faculty ratio down, thereby allowing BMB faculty to preserve their research time as well as to offer small(ish) advanced electives (BMB currently does not offer *any*

advanced electives for undergraduates) and to continue serving as research and career mentors to BMB majors.

The instructional support allocations for BMB have not changed in 4 years, although the number of BMB majors has doubled in that time. Normalization of TA workloads within CNS is long overdue. (Staff support for the teaching mission within departments is similar to instructional support allocations in that it is mostly an historical artifact. Normalization of staff support within departments is also overdue.) BMB is facing the prospect of lowering expectations for timely graduation in the case of students changing to the BMB major as sophomores and juniors. The CNS Life Sciences Curriculum Task Force is currently looking at required courses in the first two years of several life science majors with common early requirements. In particular, we are hopeful that the Intro Biology (and chemistry and physics for non---majors) laboratories will be revamped to be more inquiry driven and upgraded to provide exposure to state-of-the-art research instrumentation. We anticipate that lab fees can be deployed towards this goal, which would allow BMB to rethink our two required lab courses. We could conceivably move content from the junior lab into the sophomore lab and convert the junior lab to a course---based research format in which teams of students engage in authentic research projects in the teaching lab space. In this sort of scenario, we could move away from specific lab sections (for the junior lab course) of 24 students with one graduate TA per 10---hr per week lab section. Instead, we would achieve better outcomes if the “open” project lab was staffed by a professional technician who would train students in proper use of the equipment, prepare reagents and ensure the safety of the students, much as a TA does, but at lower cost overall. We expect that BMB majors will continue to pursue independent study research in high numbers, and this combined with a required section of authentic research will ensure that every BMB major engages in the most impactful experiential learning possible. Time frame: approximately 1 year to convert both laboratory courses.

CHEMISTRY ACTIONS

1. Resource neutral

By the beginning of Spring Semester...

- 1) Faculty discussion: Advising students beyond basic curricular matters including career advising, Updating advising documentation
- 2) Faculty discussion: Website improvement
- 3) Update and expand course descriptions on the Chemistry website
- 4) Define specific roles for the Undergraduate Program Director and Chief Undergraduate Advisor
- 5) Discuss best practices for TBL implementation in majors Chemistry courses with emphasis on learning retention

6) Continue Chemistry Department “learning goal” visioning process initiated during Summer 2015, which originated with a team of chemistry faculty being awarded participation in a chemistry and physics educational reform workshop by the APLU. The team has been leading an all-faculty discussion following a “backward design” approach to the chemistry majors’ curriculum.

By the end of Spring Semester...

- 1) Develop a resource for advisors and students that includes information regarding international programs, internships, and summer research programs
- 2) Develop specialty concentrations (biological, materials) to add to our existing curriculum
- 3) Faculty discussion: Adding a professional development seminar to the junior/senior year
- 4) Faculty discussion: Diversity in Chemistry with Charlana Simmons
- 5) Increase awareness of newly formed UMass Undergraduate Chapter of the American Chemical Society and establish a partnership with the UMass Chemistry Club
- 6) Identify specific measurements for targeted learning goals to begin the process of taking quantitative stock of the Chemistry undergraduate curriculum.

Within 1 year...

- 1) Develop a resource for students to facilitate finding a research group
- 2) Faculty discussion: Developing an “Introduction to Laboratory Research” short-course or other approaches to engage students in undergraduate research earlier in their sequence.
- 3) Faculty discussion: Optimizing partnerships between tenure-track faculty and lecturers for teaching large enrollment courses
- 4) Build on current successful partnerships (University of Glasgow, DAAD, Heriot Watt University) with international institutions and publicize study abroad opportunities to students and advisors
- 5) Expand learning goal assessments, and begin to institute new curricular and pedagogical interventions in specific, targeted areas of need (as determined by assessment and visioning results) to enhance Chemistry undergraduate education.

2. Require resources

- 1) Restore tenure system faculty numbers to allow more participation in lower division courses - **Increased faculty, TAs needed**
- 2) Restore our ability to offer upper level advanced courses, while updating them to current research thrusts: biomedical chemistry, materials chemistry, renewable energy- **Increased faculty, TAs needed**
- 3) To complement the core curriculum, add modular upper level electives (e.g., imaging cellular chemistry, physics of photovoltaics, vehicles for drug delivery, adaptive materials) - **Increased faculty, TAs needed**
- 4) Expand career guidance courses in the junior and senior years, including resume building, networking, and employment search skills - **Increased faculty, TAs needed**

- 5) Properly address website improvements with professional developers- **Partnering with web development professionals needed**
- 6) Further develop nascent relationships with local high schools servicing primarily underrepresented minority groups - **Additional staff needed**
- 7) Expand new curricular and pedagogical interventions in broader areas of need (as determined by assessment results) to enhance undergraduate education - **Increased faculty, TAs needed**

ENVIRONMENTAL CONSERVATION ACTIONS

1. Resource neutral

Throughout this document, we have identified opportunities and plans for improvement by individual sections, including:

- Review of all curricula to identify opportunities to reduce the large number of requirements for each major without jeopardizing certification of students by our professional societies (begin process Spring 2016).
- A full assessment of ENVSCI will be done in collaboration with Geosciences and Stockbridge School of Agriculture as we grow under the School of Earth and Sustainability.
- Expand marketing of our programs to attract students into our undergraduate majors as freshmen, including:
 - target high school counselors and students and undeclared freshmen via a new, digital “roadmap” to environmental and earth sciences programs planned as part of the marketing and advertising plan for the proposed School of Earth and Sustainability (begin process Spring 2016);
 - build upon existing outreach efforts to students at vocational high schools for the 2-year Associates degree in Arboriculture & Community Forestry program within the Stockbridge School of Agriculture;
 - expand offerings in ECo Rap as part of the Residential Academic Programs;
 - expand environmental offerings in the First Year Seminar program;
 - expand environmental offerings in the Summer College Program;
 - assess opportunities for offering new 100-level GenEd diversity courses (i.e. community forestry, marine conservation, renewable energy, climate change).

Overall, hiring of several new faculty and expansion of teaching appointments for our extension faculty have greatly contributed to our ability to keep pace with increasing student numbers and the associated higher demand for access to courses. Increasing course capacity may be an option for some of our over-subscribed courses, especially those that are lecture- based. However, there are

several challenges to simply increasing capacities for skill-based courses, especially courses with field and computer components, our IE courses, and courses taught in team-based learning formats. Additionally, we are aware that some of our NRC major core courses (e.g., NRC 260, NRC 409) continue to have scheduling conflicts with some of the science core requirements. The Urban Forestry and Arboriculture concentration is also challenged because it no longer has access to a small business management course.

The logistics of field-based lab courses pose special challenges, including transporting students to field sites and providing safe and authentic field experiences, especially for our three sophomore field courses (NRC 211, 212 & 297F). Further, some labs require more than one teaching assistant to ensure safety, especially for field labs that include aquatic sampling (NRC 297F), chain saws and tree climbing (NRC 102, 210, 213). Consequently, enrollment in our field lab sections should not exceed a maximum of 20-24 students. Yet, with two sections now offered in the three field courses, the demand now exceeds capacity, and we need to have the capacity for up to 60 students to meet current demand.

In recent years, extra lab sections were added to help meet this demand; however, expanding student accessibility to field labs will require increasing the teaching load of some faculty or increasing the use of graduate students as the primary instructor in lab sections. However, both of these options would require additional graduate TA support to meet the logistical challenges of field labs. Another alternative is to reduce the number of labs meetings for students by having them meet only once every other week, thereby reducing their lab experiences by 50%. This strategy is currently used in one of our field courses (NRC 211) to accommodate the high demand.

The dual challenges of seating capacity in computer labs and access to computers with the necessary software limit our ability to meet the growing demands of students for our courses with computer-intensive training.

We were able to meet the demand in part by adding extra lab sections and offering the same course both semesters. However, meeting the current and future demands for these courses will require additional faculty, increasing the teaching load of some faculty, or increasing the use of graduate students as the primary instructor in course sections. All of these options would also require additional graduate TA support to meet the instructional challenges of these computer labs. Additionally, increased access to suitably equipped computer labs will also be needed to accommodate these extra sections.

The current search and hiring of a new joint lecturer in GIST in Geosciences and ECo will help provide greater access to introductory GIS courses. Yet, the challenge of expanding course access persists for two of our computer-intensive BCT courses (BCT 320 & 420), one of which is already offered both semesters.

Currently, our three IE courses (BCT 494BI, ENVSCI 445, NRC 382) are too large

and fail to meet the aspirational goals for class size outlined by the Provost. Our current demand for IE courses total about 120 students across two courses for ENVSCI and NRC majors, and nearly 50 students for BCT majors. As a core partner in the ENVSCI program, Geosciences currently provides some seats for ENVSCI majors in their IE course, GEO 494LI. Up to 10 seats are also now provided to ENVSCI students in NAT-SCI 491I, the IE course offered by CNS.

To meet current and near-future IE enrollment demands for ENVSCI and NRC majors, we are developing two new IE courses expected to be available for 2016/17, which will enable us to accommodate another 84 students. Our best option for reducing the numbers of students in our BCT IE course is to redesign one of the existing upper level BCT courses to meet the IE requirements. Ultimately, our goal is to have no more than 42 students in any of one of our IE courses.

As a faculty, we are committed to creative teaching methods. A substantial number of ECo faculty have participated in the Lilly Teaching Fellowships, Team-Based Learning (TBL) Scholars, Fellowships for Innovative Teaching (FIT), and Civic Engagement and Service- Learning Faculty Fellows programs. Further, all new ECo faculty are incorporating TBL learning strategies into one or more of their courses. Yet, effective TBL courses require that students be able to work together in small teams, which is often logistically difficult in classrooms designed for lecture format classes, especially for classes with high enrollment.

The new Integrated Learning Building provides excellent facilities for offering TBL courses; yet, the demand is great and several of our ECo faculty are unable to use these classrooms, despite having participated in the required training programs. To better meet the increasing needs of ECo faculty to teach in TBL classrooms, we have renovated two of our own labs into TBL classrooms. Although a great resource, the capacity of each of our TBL classrooms is 42 students, so we will also continue to need access to campus TBL classrooms for our TBL courses that exceed this capacity. This is a continuing challenge across campus as more faculty incorporate TBL pedagogies into their courses.

- Expand our 1-credit curriculum and career planning seminars across our all our NRC concentrations;
- Hire an engagement specialist, who will help to establish a peer advising centers and a comprehensive framework for disseminating internship and job opportunities;
- Once the School of Earth and Sustainability is launched (pending Faculty Senate approval), develop a new website to better market and recruit students into our undergraduate programs in earth, sustainability and environmental sciences.
- Develop targeted communications to better promote our majors/concentrations with high job placement rates and/or underutilized resources.

2. Require resources

- To address curricular issues with course accessibility for BCT students, ECo needs to create more capacity for student enrollment. We are hopeful that we can secure additional faculty hires in the coming years – either independently or as a joint hire with our campus partners (e.g., Architecture and Landscape Architecture & Regional Planning as part of the proposed School of the Built Environment). It would also be an opportunity to further expand enrollment in the program through development of a new concentration in Construction Management, which would make us more competitive and comparable to our primary peer – Wentworth Institute of Technology). New faculty would also help facilitate development of online courses and take advantage of distant learning opportunities in Springfield. These changes would improve the student experience, attract transfer students, and benefit a subsection of our student body that we recruit from the Springfield area.
- Applied, hands-on experience is an integral part of how we teach and learn in ECo. Consequently, greater access is needed to computer labs and Team-Based Learning classrooms to meet the professional training needs in our curricula.
- Hire an Academic Advisor – Immersive Learning Program Manager to establish peer advising centers and a comprehensive framework for disseminating internship and job opportunities (this position was approved but delayed in the recent campus hiring freeze).
- Additional Graduate Teaching Assistant support is needed to meet the existing and growing demands of offering our field courses that are so critical to the professional training of our

FOOD SCIENCE ACTIONS

1. Resource neutral

We are currently developing a 1-credit product development course that will be taught each semester that would be required for all students interested in participating in the national product development competitions. This course would teach the fundamentals of product development, marketing and food regulations such as labeling and would help to student prepare for the competition. An additional advantage of this course is that it would increase student contact with faculty.

We would also develop a similar 1-credit undergraduate research methods course that will be taught each semester for students that participate in undergraduate research projects. This course would cover topics such as literature searches, understanding scientific papers, scientific writing and experimental design. Students in this course would then be encouraged to enter undergraduate research competitions. This course should help increase the productivity of undergraduate

research, increase student accessibility to faculty and improve our national research stature.

GEOSCIENCES ACTIONS

1. Resource neutral

In the Geology and Earth Systems majors, we are fortunate to not observe systemic issues with our curricular sequence or access to courses. We also are fortunate that our class size goals closely match, if not exceed, those envisioned by the Provost; after 100-level introductory courses, our students enjoy classes with less than 40 students throughout the sequence of 200-, 300- and 400-level required courses. Elective courses (including 500-level grad courses) commonly have even higher faculty : student ratios.

Nonetheless, through review of the geology and earth systems majors curriculum we have identified several specific actions that could improve coherence of our curriculum, clarity of our communications and effective use of faculty time. Several actions can be accomplished within existing resources:

- (1) Foremost of these is to implement required advising sessions with students identified as geology or earth systems majors. Commonly known as “RAC holds” or advising holds, these require students to meet with an undergraduate advisor who can then release the hold and allow students to register for the next semester’s courses. We know that strong faculty advising is an excellent way to communicate and engage with students. In the past, the geology major has not forced this advising on students, but as opportunities for courses, research experiences and career guidance increase for our majors, we recognize the need to more effectively communicate these opportunities and expectations to students. Within our existing resources, we will instate advising holds for our identified majors effective for the Fall 2016 semester. As part of this change, we will distribute advising responsibilities among our faculty. The Chief Undergraduate Advisor and Honors Program Director will become advising coordinators for the major.
- (2) A second step we can take within existing resources is to re-focus the prefix by which our courses are listed in the course catalog. For many years, the Department of Geosciences (comprising undergraduate programs in geography, geology and earth systems, and graduate programs in geography and geosciences) had a single course prefix for all courses: GEOSCI. This worked well for the geology and earth systems undergrad majors and for the geosciences graduate program, but was felt to negatively impact visibility of the geography program. Beginning in Fall 2014, undergraduate courses were separated into GEOG and GEOL prefixes to distinguish geography-courses from other offerings. While well-intentioned, this has caused significant confusion for many undergraduates. The breadth of curricular offerings and courses within the Geosciences is not adequately captured by the GEOL prefix, as it is not apparent to many students

that courses in climate, water resources, landscape/surface processes, and environmental chemistry would be housed under the GEOL prefix. To better promote our visibility in the fields, and to address the strong student interest in a curriculum that provides the basic scientific training in sustainability and environmental issues, we will propose to return all undergraduate and graduate courses in our curriculum (outside purely GEOG courses) to the GEOSCI prefix. To avoid the case of interdisciplinary courses being overlooked by students, these courses can be listed as “shared sections” from both GEOG and GEOSCI. We hope to have this change in place for the Fall 2016 semester.

(3) A third step we can take to improve communication and coherence involves the earth systems major. In recent years, the number of students declaring this major has been declining. We feel that this is a likely result of the growth the Environmental Science major (co-housed within the Department of Geosciences) as well as a lack of clarity among students about what this major, and this field, entails. As such, we propose to suspend this major at least temporarily and roll its curriculum into the existing Geology major. Moreover, we will propose to rename our Geology major as the Geosciences major. As these changes will involve approval from the Geosciences department, CNS, Faculty Senate and others, we will begin the process of these changes this academic year and hopefully have the name change completed by the 2017/18 academic year.

(4) Fourth, we propose to phase out the teaching of GEOL 105 (Dynamic Earth, prior to Fall 2014 known as GEOSCI 105) and reallocate those teaching resources towards teaching an additional section of GEOG 100 (Global Environmental Change, which will be cross-listed as GEOSCI 110 / GEOG 100). GEOSCI 110 will thus be taught every semester, instead of the current fall-only offering. There is substantial overlap between GEOL 105 and the core introductory course GEOL 101. Through advising and other communications, we will redirect students who might have taken GEOL 105 to either GEOL 101 or to other introductory geoscience courses.

(5) Lastly, together with the name change from geology to geosciences, we are proposing a re-organizing and re-focusing of the major. We seek to increase attraction of students to our major, especially from groups typically under-represented in the geosciences and in STEM fields in general. We are proud that retention once in the major is not an issue; once students find the geosciences, they like the experience and career opportunities it provides. In part because of lack of visibility of geosciences in K-12 education, we recognize that we need to invest in more deliberate and focused branding of our major to graduating high-school seniors and first-year students. Additionally, because UMass is not located in an oil/gas or other resource-extraction state (where undergraduate geology programs are growing), we need to emphasize the skills, concepts and competencies in our undergraduate curriculum that serve the needs of our graduating geoscience majors for employment and future education. This will not come at the expense of a broad geologic training that trains students to be competitive in the national workplace that has significant job opportunities in

geologic hazards, mineral exploration and petroleum resources. This re-focused emphasis thus includes not only traditional geology curriculum, but also offerings in water resources, climate, landscape processes, geochemistry and geophysics. Fortunately, these offerings exist within our current curriculum (although many are currently electives rather than required courses); unfortunately, many students do not find these offerings.

To better make students aware of the array of career opportunities in the geosciences, to serve the Commonwealth, the region and the nation with well-prepared scientists, and to serve a student body with a growing interest in an education and future careers in sustainability, we propose to reformat our undergraduate geoscience major. The reformatted major will likely comprise:

- (1) A small suite of core courses (3-4) taken by all geoscience majors.
- (2) A division of the major into a set of concentrations, such as geology, hydrology, climate, geochemistry, geophysics, and landscape processes. Each concentration may require a suite of 4-5 required courses. There will be overlap of some courses between concentrations, and all courses for these concentrations can be drawn from our existing course offerings.
- (3) The remainder of geoscience major credits will be achieved through supporting sciences courses, as is done presently, as well as upper-level undergraduate and graduate geosciences electives.

No additional or new courses are proposed, although the frequency of some course offerings may need to be increased (bi-annual to annual, for example). This is a significant change for the geosciences program, and will likely require some time to achieve. First steps will involve formalizing the proposed changes in curriculum and concentrations within the Department (Which core courses? Which concentrations with which required courses?), followed by the CNS curriculum committee, the Registrar and the Faculty Senate. We are beginning the process now, and will proceed as rapidly as possible.

2. Require resources

While there are steps that the Geology and Earth Systems programs can take to improve student outcomes within our existing resources, we recognize that substantial changes with more significant improvements to student outcomes will require additional resources.

- (1) Among these is the issue of hiring lecturers and increasing TA allocations as a means to improve the teaching effectiveness and student outcomes in our 100-level course offerings. At present, we are limited to offering only section per semester of courses such as GEOL 101 and 103 as well as GEOG 100; TA allocations are insufficient to support graduate student-led lab or discussion sections in any 100-level course except GEOL 101. Yet recent enrollments and

past experience shows that these courses fill, and additional sections of these have filled in the past (e.g. Oceanography – GEOSCI 103 – was taught in the past as two 300-person sections each semester, and the course was full). Additionally, SRTI survey results suggest that our teaching effectiveness is lower in large-enrollment courses compared with other CNS departments, while at the same time we actually teach more larger-enrollment courses than our peer departments. We could improve student outcomes and learning by teaching more sections of our introductory courses, each with lower enrollment capacity. However, at present we do not have the faculty resources to do this; as faculty are also need to teach upper-level major courses and graduate courses. Our teaching load per tenure-stream faculty (in both credit hours per instructor and course sections per instructor) is already among the highest in CNS. So while we see a means to improve our teaching effectiveness, and thus improve student learning in the geosciences, we can likely only achieve this by hiring additional instructors. Tenure-stream faculty hires are likely, but we also plan to integrate non-tenure-stream lecturers who could be dedicated to the effective teaching of a small number of undergraduate courses.

(2) Additionally, we recognize that clarity of communication between faculty and students, and student engagement through research and mentoring, is essential. Many departments have dedicated financial resources to a hired non-tenure stream faculty member whose chief role is a program manager and chief undergraduate advisor, and for programs with large numbers of majors there may be entire staff and offices dedicated to undergraduate advising. In contrast, undergrad advising of the geology and earth systems majors has up until now been achieved entirely through efforts of tenure-stream faculty with no staff support. Moving forward, we will propose resources to hire a lecturer who, in addition to teaching responsibilities, will be charged with serving a program manager and chief undergraduate advisor for the geosciences major.

(3) **Actions addressing Building Needs.** It goes without saying that large parts of Morrill are not a “destination of choice”. The curriculum in geosciences and the perceptions of our majors is currently compromised by the quality of our classrooms – even the restrooms in the building are horrible. We have lost 6 teaching/laboratory classrooms in recent years due the need for research lab space and the addition of the Northeast Climate Center/Climate System Research Center. The Intro Geology Laboratories are current taught in a horrible space in Hasbrouck that we hoped was temporary.

We have working closely with the CNS office to develop plans for recovering dry laboratory space for an introductory geology/physical geography/geomorphology class room as well as a remodeled computational geology classroom and new GIS teaching lab. More over we are actively in conversation with CNS about developing new, shared wet laboratory space (shared with 3 other departments) to enrich several of our upper level courses for all of our majors including Environmental Science.

MATHEMATICS AND STATISTICS ACTIONS

1. Resource neutral

- As of Spring 2016, we have changed the requirements for the teaching concentration, which will alleviate pressure on MATH 551 (Numerical Analysis); instead, we are going to offer an additional MATH 471 (Number Theory).

- The new requirements commit us to offering a section of MATH 475 (Math History) every year. We began offering this course only last year after 15 years of not offering it. We have successfully converted MATH 475 to an Integrative Experience course, which will hopefully relieve enrollment pressure on MATH 455, 456, and STAT 525.

- We are canceling a section of STAT 515H for FY17 (which we have taught every year for the past dozen years), and replacing it with a section of STAT 515. STAT 515H is limited to 25 students; demand for STAT 515 is so large that we cannot afford to leave 15 seats (or more) empty, despite the curricular and pedagogical benefits to Honors College students. Even with this change, we anticipate having to add an additional section or two of STAT 515. With the increased interest in Data Science, there has been dramatic rise in enrollment for STAT 515. This has catalyzed us to impose more uniformity among the sections, including the creation of an online homework system (with an accompanying addition of in-class quizzes) as well as devoting more TA support to this class.

- We will offer one or more sections of MATH 131 and MATH 132 in 99-person Team- Based-Learning format (instead of the standard 60-person section) per semester. This is a pilot program to determine the viability of offering MATH 131 and 132 in larger sections. If we offer two such sections, we will save one 60-student section - we will convert the resulting savings into a course release for a faculty member who will work on developing materials for teaching the class in a TBL format, and who will also lead of team designing worksheets to be used in the recitations for these courses. Currently, the recitation sections are largely ineffective. Developing curricular materials for recitations to become more student-centered is a time-consuming task that by itself more than justifies the course release. Appropriate supports must be created in order to cope with a larger class size - having it in a TBL classroom is not enough. We can illustrate this issue with a concrete example. Every semester we offer five to six sections of Math 331 (Differential Equations), an important service class taken mostly by students in engineering, physical sciences and even economics and biological sciences. A year ago we experimented with combining two 60-seat sections of Math 331 into a single, 120 seat section. This experiment did not work very well because we did not provide the instructor with any additional TA support to handle the extra office hours and email queries.

- We plan to investigate interest in collaboration from our colleagues in CICS and the College of Engineering on offering a selected number of Math 131/132 discussion sections for students in engineering and computer science. This is revenue neutral, but only after one-time setup cost at the level of support for a couple of summer graduate TAs. Currently every section of Math 131 and Math 132 (both are 4-credit classes) has a weekly discussion, in which the graduate TA will go over additional examples and answer questions about homework and lecture material. This is typical among peer institutions. Students in a typical discussion section come from very diverse backgrounds, so the TA can only work out general examples and problems that are not discipline-specific.

The Department will coordinate with the engineering departments and Computer Science to schedule a number of discussion sections targeted towards students in each of these departments, and our faculty will collaborate with those in these departments to design active-learning projects specific to their fields. We have had preliminary discussions with some of these departments and the reaction has been very positive. A similar program has recently been successfully implemented at the University of Illinois at Urbana-Champaign, and the Mathematical Association of America recently published several volumes of classroom-tested source books for active-learning calculus projects. We will consult these resources and make appropriate modification to suit the needs of the UMass students. With the support of a couple of summer graduate TA, the Department can put together a solid set of active-learning projects for these targeted Math 131/132 discussions. Once the program is in place, and should it prove successful, we will be happy to create similar targeted discussions for other departments if they can provide a stable group of students within specific time slots and if there are resources for the initial setup.

2. Require resources

Departmental Investment

- In FY17, the Department will hire Emeritus Professor Eduardo Cattani to teach two upper division undergraduate courses in the Fall term (MATH 300 and MATH 545), at the cost of \$27,500. Professor Cattani is an exemplary teacher and mentor, he brings tremendous value to the department's upper division courses at a comparatively low cost, especially when the negligible fringe cost is included in the calculation of what it would cost to teach those courses using regular tenure-stream faculty or VAPs.

- In FY17, the Department will continue to pay all salary, fringe, and other costs associated with a VAP (Gufang Zhao), who will teach 4 courses of 60

students each ($4 \times 60 \times 3 = 720$ student credit hours). This represents the third year of an investment in the teaching mission of the department at the cost of approximately \$54,000 in salary and research funds per year, plus fringe per year.

- In FY17, the Department will appoint a VAP in the area of Applied Mathematics to teach 4 courses; the cost, including fringe, will be fully covered from grants garnered by Professor Panos Kevrekidis, who will be released from his teaching duties (2 courses per year). Thus, at no cost to the college, the Department will offer two more courses than it would have been able to teach otherwise, representing a net gain of 360 student credit hours at no cost to the college. The two additional courses will be to add a section of MATH 300 (Fundamental Concepts in Mathematics) and a section of MATH 545 (Applied Linear Algebra), both of which have seen dramatic increase in demand this year from math majors.

- In FY17, the Department will continue to invest in enhancing existing online courses and to create some new courses. The most important planned addition (in terms of financial impact) is STAT 515. We also plan to videotape the MATH 551 and MATH 552 lectures in preparation for online versions of one or both of those courses starting Summer 17. We also plan to launch of several 1-credit courses in mathematical computation and numerical analysis. We believe the 1-credit format (for courses on using MATLAB, R, and Python, for example), would draw a bigger audience, especially from industry, than a 3-credit course. The department generally invests \$3000 to \$5000 per course for designing a new online course. We plan to increase our investments in online courses so as to increase revenue from this source.

- Begin to offer a course in Time Series on a regular basis to meet the VEE (Validation by Educational Experience) requirement of the actuarial professional societies.

- Expand the REU program by actively recruiting students from Five Colleges, particularly Mt Holyoke and Smith - our hope is that some of them would subsequently apply for our graduate programs. This is a modest investment of about \$3500 per students. We also need to increase the stipends from \$3000 to at \$3500, as the stipend has not changed for ten years. The Department has generous support of alumni for this (in particular from Joan Barksdale).

- Increase the visibility of work done by undergraduate by offering many more awards to our best students in a number of categories. We will dedicate gift account funds for the purpose.

- Institute a well-funded Lecture Series for undergraduates focused on possible career paths for math/stat majors. Would particularly invite alumni. The first such talk to be given in Spring 16 by Robert Reitano. Funded from the gift account.

Strategic Investment from College & University

- We plan to convert Math 233 (Multivariable Calculus) and Math 235 (Linear Algebra) to 4-credits, through the addition of a recitation section. The cost consists of: (i) A one-time setup cost at the level of a couple of summer graduate TA, and (ii) an on-going cost of three to four graduate TA for each of Math 233 and Math 235. Currently both Math 233 and Math 235 are lecture-only, 3-credit classes. Comparable courses in most peer institutions, including MIT, have an additional weekly discussion. There is an urgent need for a discussion section for Linear Algebra (Math 235), a very popular service course that provides crucial quantitative tools for machine learning and mathematical modeling. This is also a challenging course for many students, since unlike calculus, to properly utilize these tools it is not enough to just memorize the computational recipes; the students must understand the underlying concepts, a first for most students. Instructors in turn must devote considerable class time on theoretical materials, leaving little time for applications and examples. This pedagogical issue is not unique to UMass: Most peer institutions deal with it by adding a weekly discussion section so the instructors can focus on the key concepts and main applications, TA can then work out the need for a discussion section for Math 235 is equally urgent. In its current 3-credit format, we can only cover in Math 233 about 80% of the content of a standard multivariable calculus class as taught in peer institutions. Specifically, we can only cover just one of the three basic integration theorems, and we have to leave out most of the applications. This last issue has been particularly problematic for students in physical sciences and engineering, which constitute the majority of the Math 233 population, By adding an extra weekly discussion, Math 233 instructors can relegate the working out of computational examples (which is an essential and non-trivial component of the course) to the TA and focus the class time to the core topics.

- The College has agreed to invest in one VAP to work with Professor Hongkun Zhang (3-year temporary appointment). This VAP will allow us to maintain the same level of teaching capacity since we are losing VAP Robin Koytcheff who was hired on a one-year term.

- The Department requests hiring one more VAP to teach 4 courses in AY16-17 on state funds, to support the (lower as well as upper division) undergraduate program (though of course a VAP also makes significant contributions to the research activity of the department). Hiring this VAP would allow us to offer a new course MATH 571 (Intro to Cryptography), as well as add three other sections in the undergraduate program which we anticipate we will need to keep up with addition of new students. Our projection is that we will need to open 120 more lower division seats (in MATH 131, 132, 233, 235, 331) in Fall 16 than we did in Fall 15 and 60 more lower division seats in Spring 17 as compared to Spring 16. In addition, we expect at least one but probably two additional sections of

STAT515 will be needed as well.

- The Department has relied increasingly in the use of temporary lecturers to serve the needs of undergraduate in the lower division; we have gone from 1 or 2s FTE temporary lecturers 3 years ago to approximately 5 FTE temporary lecturers this year. While we are hoping/assuming that the college will continue to fund this number, we request running a national Lecturer search from which we hope to draw at least one but hopefully several new temporary lecturers, and converting at least one of them to permanent lecturer down the road. The exact number of temporary lecturers needed will be dependent upon the success of the tenure track and VAP searches, to be determined later this spring. Depending on how quickly the plans for a proposed online Masters degree program in Actuarial Science comes together, we may draw on the lecturer search to hire a qualified candidate for helping with designing and teaching those online courses.

- The Department is instituting new dedicated Help Centers for MATH 331 and STAT 515, two courses which large enrollment which largely serve Engineering, CS, as well as CNS but are also crucial for our own majors. These are to open for the first time in Spring 2016 on a very small budget (less than \$3000); we hope to expand them and find better space for them in FY17. For the computers needed for the new Help Centers, we plan to use funds from the college from Lab Fees, with a small supplement from the Department. For a bigger strategic investment, we ask to go ahead with a commitment to one single very large room (capacity 75) to be dedicated, hopefully on the first floor of Lederle, as the all-encompassing Mathematics & Statistics Resource Room.

- With the addition of many new postdocs, visitors, and temporary lecturers (especially the latter), the Department is in desperate need of more office space. We continue to propose the immediate allocation of 13A to Mathematics & Statistics for this purpose.

MICROBIOLOGY ACTIONS

1. Resource neutral

We have several ideas on how to improve our curriculum. First, we will re-examine the learning goals of our Molecular Biology Lab course (MICROBIO 385). The lab currently teaches both molecular biology techniques and tissue culture techniques. Both are important and are “value-added” skills when applying for jobs in biotechnology. However, we need to increase the number and depth of skills the students are taught and the time they get to practice them. To solve this problem, we have started a dialog with the Department of Veterinary and Animal Sciences (VASCI) who were thinking of creating a similar lab class. The idea would be to create two third-year lab classes, one in each department, that would be offered in

different semesters: one would focus on tissue culture techniques; the other, molecular techniques. Each course would emphasize different aspects of data analysis. Majors in either department would then have the choice of taking one or both courses. These courses would not require additional instructors or TAs. This would provide the students with more relevant lab skills along with the necessary practice and application of those skills before taking more advanced classes that tend to be more about applying skills in certain areas.

Another idea that arose regarding our curriculum is that we could teach two new summer classes. One would be a molecular biology lab, similar to MICROBIO 385, and the other would be a lecture or online class on Introduction to Microbiology (MICROBIO 310). We have designed a syllabus for the lab class (called MICROBIO 490) that is currently under review within the Faculty Senate. Dr. Jeffrey Kane, a Lecturer who teaches our Advanced Molecular Biology (AMB) Master of Science Program during the academic year, is slated to teach the lab class in the summer. The syllabus for MICROBIO 310 is also already established. We would need to further define whether this class would be in the classroom or online and an instructor would have to be identified. These classes are designed to be revenue generating, paying for the instructors themselves, and could be available by the summer of 2017.

In consultation with Heath Hatch, the Director of Program Development in the College of Natural Resources, it became apparent that we could push back our “enrollment cliff” by increasing our use of online resources consisting of pre-recorded lectures. Initially, we could create a series of online lectures by using the automatic recording system available in most lecture halls. In subsequent semesters, we could refine the lectures with other methods recording and editing, adding to the quantity and quality of the resources. Such resources could be used by students during the normal academic year and could be further used for summer session online classes. Giving students the option to take classes in the summer will reduce their stress during the semester and decrease class size during the academic year.

Finally, we discussed that we could do more in career preparation. One way we could improve is to help students who are not doing Independent Study in faculty labs on campus to obtain internships with biotechnology companies. To some degree, this is already being done at college level for life sciences. We would coordinate our efforts with Rick Robar. We would also like to explore using reagents or technologies from biotechnology companies in our laboratory classes. The companies would then have access to our experienced students as interns.

2. Require resources

Improving the unified molecular biology laboratory skill set of our majors would require all of them to take our molecular biology lab course. However, this introduces a number of problems. If we keep the course as a single class of 24

students and offer it only once a year as it is currently done, then we will have created a graduation bottleneck for our students. To remove this bottleneck with our current number of majors, we would need to make the course available for 24-30 students every semester. This means that we would need an additional instructor, at least one additional TA, and more teaching lab space and lab equipment.

PSYCHOLOGICAL AND BRAIN SCIENCE ACTIONS

1. Resource neutral

The PBS UCTF is committed to curricular development that best serves our students. As discussed previously, these changes are potentially complex and require careful consideration prior to implementation, especially considering the size of the major. Table 2 provides a current snapshot of the UCTF's assessment of areas where the department is doing well and areas that need to be addressed. In the process of identifying the specific changes we wish to make, we will also determine which additional resources will be required and which changes can be made without additional resources.

2. Require resources

Although it is too early to determine the scope of resources that may be needed for a curriculum change, the following resources would be instrumental for improving the undergraduate experience in the very near future.

- Additional graduate teaching assistants (e.g., to support large classes and teach lab sections).
- Resources for advising (e.g., additional faculty and advisors, including career development).
- Support for our large classes (e.g., lecturers who specialize in teaching and organizing large classes).
- Additional faculty to reduce our student/faculty ratio and improve our small-course offerings.
- Resources for lab courses (e.g., additional faculty, space, and equipment for specialized labs).
- More state-of-the-art classroom space for a variety of class sizes.

The following resources would greatly help with the process of curriculum development and change.

- Consultation by experts in curriculum development.
- Administrative support for organizing and implementing changes.
- Travel funds to visit other institutions or bring in speakers.
- Course releases to help develop new courses.

PHYSICS ACTIONS

1. Resource neutral

- The continual development of curriculum to 21st-Century standards is under way with an emphasis on better coherence of curriculum and the student experience. Aspects of the planned professional development training are taking place within the confines of existing resources through modest changes in course emphasis.
- More consistent professional development components in our Freshman Colloquium and Junior Year Writing Course.

2. Require resources

- Additional faculty members are needed to:
 - reach our goal for each undergraduate to have a research experience, internship, or teaching practicum.
 - Create a new junior colloquium course, focusing on career options and guidance.
 - Offer a requisite 500-level Senior Research Experience capstone with fewer than 35 students that will help prepare students for future careers.
 - Offer at least three 500-level courses (including at least one lab course) each semester, and a new 500-level course *Data: The Art of Measurement and Analytics*
- Additional TA support is needed to:
 - Offer undergraduates access to students and better grading in all courses. Physics courses above the 100-level have weekly assignments that can be many pages long. It is equivalent to writing a literature paper every week. We rely on TAs to grade these papers. When grading is done poorly, undergraduates' attitudes toward the course and the major are adversely affected. Currently, our TAs are taking on load far higher than any of our peer institutions (responsible for 2-3 courses). This is untenable and results in poor assessment and reduced learning gains for our undergraduates.
 - Enable a full array of TBL courses. Currently, the TBL format is used for the introductory majors sequence Physics 181 and 182, and the introductory life science majors course, Physics 131.
- To succeed in bringing the 400- and 500-level laboratory courses to 21st-Century standards, larger lab space is needed. This space is also necessary to accommodate the increased number of majors from other CNS and Engineering departments that take physics.

POLYMER SCIENCE AND ENGINEERING ACTIONS

1. Resource neutral

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.

2. Require 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.

STOCKBRIDGE SCHOOL OF AGRICULTURE ACTIONS

1. Resource neutral

1. Reduce the number of small undergraduate classes taught by tenure track faculty and increase the number of large General Education classes.

In Stockbridge we need to use limited faculty resources wisely. We must increase the number of students taught and at the same time continue to provide access to faculty, maintain reasonably sized classes and improve the student experience. This might be achieved by increasing large service GenEd's, reducing the number of undergraduate classes with fewer than 12 students, and offering classes on alternate years to ensure that required courses in the major have about 25 students.

Specifically we plan to:

- Increase enrollment in GenEd classes, STOCKSCH 100, 120 and 171
- Submit STOCKSCH 197P - Introduction to Permaculture as a GenEd
- Ask the director to review the need for classes taught with less than 12 students
- Review the A.S. program to eliminate small classes (combine or move to alternate years) and allow more flexibility for those students planning on continuing into the B.S. degree programs
- Introduce more hands-on experience lab and field courses
 - > We have significantly expanded the Student Farming at the Agricultural Learning Center (ALC)
 - > We have added several new student projects at the ALC:
 - Art Garden
 - Food for All Garden
 - Poultry Production
 - Pollinator Garden
 - Herb Spiral
 - Permaculture Food Forest
 - > We plan to add a grape vineyard at the ALC
 - > We will plant a small apple orchard at the ALC
 - > We have begun the establishment of a utility arboretum at the ALC
 - > We plan to create a Landscape Horticulture project at the ALC
- STOCKSCH 118 (Intro to the SFF Major) was approved by the Faculty Senate and satisfies the required freshmen seminar for all new students in SFF
- We plan to strengthen the career development components of classes to support Sustainable Horticulture, Turfgrass Science and Management, and PSIS majors
- A new position in Sustainable Food & Farming will be created to monitor and manage internship experiences to insure educational quality and optimize the experience for students in SFF

2. Address the current weaknesses in our educational offerings.

The restructuring of PSIS and unfilled retirements has created a situation in which there are several disciplinary weaknesses. Specifically we commit to the following changes:

- Applied physiology in the areas of turf and greenhouse are strong but there is a gap in the area of applied physiology in food crops. We will enhance the applied aspects of the current Plant Physiology course with specific examples that engage Food & Farming students
- Add classes in business management, marketing and finance or improve access to suitable classes taught by other departments – **DIRECTOR TO INITIATE CONVERSATION WITH RESOURCE ECONOMICS AND GREENFIELD COMMUNITY COLLEGE**

- New classes with an urban and particularly a soil health (in urban areas) focus are needed perhaps with financial support from state government –
- Classes and study abroad opportunities to support the international certificate
 - > A new winter term class will be offered on food systems in Cuba
 - > A 3+2 (fifth year) curriculum for international students is being developed
- Build our capacity in teaching integrated plant/animal agriculture by offering new classes and/or gaining access to Animal Science classes for our students
 - > New classes are being offered in Small Farm Husbandry
 - > A poultry production project has been initiated at the ALC
- We need additional courses in food safety and food security –
CURRICULUM COMMITTEE WILL REVIEW OPPORTUNITIES IN FOOD SCIENCE AND NUTRITION DEPARTMENTS
- New courses in the rapidly expanding major of Sustainable Food & Farming are being taught by part-time instructors paid by revenues from the online CPE program. While this will work in the short-term a long-term solution must be developed. Specifically full-time Instructors should be hired in the areas of:
 - > Agricultural Education
 - > Small Farm Animal Husbandry
 - > Permaculture Design
 - > Food & Farming Policy
 - > Sustainable Agriculture Production

3. Develop summer opportunities for applied agriculture classes.

Classes offered at the Hadley Farm and the Agricultural Learning Center to the both agricultural and non-agricultural students will serve as recruitment mechanisms for the majors while generating income.

4. Creatively reposition our PSIS major to attract more students.

This major has very few students. We need a new strategy to build enrollment. While students can focus on basic sciences and graduate school preparation in the other three majors, this major should attract students less interested in a commodity or production focus.

- We need a more aggressive campaign to make other students in CNS aware of this applied biology and applied ecology option.
- Rename the PSIS major

5. Create a bachelor's degree in Equine Management.

Currently the rapidly growing A.S. major in Equine Management sends students to

BDIC for a B.S. degree. We need to maintain a strong equine program to support this important economic driver in Massachusetts agriculture. To be successful we need to strengthen the equine assisted therapy, leadership, and community building aspects of the Equine program.

6. Change the requirement for the International Agriculture Certificate.

Students completing the Special Program in Agriculture will have it noted on their transcript and will receive a letter to that effect. Students choose a major from among those offered in the College of Natural Sciences (or an approved area of agricultural study). In addition to courses required for the student's major, they will take courses to prepare them to work effectively in other cultures and areas of the world. Students will take at least one course that takes place in a county outside of the United States and is related to agriculture. This international course must be approved by the International Agriculture Committee of the Stockbridge School of Agriculture.

To help build recognition for the revived International Agriculture Certificate, we will:

- Assign a faculty member to manage the Certificate Program
- Dr. Frank Mangan will offer a new course - Food Systems in Cuba: Production, Logistics and Marketing (SSA 397), which will be taught in Cuba every year during the winter break. This course will meet the requirement of an agricultural course that takes place outside of the United States
- The Tropical Agriculture course offered through SSA needs to be revised to accommodate the needs of students and also broaden it by encouraging SSA faculty to participate and teach.
- An internship abroad can also be used to satisfy the need of the International Agriculture Certificate.
- International students visiting UMass and USA can be eligible to get the International Agriculture Certificate after taking a course at UMass and satisfying other requirements.

7. SSA students will gain international exposure and experience.

- UMass faculty and SSA in particular will develop courses that can be offered in other countries. Dr. Wick is teaching Plant Diagnostics in Bangladesh, which can be modified to accommodate our students. Dr. Mangan's course in Cuba is another example. Summer courses taught in other countries should be developed to run 3 to 6 weeks, and give students experience in specific topics such as organic vegetable production, grape production, sustainable agricultural practices etc.

- A course that is offered abroad by UMass faculty can be set up through CPE to offer opportunities to our students and generate revenues for the college and department.
- SSA will develop ties with Agricultural Schools in other countries so that our students can visit, take courses and internships abroad to enhance their International exposure and experience. We have established official ties with universities in Germany (Freiburg, Heidelberg, Mannheim, Konstanz, Tübingen, Hohenhim, Stuttgart, Karlsruhe, & Ulm). Perhaps other established agreements? See 4.
- SSA faculty should develop more courses in collaboration with other International universities in Asia, Southeast Asia, Europe and South America. These courses ranging from 3 to 5 weeks can be taught along with students and faculty from host institutions during winter and summer breaks. Several SSA faculty already have active collaborations in India, China, Bangladesh, Chile, Brazil, Cuba, among others. and these collaborations and links should be exploited to develop joint courses and create opportunities for SSA majors to get International exposure, cultural exchange and experience.
- UMass has developed strategic partnership with the Jawaharlal Nehru University (JNU) in India and SSA will utilize this opportunity to initiate student and faculty exchange, offering short duration courses jointly taught by SSA and JNU faculty. Similar model will be expanded to other Agricultural University in India and SSA. Also SSA faculty (Baoshan Xing and Om Parkash) are developing a special collaborative arrangement for student/faculty exchange with the Fujian Agricultural and Forestry University (FAFU) in China. These strategic collaborations will provide International exposure/experience opportunities for SSA students.
- SSA faculty should be giving 'knowledge seminars' about their experience in other countries and encouraging students to apply for Fulbright scholarship and other opportunities

2. Require resources

- We are currently weak in plant genetics, plant breeding and the practical aspects of seed selection and saving. This is an opportunity to attract new students

VETERINARY AND ANIMAL SCIENCE ACTIONS

1. Resource neutral

- We have identified certain gaps in the curriculum we have been trying to solve by developing more targeted courses. First, we have developed a “Business Animal Management” course, as our students could not gain access to similar classes offered in SOM. This topic was deemed very important, as farms are small or large businesses and students need this knowledge if they eventually run their own farms or are hired to manage farms. Second, in one of the surveys, our students expressed dissatisfaction with their preparation for “Solving Complex real-world problems”. To that end, we have developed a new course based on problem solving of routine cases observed in veterinary clinics entitled “Advanced Animal Health and Management” where students are made to work through clinical cases and come up with the diagnosis and treatment. This is the first semester the class is offered and the enrollment was limited, but we plan to expand it next fall. Besides working in teams, students must read the literature to request tests to arrive to a diagnosis as well as to make recommendations for treatments. Third, we are in the second year of offering a “Veterinary Microbiology Lab”. This arose from the need of some our students applying to veterinary schools needing a 2-credit microbiology lab, which at the time the Microbiology department was not offering. It has been a big success and all our seat available for this course are now taken. Forth, we have been teaching a very successful class, research animal management, AnSci 455, which teaches all the regulations required to house and manage research animal colonies. Many of our graduates have gone on to important management positions in Animal Care in places such as Novartis and New England Medical Center. Besides, there is a great demand for this type of training in the state, given the large number of pharmaceutical companies. Thus, we have added a second semester to AnSci 455, during which students gain experience using our own animal colonies, including managing mice, rats, fish and frogs. This is an excellent opportunity that makes use of existing resources and train students for immediate employment. Additional resources could be used to visit other state of the facilities that are not available on campus.

2. Require resources

- We have identified a few additional gaps that to implement corrective measures for would require some investment. First, it is imperative better laboratory space is made available to the college and departments. In our particular case, we don’t have any designated laboratory space and must negotiate every semester with other departments to teach our courses that require modern laboratories space. Besides being time consuming, this process creates unpredictability in the program, as for some courses meeting times are changed year after year. Thus, our students would greatly benefit for good quality and stable laboratory space. An area we have identified as a gap of training for our students, and for most students in the life sciences,

that would benefit from more laboratory space is the teaching of “sterile cell culture technique”. We plan to modify a course already in existence, AnSci 385, which is also Micro 385, to emphasize it. Almost any research laboratory in the life sciences today, whether at a research institution or at a Biotech company, uses this technique to probe any type of scientific question. Thus, students completing such a course and with expertise in this subject would be highly employable. However, these types of courses require spaces equipped with incubators, hoods, and a whole host of complementary equipment, reagents and consumables. An additional area of improvement identified by students, see Senior-Survey Open-Ended Responses, is the need for better hands-on animal experience. While we have the animals and barns, we don’t have the teaching facilities in the Farm. A classroom and a studio/lab space would go a long way to make the many classes that take place in the barns more enjoyable and better teaching experiences. For example, presently there are no rooms in the farms where microscopes can be used and stored, or for surgical procedures and necropsies to be conducted safely and aseptically, and available Wi-Fi and computer terminals to enter data collected on site. Whereas it is understandable that not all requests can be granted at once, a list of priorities should be initiated and subsequently implemented and long-term solutions found so that the overall learning experience of our undergraduates is improved.