MIDDLESEX COMMUNITY COLLEGE

ACADEMIC DEPARTMENT REVIEW

SCIENCE DEPARTMENT

2000 – 2007

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MIDDLESEX COMMUNITY COLLEGE

Academic Department Review

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Middlesex Community College

Academic Department Review

Section I: Introduction

This is an opportunity to provide background or contextual information, set goals for the departmental review and/or include any other introductory information that the committee believes will be helpful to the reader. Include information about previously completed departmental reviews, such as findings, improvements, and unfinished items.

The Science Department completed its first program in 2000. The team for this review included Jessie Klein, Arthur Lavigne, Lynne Osborn, Paul Patev, Marshall Yokell and Linda Young.

The 2000 Program Review uncovered both strengths and areas in need of improvement within the department.

Strengths in 2000

A Leader in Interdisciplinary Learning
A Promoter of Service Learning Opportunities
Use of Microcomputer Based Laboratories and Internet Based Courses
Development of New Assessment Methodologies
Enhanced Classroom Presentation Through Use of Multimedia
Constant Communication and Inclusion of Adjunct Faculty

Issues and Areas in Need of Improvement or Further Study in 2000

Science Requirement-
At the time of the review MCC's science requirement(3 or 4 credit) was the lowest of all the community colleges. This issue has been addressed and will be discussed in this current program review.

Science Tutoring-
In 2000 the tutoring situation in Lowell was less stable and satisfactory than that in Bedford. Since that time there has been a great improvement in tutoring availability on both campuses.

Major Educational Outcomes-
Science Department and course outcomes have to be rewritten to indicate student learning outcomes. This will be part of the college wide assessment initiative.

Advising of Students in Science Concentrations-
In 2000 there were 26 students in the science concentrations and it was unclear how their advisors were being assigned. As of Fall 2007, there are 56 students enrolled in the life sciences and 29 students enrolled in the physical sciences. According to Enrollment Management all science students are assigned science faculty as advisors.

Questions and Issues in 2007

The current program review team represents faculty from both the life and physical sciences and the Bedford and Lowell campuses. The team members are:Jean Cremins, Iveta Dinbergs, Jessie Klein, Kevan Murphy, Paul Patev, Sally Quast, Jane Wiggins and Marshall Yokell. The issues we would like to address in this self study are:

- *In 2003 stronger prerequisites were added to many science courses. Has this led to an improvement in passing rates?*
- *Is there student interest in an Environmental Studies course with lab and an Environmental Science Program?*
- *How can we address the need for improved prerequisites for A+P I?*
- *Are students being adequately prepared for entrance into health careers and transfer?*
- *How can we increase offerings to stay current with newly developing science fields?*
- *Are there ways to increase interest in science majors among woman and minorities?*

Section II: Mission and Goals

1. State the mission of the department/area. Please indicate if the mission statement is new or has been significantly revised as part of a prior departmental review process.

   The mission statement of the Science Department has not changed since the completion of the 2000 Program Review. The members of the department continue to be a group of forward thinking and energetic educators dedicated to student success.

   The Science Department provides successful learning experiences for MCC students in the physical and life sciences. The department offers a wide spectrum of challenging courses ranging from introductory to advanced allowing students to fulfill science requirements for an associate degree, health program or transfer for credit.

   These curricula enable students to:

   - *Ask pertinent questions about the natural world around them*

- *Use the scientific method to formulate and test defensible hypotheses*

- *Recognize the interconnectedness of humanity with the rest of the natural world, and the impact each has on the other*

- *Effectively communicate their ideas to others*

2. a. What is the relationship of the department/area's mission to the overall mission of the College as adopted by the Trustees and approved by the BHE?

   The mission of the Science Department parallels and supports the overall mission of the college in every area: learning, professional development, educational preparation, and community partnerships.

   In addition to the traditional roles of transmitting to our students the body of knowledge that comprises the discipline of science and developing in them the investigation skills that underlie the scientific method, the science faculty have adopted the goal of promoting science literacy in all students. In addition, science faculty have responded to the needs of a diverse and changing student body through more active, hands-on learning, increasing student use of technology, promoting interdisciplinary courses, and widening availability of service learning.

   The faculty constantly strives to update skills and evaluate and adopt new pedagogies as appropriate. This has been accomplished by active participation in on-site professional development as well as attendance at professional conferences and seminars. The department has forged links to other constituents through teacher training, open houses, programs for students in primary and secondary grades, and active outreach to students currently enrolled at the college.

   b. Please explain what specific institutional goal(s) the department/area satisfies. You may include any goals referenced in the College Mission Statement or any goals illustrated in the Pillars of the College Mission Statement.

   The Science Department satisfies the values and goals that support the Middlesex mission by providing:

   ***A Dynamic Learning Environment**- Students are given the opportunity to take traditional laboratory courses, lecture courses, on-line courses, hybrid courses and interdisciplinary courses.*

   ***A Supportive Caring Community-** Laboratory classes are small allowing faculty to interact and guide the students not only in science content but by advising students on their course choices. There are a wide range of courses*

appropriate for students in various stages of their college careers. For example, developmental students can enroll in Explorations in Science and more advanced students can enroll in sophomore level science courses.

Responsive Workforce Development- *The Science Department provides courses that support other programs within the college: Integrated Science I and II for the Elementary Education Program, Forensic Science for Criminal Justice, Anatomy and Physiology and Microbiology for Health Careers Programs, Immunology, Biochemistry, and Molecular Biology for the Biotechnology Program, Chemistry for Fire Service for the Fire Protection and Safety Technology Program and Topics in Mathematics for the Diagnostic Medical Sonography Program. The department is entering into collaborations to begin workforce development programs in renewable energy and nanotechnology.*

Active Civic Engagement- *Several science faculty have incorporated service learning into their courses through the Lowell Civic Collaborative.*

Extended Learning Opportunities- *The Science Department offers two courses Water and the Living World and Effects of Environment on Health through the Honors Program. Middlesex students who have successfully completed General Chemistry for Engineering and Science I and II are eligible to take Organic Chemistry at UMASS-Lowell under the NECCUM Agreement. Two students completed summer internships in the Polymer Science and Engineering Department at UMASS-Amherst. In spring 2007 a select group of students and instructor took an on-line Introduction to Nanotechnology course through the University of Massachusetts-Lowell. Students did ecological research on the coral reefs of Belize through the college's International Program in July 2007. The department has also provided support for the home school science courses and science summer camps offered through the Community Education Department.*

A Commitment to Excellence- *Science instructors participate in professional development to broaden their teaching strategies to include active learning and the latest innovations in technology. Computers are used in the classrooms and labs to help facilitate the curricula. Three members of the department participate in the Carnegie Scholarship of Teaching and Learning Cluster.*

Section III: Data

The Institutional Research Office will provide a significant portion of the data. Your committee is encouraged to request additional relevant information from Institutional Research and to develop and conduct alternative assessments as well. Some examples of assessments that the committee may choose to implement are student focus groups and/or student surveys. Input from relevant internal groups such as Advising, Admissions, and/or connected departments will also be necessary. Please

include a copy of the data from Institutional Research and all departmentally-developed surveys or focus questions in the Appendix of the review.

3. a. Please note important trends, patterns and issues that emerge through the enrollment, academic progress and retention data. (Data from Institutional Research Office)

The data in Table 1 shows that Science Department enrollments increased by 512 students between fall 2000 and 2006. This represents an increase of 32%.

Table 1:

Science Course (Lecture and Lab) Enrollments for Fall Semester 2000-2006

Fall	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Day	1074	1019	1250	1403	1399	1368	1340
Evening	520	555	638	776	829	883	766
Total	1594	1574	1888	2179	2228	2251	2106

(Evening includes web and Saturday classes)

The data in Table 2 shows that between 2000 and 2006 there was an increase in 26 science sections. Between the fall of 2000 and 2004 the number of sections offered college-wide increased by 17%. The number of sections offered by the Science Department for the same time period increased by 39% indicating that the Science Department has been one of the fastest growing areas of the college.

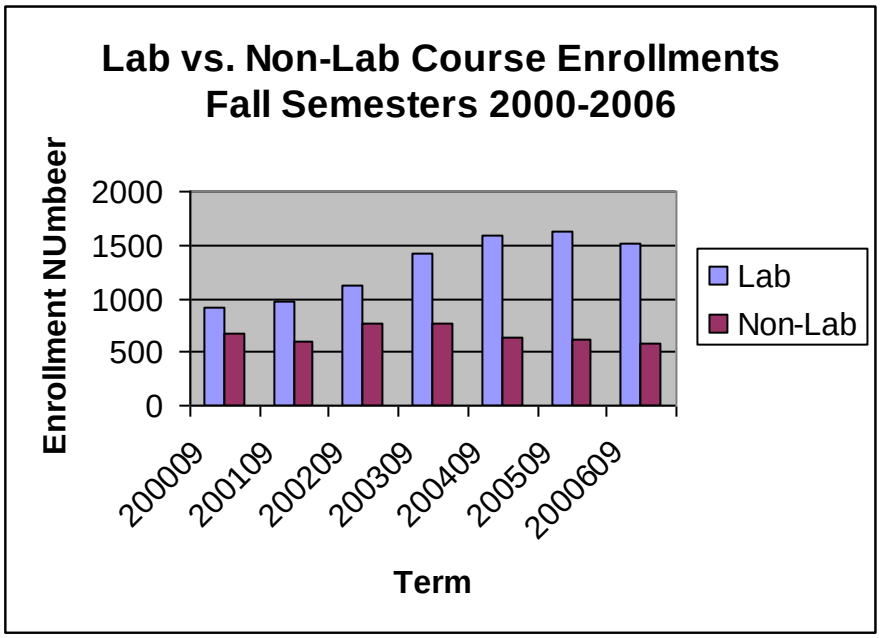
Table 2:

Number of Science(Lecture and Lab) Sections for Fall Semester 2000-2006

Fall	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Day	48	45	51	58	64	64	63
Evening	26	27	30	30	39	44	37
Total	74	73	81	88	103	108	100

Beginning in the fall of 2002 the Liberal Arts and Sciences science requirement was changed to eight credits of science in order to meet the new Transfer Compact science requirement. As shown in Chart 1 the number of lab science enrollments increased steadily since fall 2000 whereas non-lab enrollments slightly decreased.

Chart 1:



The increase in lab enrollments of 712 students reflects an increase of the need to offer 30 additional laboratory sections since fall 2000. The greatest increases in lab course enrollments occurred in Introduction to Biology(38%), Anatomy and Physiology I(41%), Introduction to Microbiology(57%), Introduction to Chemistry(26%) and College Chemistry I(35%). During the same time period (2000-2006), Middlesex added part-time weekend/evening Nursing and Dental Hygiene Programs, thereby increasing the number of students in health careers requiring science courses.

b. Please comment on significant information that emerges from the Student Transfer and Employment Follow-up data. (Data from Institutional Research Office and Department Records)

Currently 56 students are enrolled in the Life Science Concentration and 29 are enrolled in the Physical Science Concentration. As of 2005, 11 students graduated and/ or transferred from the Life Science Concentration. In the Physical Science Concentration, 16 students have graduated and or transferred since 2000.

Data provided by Enrollment Services shows that over 50% of science transfers are to other state institutions in Massachusetts such as Salem State, Fitchburg State and the UMASS campuses at Amherst, Boston and Lowell.

The Science Department has increased its focus on developing strong articulations with the state schools to promote smoother transfers. This is an area for further development in 2007 and in the future.

c. Please summarize findings from student surveys, student focus groups, and/or other types of surveys and focus groups the Committee chose to undertake. (Data from surveys and/or questions developed by the Committee)

The Program Review Committee conducted the following student and faculty surveys during the spring of 2006:

- *Dental Hygiene, Nursing, Sonography and Radiologic Technology students and faculty were surveyed as to their opinions on the preparation provided by science courses.*

- *Environmental Studies students were surveyed for interest in taking a four credit Environmental Science course with lab and enrolling in an Environmental Science Program.*

- *Chemistry students were surveyed regarding their interest in taking an organic chemistry course.*

Results of the Health Student and Faculty Survey

Table 3:

Question: If you were an MCC student and completed your prerequisites at MCC, did your MCC Science curriculum properly prepare you for your program?

Program	Yes	No	Somewhat	Blank or NA
Nursing	103	2	5	12
Dental Hygiene 1st year	21	1		
Sonography	17			8
Radiologic Technology	29	1		

As can be seen in Table 3 the majority of the health students surveyed thought their science courses adequately prepared them for their health related course work. Students also made suggestions on other topics or techniques that would have been helpful. This information will be shared with the Science faculty.

Ten instructors from Dental Hygiene, Nursing and Radiologic Technology responded to the question: "How well were your MCC students prepared for your courses?" They were all satisfied with the level of student preparedness in Anatomy and Physiology and Microbiology. One instructor noted that students who take science courses in the summer are not as well prepared as students who take the courses during the academic year. The summer students struggle to get all the assignments completed and do not have the background to answer nursing test questions.

Results from Environmental Studies Survey

Students in the Environmental Studies classes were asked the following questions:

"Would you be interested in taking an Environmental Studies course with a lab?"

"Would you be interested in majoring in Environmental Sciences if this major was offered at MCC?'

The results of the survey are shown in Table 4 below:

Table 4:

Question	Yes	No	Maybe
Environmental Studies with Lab	53	24	4
Environmental Science Major	18	58	5

Based on these results, the Science Department is developing a four credit Environmental Science class with lab to be offered in spring 2008. At this time there does not appear to be enough student interest in an Environmental Sciences Program.

Results of the Chemistry Survey

Students enrolled in College Chemistry I, II and Chemistry for Engineering and Science Transfer II were asked:

"Would a year course in organic chemistry with lab at MCC help you reach your career goals?"

The results are shown below in Table 5.

Table 5.

Area of Study	Yes	No	Maybe
Life Science	4		
Physical Science	4	2	1
Nursing		5	
Dental Hygiene	3	22	1
Liberal Arts	3	2	2
Liberal Studies	3		
Other	13	7	
Total	30	38	4

Although 42% of the students surveyed indicated a interest in an organic chemistry course, the Science Department does not presently have plans to develop a course. In order to take organic chemistry, students should take General Chemistry for Engineering and Science I and II as a prerequisite. As can be seen from the chart only eight (Life Science and Physical Science) of the 30 students would have the necessary prerequisite. It would also be very expensive to purchase the equipment necessary to run an organic chemistry lab. We would at best have the enrollment for one section and the equipment cost does not warrant the expenditure for one section. Presently students who successfully complete General Chemistry for Engineering and Science I and II can take Organic Chemistry at UMASS-Lowell under the NECCUM Agreement.

Section IV: Department/Area Analysis

Target Populations:

4. a. Is this department/area intended to serve a target population(s)? Please explain.

MCC's science courses serve five general categories of students:

1. *Career-oriented students such as those involved in Health Careers, Biotechnology, Computer Science, Engineering Science, Criminal Justice, Elementary Education and Fire Service.*
2. *Students who need to satisfy the general education requirement for science.*
3. *Students who intend to transfer to baccalaureate degree programs in areas such as Life Sciences, Physical Sciences.*
4. *Students who are enrolled in developmental courses can take Explorations in Science to learn college success skills while taking a content based course.*
5. *Honors students can take two Honors science courses towards their science requirement: Water and the Living World or Effects of the Environment on Health.*

b. Are there plans to market the courses in this department/area to any new or different groups that are not currently being served by this department/area? Please explain.

The Science Department is beginning initiatives to develop and market courses for students in the following areas:

1. *Engineering students interested in the field of nanotechnology.*

The Science Department is collaborating with the University Massachusetts Lowell to educate MCC students in the developing field of nanotechnology. In the spring of 2007 a selected number of Middlesex physics students enrolled in an online Introduction to Nanotechnology course offered through the University of Massachusetts Lowell. John Smith, the MCC physics instructor, also participated in the online course.

2. Students interested in the field of renewable energy.

The Science Department is collaborating with Cape Cod and Greenfield Community Colleges to submit a grant proposal to the National Science Foundation to develop curricula and courses for renewable energy programs at the colleges and regional vocational high schools. In the fall of 2007, MCC offered an online course in renewable energy and will begin developing a four credit environmental science course to be offered spring 2008. These courses/programs would target students who are interested in environmental issues and also allow students at the vocational schools who are being trained for the building industries to become certified to install photovoltaic and solar systems.

3. Women and minorities interested in science, technology, engineering and math (STEM) careers.

There is a national need to encourage all students but especially women and minorities to enter STEM careers. In 2004, 605,403 associates degrees were awarded nationally, of these 48,309(8%) were in science and engineering. As the data in Table 6 shows, woman earned only 41% of the science and engineering degrees. Blacks and Hispanics earned an even smaller percentage.

Table 6. Percentage of Associate Degrees Earned Nationally by Women and Minorities in 2004

Degree Type	Women	Blacks	Hispanics
% all Associate Degrees	62%	11%	11%
% of Science and Engineering Degrees	41%	12%	11%

Table 7 shows that a very small percentage of the students enrolled at MCC; especially minorities, are pursuing degrees in the sciences. The Science Department is collaborating on the following NSF sponsored initiatives: Women in STEM Initiative at MCC, the Louis Stokes Alliance *for Minority Participation* with *UMASS Boston and UMASS-Lowell and the Northeastern University – STEM Talent Expansion Program to encourage students from under-represented populations to enter science fields.*

Table 7. Number of Students Enrolled in the Science Concentrations at MCC in Fall 2004

Program	Men	Women	Blacks	Hispanics
Life Science	8*(0.1%)*	19 *(0.2%)*	0	2*(0.02%)*
Physical Science	4*(0.05%)*	6*(0.08%)*	0	3(0.03%)

Numbers in parenthesis represent % of total MCC student enrollment

c. Are there plans to change or add to strategies currently in place to assess the department/area's fit with student interest and market demand?

Yes, two existing strategies listed below are adequate for assessing the fit of course offerings with student interest and market demand and will be continued.

1. An examination of enrollments in courses currently offered.
2. Collaborate with the Associate Dean of Articulation and Transfer to examine the transferability of science courses, particularly with the state colleges and universities.

In addition surveys of student and faculty needs and satisfaction as discussed in Section IIIc will be continued as needed.

d. Are department/area faculty and staff currently working with the Academic Planning Center or other areas of the College to interest students in taking courses in the department/area? Describe these interactions and the roles that the parties play.

On several occasions the department participated in open houses and "Exploring Majors" during registration periods to interest students in our courses. Science instructors have made presentations when public school students toured the MCC campuses. Some high school students and home-schooled students have attended science classes through dual enrollment and through Community Education.

Students are attracted to science courses because of the innovative use of alternative pedagogies. Chemistry students do civic engagement projects with Girls, Inc. of Lowell. The expanding opportunity to do coral reef research in Belize through the MCC International Programs will attract more students to science.

The STEM initiatives (Woman in Science, Louis Stokes Alliance *for Minority Participation*, *Northeastern University – STEM Talent Expansion Program) will provide a means for students to explore careers in science.*

The Biotechnology faculty work with the Admissions Office and through project AWESOME to recruit new students to the Biotechnology program. (This is part of the Biotechnology program review.)

Through the biotechnology outreach programs and presentations at the Museum of Science and biotechnology company sponsored open-houses, MCC faculty have introduced area middle and high school teachers to our science facilities and course offerings. In some cases teachers have brought their classes to MCC for lab activities. It is hoped that these teachers will encourage their students to attend MCC.

The faculty interacts with science departments from area high schools by judging science fairs and scholarship competitions and collaborating on grants. Several of our adjuncts teach in public and private high schools and encourage their students to attend MCC.

e. Are there additional student recruitment/marketing efforts in which department/area faculty and/or staff would like to be involved? Please be as specific as possible.

Science faculty are interested in doing more teacher-training workshops on inquiry-based science activities, biotechnology, computer-aided laboratory activities, and the integration of science and math into the public school curriculum. They would also welcome the opportunity to visit area high schools with the Admissions staff.

f. Please comment on any Advanced Placement (high school) or Articulation Agreements (4-year institutions) that apply to your department/area. Are the agreements current and signed by all partners? What percentage of students takes advantage of each agreement?

The Science Department is in the process of renewing or initiating discussions regarding articulation agreements for the Life Science and Physical Science concentrations with Salem State College and the University of Massachusetts-Lowell. We will also be renewing articulation agreements for the biotechnology program with Boston University and investigating possible biotechnology articulation agreements with Northeastern University and the University of Massachusetts-Lowell.

External Perspectives:

5. a. Based on a review of other college catalogs, list the colleges in our general area that have similar departments/areas and comment on significant differences from the MCC offerings that bear further exploration.

The science course offerings at MCC are very similar to those offered at the other community colleges. The following is a list of all the courses presently offered by the Science Department.

Science Courses Offered at MCC

BIO 100 Sexually Transmitted Diseases (H) BIO 105 Basic Anatomy and Physiology BIO 108 Nutrition(*H*) BIO 112 Infectious Diseases(H,W,C) BIO 115 Human Genetics(H) BIO 120 Introduction to Biology* BIO 131 General Biology I (H) BIO 132 General Biology II*****(W) BIO 140 Botany(E) BIO 145 Zoology BIO 231 Anatomy and Physiology I*****(H) BIO 232 Anatomy and Physiology II* BIO 255 Molecular Biology* BIO 235 Introduction to Microbiology*(H) BIO 240 Microbiology for Industrial App.*(W) BIO 250 Immunology*(MC) CHE 110 Chemistry for Fire Service* CHE 121 Introduction to Chemistry* CHE 131 College Chemistry* I CHE 132 College Chemistry II* CHE 151 Gen. Chem. for Eng. And Sc. I*(W) CHE 152 Gen. Chem. for Eng. And Sc, II*(W) CHE 160 Principles of Biochemistry* **ENV 105 Natural Disasters** **ENV 108 Renewable Energy**(E) ENV 110 Intro. to Ocean and Marine Bio(E)	ENV 115 Environmental Studies (E,V) **ENV 120 Coral Reef Ecology** (E,MC) **ENV 131 Environmental Science with Lab***(E,V) **ENV 141 Introduction to Geology*** ENV 917 Effects of the Environ. On Health(H) ENV 920 Water & the Living World* GEO 105 Age of Dinosaurs GEO 110 Introduction to Meteorology (IT) GEO 121 Physical Geology* GEO 122 Historical Geology* PHY 105 Astronomy PHY 107 Technical Physics **PHY 110 Physics for Networking Systems** PHY 151 Physics I* PHY 152 Physics II* PHY 171 Physics for Eng. And Sc. I* PHY 171 Physics for Eng. And Sc. II* SCI 100 Explorations in Science **SCI 121 Integrated Science I***(E) **SCI 122 Integrated Science II***(E) SCI 130 Forensic Science*(IT) **SCI 175 Methods of Applied Statistics*(C,W)**

(H) Indicates courses that meet the Health Intensive
(E) Indicates courses that meet the Environmental Intensive
(V) Indicates courses that meet the Values, Ethics and Social Policy Intensive
(W) Indicates courses that meet the Written Communication Intensive
(C) Indicates courses that meet the Computer Literacy Intensive
(IT) Indicates courses that meet the Impact of Technology Intensive
(MC) Indicates courses that meet the Multi-cultural Intensive
*Science courses with a laboratory component
Bold indicates courses developed since the last program review

Tables 8 and 9 compare the science requirements of the MCC Liberal Arts and Sciences Transfer Program and the Liberal Studies Program to similar programs at area community colleges.

Table 8. Comparison of Science Requirements for Transfer Programs at Massachusetts Community Colleges

Community Colleges	One Science	Two or More Sciences	One Lab Science	Two Lab Sciences	Lab Science Sequence
Middlesex CC		X	X		
Berkshire CC		X		X	
Bristol CC	X				
Bunker Hill CC		X	X		
Cape Cod CC		X		X	
Greenfield CC		X		X	
Holyoke CC		X		X	
Mass Bay CC		X		X	X
Massasoit CC		X		X	
Mount Wachusett CC				X	
Quinsigamond CC		X		X	
Northern Essex CC		X		X	
North Shore CC		X		X	X
Roxbury CC				X	
Springfield Technical CC		X		X	

Table 9. Comparison of the Science Requirement for Programs Similar to MCC's Liberal Studies Program

College	One Science	Two or More Sciences	At Least one Lab Science	Science Sequence
Middlesex CC	X			
Bristol CC	X		X	
Bunker Hill CC	X		X	
Mass Bay CC		X	X	X
Massasoit CC		X		
Mount Wachusett CC	X		X	
Quinsigamond CC		X	X	
NECC		X	X	
Roxbury CC		X	X 2 required	

Table 8 shows that 12 of the 14 community colleges surveyed are now requiring at least two lab sciences for the LAS transfer. Table 9 shows that

seven of the community colleges that have a program similar to MCC's Liberal Studies program require at least one laboratory science.

The National Science Education Standards (National Research Council [NRC], 1996) states that all students should have the opportunity to do inquiry based science as presented in the laboratory setting.

***Recommendation:* Because of the emphasis that is now placed on critical thinking and the inquiry approach to study, the Science Department recommends that students in the Liberal Arts and Sciences Transfer program take two lab sciences and students in the Liberal Studies program take at least one laboratory science.**

Table 10 is a comparison of the science concentrations or programs offered at the Massachusetts community colleges. Five of the 15 colleges offer students the opportunity to concentrate in Environmental Sciences. In fall 2006 the Science Department began discussions with Cape Cod Community College about collaborating on developing programs around renewable energy. This prompted the creation of an online course in renewable energy to be offered in fall 2007. Our student survey indicated that there was not enough interest in an Environmental Sciences Program at this time, but by offering courses in renewable energy and a four credit environmental sciences course we may be able to generate future interest.

Table 10. A Comparison of Science Concentrations/Programs at Massachusetts Community Colleges

College	Life Science Concentration	Physical Science Concentration	Other
Middlesex CC	X	X	
Berkshire CC	X		
Bristol CC			Math and Science Option
Bunker Hill CC	Biology	Chemistry	Physics and Engineering
Cape Cod CC			Environmental Studies, Pre-Engineering Concentration
Greenfield CC			Environmental Studies Math/ Science
Holyoke CC	Biology Option	Chemistry option, Physics option	Environmental Science, Natural Resouces,
Massachusetts Bay CC	Life Science Option		Environmental Science
Massasoit CC			Science Option
Mount Wachusett CC			Natural Resources Technology
Quinsigamond CC	None	None	

College	Life Science Concentration	Physical Science Concentration	Other
Northern Essex CC	Biology Option	Chemistry, Earth Science, Physics	
North Shore CC			Horticulture
Roxbury CC	Biological sciences	Physical Sciences	Environ. Management
Springfield Technical CC	Biology	Chemistry, Physics	

Tables 11 and 12 compare the science, math and computer science requirements for the life and physical science concentrations/programs at selected Massachusetts community colleges.

For the life science concentration the eight colleges surveyed are similar in requiring a general biology course or sequence and a year of inorganic chemistry. Four colleges (Berkshire, Bunker Hill, Mass Bay and Springfield Tech) suggest organic chemistry as an elective. In the physical sciences all the colleges require a year of inorganic chemistry and physics.
Three colleges (Bunker Hill, Holyoke and Springfield Tech) suggest an organic chemistry sequence for their chemistry or physical science students. Middlesex does not plan to offer organic chemistry, but through the NECCUM Agreement, our students have taken organic chemistry at UMASS-Lowell after successful completion of General Chemistry for Engineering and Science I and II.

Five of the colleges (Middlesex, Mass Bay, Northern Essex, Roxbury and Springfield Tech) require or suggest a computer applications course for science students. Because many MCC students enter college skilled in computer applications, as of fall 2007 the Science Department will accept Computers for Technology, Introduction to Computer Science or Programming I to satisfy the computer science requirement for life science and physical science students.

Bunker Hill, Holyoke, Northern Essex and Springfield Tech suggest statistics as an elective for their science students. The Science Department suggests that our science students consider taking Methods of Applied Statistics as an elective. This would provide them with the opportunity to plan and perform experiments and use their own data to learn statistical principles. They would be doing science and statistics as they are done in a research setting.

Table 11. Science, Math and Computer Science Requirements for the Life Science Concentrations/Programs at Massachusetts Community Colleges

Middlesex CC	Berkshire CC	Bunker Hill CC	Holyoke CC	Mass Bay CC	Northern Essex CC	Springfield Technical CC	Roxbury CC
General Biology I and II	General Biology I	General Biology I and II	Biology I and II	Principles of Biology I and II	Introductory Biology I and II	Biology I and II	General Biology I and II
General Chemistry for Engineering and Science I and II	Introductory Chemistry I and II	General Chemistry I and II		Principles of Chemistry I and II	General Chemistry I and II	General Chemistry I and II	Principles of Chemistry I and II
Precalculus I and II	Precalculus I and II	Calculus I	Analytical Geometry and Calculus I or Statistics as electives	Precalculus	Calculus I and II	Calculus I and II(Statistics can replace Calculus II	College Algebra
Computers for Technology, Introduction to Computer Science or Programming I				Computers for Technology	Computer Applications or Biology Electives		Computer Applications
Life Science Electives 6-8 Credits	Science Electives 8 Credits	Science, Math or Computer Science Elective Calculus II, Statistics or Organic Chem.	Science Electives 8 Credits	Advanced Lab Elective 4 Credits	Biology Elective 3-4 Credits		2 Lab science Electives
	Organic Chemistry I and II		Additional Electives including Science, Math and General Education	Organic Chemistry I and II		Organic Chemistry I and II	
	Environmental Studies		Botany and Zoology	Anatomy and Physiology I and II		Genetics	
		General Physics I and II		College Physics I and II	Physics I and II(Applied or Engineering)	College Physics I and II	

Table 12. Science, Math and Computer Science Requirements for the Physical Science Concentration/Programs at Massachusetts Community Colleges

Middlesex CC	**Bunker Hill CC**	**Holyoke CC**	**Northern Essex CC**	**Springfield Technical CC**	**Roxbury CC**
General Chemistry for Engineering and Science I and II	General Chemistry I and II	Inorganic Chemistry I and II	General Chemistry I and II	General Chemistry I and II	Principles of Chemistry I and II
Physics for Engineering and Science I and II	College Physics I and II	General Physics I and II	Engineering Physics I and II	College or University Physics I and II	Principles of Physics I and II
Precalculus I and II					
Calculus I and II	Calculus I and II	Analytical Geometry and Calculus II, III, and IV	Calculus I, II, and II	Calculus I, II and III	Calculus I and II
Computers for Technology, Introduction to Computer Science or Programming I				Computer Applications in Engineering or Introduction to Computer Science	Microcomputer Applications
Science Elective 3-4 Credits		Science Elective 3 Credits	Science Elective 3-4 Credits	Math of Science Elective 6 Credits	
	Organic Chemistry I and II	Organic Chemistry I and II		Organic Chemistry I or II	
	Elective from Computer Science, Statistics with Lab, Calculus III or Honors Seminar		Elective from Science, Computer Science or Statistics	Technical Elective 6 Credits	
			Differential Equations	Differential Equations	

b. Based upon the committee's knowledge of institutions beyond our geographical area that have exemplary departments/areas or are known for their 'best practices,' comment on significant similarities or differences from the MCC offerings that bear further exploration.

New York has a similar higher education system to Massachusetts with community colleges, state colleges and universities.

Rockland Community College located 25 miles north of New York City (www.sunyrockland.edu) is part of the State University of New York system with many of its 6,000 credit students transferring to one of the four year institutions within the SUNY system. Liberal arts students are required to take six credits of science and in some cases are recommended to take a lab science as opposed to the MCC requirement of eight science credits including at least one laboratory experience. Students working towards an Associate in Science in Liberal Arts: Mathematics and Science degree are required to take sixteen credits of science and eight credits of math. At Middlesex the life science students take 22-24 credits of science and seven credits of math. The physical science students take 19-20 science credits and fifteen credits of math. The Middlesex programs appear to be somewhat more rigorous.

6. Please describe mechanisms or procedures currently in place to monitor the currency and fit of the content areas and teaching methodology with the educational interests and needs of our students. Explain how these groups have contributed and/or impacted the department's/area's offerings.

   a. Relevant external parties, such as professional organizations, content skill standards, local, state, and national task forces, etc.

   The Associate Dean of Academic Programs and Articulation monitors changes in the science requirements at four-year schools. The Biotechnology Program, a program affiliated with the Science Department, monitors changes through advisory groups and conducts its own program review.

   In 2001 the Science Department proposed that Liberal Arts and Sciences students be required to take eight credits of science. This was done to ensure that the LAS program would meet the Transfer Compact. The proposal was passed by the FSA.

   Middlesex science instructors have met with science faculty from Salem State College to discuss the transferability of online lab courses. Because of this meeting, it was decided that the laboratory component of online science courses would face-to-face on campus

   In spring 2007 discussions with the Physics Department at UMASS-Lowell led to a change in the catalog description of Physics for Engineering and Science II to facilitate transfer of this course to UMASS-Lowell.

The Science Department Chair monitors national needs and trends in science education as discussed in publications of the National Science Foundation, National Research Council and Project Kaleidoscope. The Science Department has been able to enhance the students' science experiences by involvement in National Science Foundation and private grants.

When John Savage joined the faculty he brought with him a grant from the Boston University Superfund Project that allowed the department to buy equipment for environmental monitoring. John Smith and Tom Vaughn are participating in an NSF grant to MIT to build and use small interferometers in their courses. From April 2004-2007, Jessie Klein was a co-principal investigator on an NSF grant with the Concord Consortium. Through this opportunity students were exposed to free web-based modules that supported topics in biology, chemistry and biotechnology. In 2004 the department was awarded a grant from Hewlett Packard that brought wireless technology and laptops to the science area in Henderson Hall. This has allowed the students to access the internet in their classes, use probes for collecting data, and extend data collection to outside the classroom.

The department is currently participating in the UMASS Boston Stokes grant and the Northeastern University STEP-UP grant to increase the number of students from underrepresented populations who major in STEM fields.

The Science Department is participating in a Chemistry Vertical Teaming Initiative with Lowell High School and UMASS-Lowell.

b. Relevant internal groups or individuals, such as other departments, programs or areas at the college that: (1) utilize your courses as prerequisites for their courses and/or program or (2) supply prerequisites for your courses.

Frequent consultation and communication among the Liberal Arts and Sciences deans, the Associate Dean of Programs and Articulation, The Dean of Health Careers, the Office of the Vice-President for Enrollment Services and the Chairpersons of the Science and Math Departments help identify changing trends in students' needs and interests.

The Science Department provides courses such as Forensic Science for the Criminal Justice Programs and Chemistry for Fire Service for the Fire Protection and Safety Technology Program. Anatomy and Physiology I and II, Introduction to Microbiology, and College Chemistry I and II are either prerequisites or requirements for health career programs. Science Department and Health Careers faculty have discussions regarding

content of these courses. Students in the LINKS program take Explorations in Science.

Courses offered through both the Math and English Departments, such as Algebra I and English Composition I serve as prerequisites for several science courses.

The Math and Science Departments have met to discuss ways in which math can be infused into science courses. Science and math faculty collaborate to integrate mathematical principles and science applications and to promote science and math across the curriculum.

c. Other populations (i.e., students, alumni, community members, cooperative education supervisors, practicum supervisors, service learning supervisors, community agencies).

No current mechanisms exist to monitor the needs as identified by other populations. However the department attempts to be proactive and responsive to input from these groups. For example, several department members have responded to the request from the service learning supervisor to include service learning in their courses.(See Question 10)

The Science Department is working with Prof. Margie Bleichman of the Computer Science Department to develop activities to encourage women to enter STEM careers.

Section V: Curriculum

Departmental Student Learning Outcomes (DSLOs)

7. a. Identify your Departmental Student Learning Outcomes

- *Students will use their scientific educational experiences to provide a solid foundation for further study of the sciences.**
- *Students will convey scientific information through written, oral, numerical or visual communication.**
- *Students will demonstrate investigative skills that underlie the scientific method*.
- *Students will gather and interpret information about the natural world.*

- *Students evaluate and discuss societal issues impacted by science.*

**Assessment will begin during 2007.*

b. Please describe your department's plan for ongoing, annual assessment of its DSLOs.

Each year the department will assess one or two DSLO's. In the Spring of 2007 we will assess the first two DSLO's listed above by collecting student work from a variety of science courses. A department committee will use rubrics to measure the level of proficiency demonstrated in a random sample of the collected artifacts.

c. If applicable, discuss any changes you have made to your DSLOs and/or the ways in which the courses in the department support those DSLOs since your last program review.

In the 1998-2000 Program Review the DSLO's were written from the faculty perspective. The outcomes have been re-written to reflect what "the students will be able to do".

Since the last program review more faculty have students do presentations using posters or PowerPoint. In addition two additional science courses meet the writing intensive. With the development of several online courses students are doing more written assignments through the Discussion Board and Assignment Manager.

d. Map the way in which your department provides opportunities for students to progress towards achievement of each Departmental Student Learning Outcome, by noting in which courses the outcomes are **Introduced (I), Developed (D)**, or where students are expected to demonstrate **Proficiency (P).**

Course Opportunities for Student Achievement of DSLOs

The Science Department provides learning opportunities for students:

- *Concentrating in the life sciences*
- *Concentrating in the physical sciences*
- *Meeting general education or program requirements such as engineering, computer science or health careers*

Curriculum Map DSLO I: *Students will use their scientific educational experiences to provide a solid foundation for further study of the sciences.*

Curriculum Map DSLO I Life Science Concentration

DSLO	Course	Course	Course
DSLO-Use their scientific educational experiences to provide a solid foundation for further study of the sciences	Introduction to Biology (I)	General Biology I (D)	General Biology II **(P)**
	Introduction to Chemistry (I)	General Chemistry for Engineering and Science I (D)	General Chemistry for Engineering and Science II **(P)**

Curriculum Map DSLO I Physical Science Concentration

DSLO	Course	Course
DSLO-Use their scientific educational experiences to provide a solid foundation for further study of the sciences	Physics for Engineering and Science I (D)	Physics for Engineering and Science II **(P)**
	General Chemistry for Engineering and Science I (D)	General Chemistry for Engineering and Science II **(P)**

Curriculum Map I General Education, Engineering, Computer Science or Entrance to Health Careers

DSLO	Course	Course	Course
DSLO-Use their scientific educational experiences to provide a solid foundation for further study of the sciences	Introduction to Biology (I)	General Biology I (D)	General Biology II **(P)**
	Introduction to Chemistry (I)	General Chemistry for Engineering and Science I (D)	General Chemistry for Engineering and Science II **(P)**
		Physics for Engineering and Science I (D)	Physics for Engineering and Science II **(P)**
	Introduction to Biology (I)	Anatomy and Physiology I (D)	Anatomy and Physiology II **(P)**
	General Biology I(D)	Anatomy and Physiology I (D)	Anatomy and Physiology II **(P)**
		General Biology I (D)	Introduction to Microbiology **(P)**
		Anatomy and Physiology I (D)	Introduction to Microbiology **(P)**
	Introduction to Chemistry (I)	College Chemistry I (D)	College Chemistry II **(P)**

Curriculum Map DSLO II: *Students will convey scientific information through written, oral, numerical or visual communication.*

For this DSLO the Science Department assessed written communication and numeracy.

Written Communication

Assigning courses to I, D or P depended on the writing prerequisite for the course and if courses met the writing intensive. Bolded courses provided artifacts for assessment.

Course Preequisites with I, D or P Noted	Courses
No writing prerequisites (I)	Environmental Studies, Natural Disasters, Renewable Energy, Basic Anatomy and Physiology, Zoology, Nutrition, Sexually Transmitted Diseases, College Chemistry I and II, Physics I and II, Physics for Engineering and Science I and II
Requires Fundamentals of Writing (I)	Explorations in Science
Requires eligibility for English Composition I (D)	Introduction to Ocean and Marine Biology, Introduction to Biology, General Biology I, Integrated Science I and II, Astronomy, Botany. Forensic Science, Genetics, Physical Geology, Historical Geology, Age of Dinosaurs, Introduction to Meteorology, Introduction to Chemistry, Chemistry for Fire Service, Environmental Science with Lab, Introduction to Geology
Requires completion or concurrent enrollment in English Composition I (D)	Anatomy and Physiology I
Requires English Composition I **(P)**	**Anatomy and Physiology II, Introduction to Microbiology*, Infectious Diseases**, Effect of the Environment on Health, Water and the Living World
Course is writing intensive **(P)**	**General Biology II**, General Chemistry for Engineering and Science I and II, Applied Methods of Statistics, **Infectious Diseases**

**Although English Composition I is not a requirement for Introduction to Microbiology most students have completed it because they completed Anatomy and Physiology I.*

Numeracy

Assigning courses to I, D or P depended on the math prerequisite for the course and the degree to which mathematics topics were integral to the course. The Department Assessment Committee decided that students could demonstrate proficiency in courses requiring Intermediate algebra or a higher math. Introduction to Chemistry and College Chemistry I were also thought to be courses where proficiency could be demonstrated because math is used in many of the topics covered in these courses. Bolded courses provided artifacts for assessment.

Course Perquisites with I, D or P Noted	Courses
No math prerequisites (I)	Basic Anatomy and Physiology, Infectious Diseases, Botany, Water and the Living World, Forensic Science, Zoology, Nutrition, Sexually Transmitted Diseases, Physical Geology, Historical Geology, The Age of Dinosaurs, Introduction to Meteorology, Introduction to Geology
Requires Fundamentals of Math (I)	Environmental Studies, Introduction to Biology, Astronomy, Effects of the Environment on Health, Human Genetics,
Requires Algebra I or II (D)	Introduction to Ocean and Marine Biology, General Biology I and II, Integrated Science I and II, Anatomy and Physiology I and II, Introduction to Microbiology, Microbiology for Industrial Applications, Immunology, Molecular Biology, Chemistry for the Fire Service, College Chemistry II, Principles of Biochemistry, Environmental Science with Lab
Requires Intermediate Algebra or higher**(P)**	Methods of Applied Statistics, **Physics I and II*, Physics for Engineering and Science I and II, General Chemistry for Engineering and Science I and II**
Math is an Integral Part of the course although prerequisite is Algebra I**(P)**	**Introduction to Chemistry, College Chemistry I,**

e. Please comment on the **sequencing of** opportunities for students to develop and achieve each DSLO within the department, as noted on the Curriculum Maps.

DSLO I: Students will use their scientific educational experiences to provide a solid foundation for further study of the sciences.

The department program review committee agreed that students could demonstrate proficiency for this DSLO by assessing them in the second course of a two semester sequence. Students showing proficiency in the DSLO assessments demonstrate a knowledge base that would serve as a strong foundation for future science courses or courses in their programs. Depending on a student's previous experience they may enter the sequencing map at the introductory or developmental level. For example, a student might take Introduction to Biology and then General Biology I or they may start at General Biology I. Although Introduction to Microbiology is not part of a sequence students are required to take either General Biology I or A+P I as a prerequisite. The majority of students who take Introduction to Microbiology are near the end of their science experience and so this course is also used to measure proficiency of this DSLO.

DSLO II: Students will convey scientific information through written, oral, numerical or visual communication.

Students demonstrate proficiency of written communication in courses that either require English Composition I or are writing intensive as indicated in the Curriculum Map DSLO II. Life or physical science students can do this by taking General Biology II or General Chemistry for Engineering and Science I or II.

Students demonstrate numeracy proficiency in courses that have a prerequisite of Intermediate Algebra or higher or in science courses in which math is an integral part of the course such as Introduction to Chemistry and College Chemistry I. Life or physical science students can demonstrate proficiency in numeracy by taking General Chemistry for Engineering and Science I or II.

f. On the following pages, please indicate **how each DSLO is attained** and **how the attainment of each is assessed**. If the strategy for attainment of a DSLO is contained within a particular course, please list the course first, with the relevant activity (or activities) listed next to each course. If there is nothing currently in place that is intended to provide for the attainment of a particular outcome or to assess the extent to which the outcome has been realized, please leave the appropriate space blank. The blanks will help to identify areas which need further development.

DSLO I

Students will use their scientific educational experiences to provide a solid foundation for further study of the sciences

Strategies for Attainment		**Assessment Strategies**
Course	**Activities**	
General Biology II	End of Semester Synthesis Question	Essay Assessed with Rubric
General Chemistry for Engineering and Science II	Diagnostic Problems	Instructor Graded
Physics for Engineering and Science II	Exam Problem	Instructor Graded
Anatomy and Physiology I and II	End of Semester Synthesis Question	Essay Assessed with Rubric
Introduction to Microbiology	End of Semester Synthesis Question	Essay Assessed with Rubric
College Chemistry II	End of Semester Synthesis Question	Essay Assessed with Rubric

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

  Instructors in General Biology II, Anatomy and Physiology II, Introduction to Microbiology and College Chemistry II developed synthesis questions and grading rubrics(see appendix). Full-time and adjunct faculty administered the questions to students as either an in-class assignment or final exam question. For Anatomy and Physiology II and Introduction to Microbiology two instructors were normed for each course and they assessed the questions using rubrics. In the case of General Biology II and College Chemistry II the questions were assessed by individual faculty. For General Chemistry for Engineering and Science II, John Savage administrated and graded two diagnostic questions. In Physics for Engineering II John Smith graded a final exam question that required students to use knowledge acquired over the course of the semester (see appendix).

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

  General Biology II

  Thirty-nine General Biology II students completed the assignment. Thirty papers were randomly selected and assessed.

  The scoring range on the rubric was

Score	Description	Number of students in Range
12-14 Points	Exceeds Proficiency	0(0%)
7-11 Points	Proficient	14(47%)
Less than 7 points	Below Proficiency	16(53%)

  Anatomy and Physiology II

  Eighty-one Anatomy and Physiology II students completed the assignment. Thirty papers were randomly selected and assessed.

  The scoring range on the rubric was:

Score	Description	Number of students in Range
23-26 Points	Exceeds Proficiency	1(3.3%)
17-22 Points	Proficient	8(26.7%)
Less than 17 points	Below Proficiency	21(70.0%)

Introduction to Microbiology

Forty-eight Introduction to Microbiology students completed the assignment. Thirty papers were randomly selected and assessed.

The scoring range on the rubric was:

Score	Description	Number of students in Range
16-24	Proficient	6(20%)
6-15	Developing	10(33%)
Less than 6 points	Failure	14(47%)

College Chemistry II

Fifty-five College Chemistry II students completed the assignment. Forty-nine papers were randomly selected and assessed.

The scoring range on the rubric was:

Score	Description	Number of students in Range
4	Exceeds Proficiency	10(21%)
3	Proficient	17(35%)
2	Developing	11(22%)
1	Failure	11(22%)

General Chemistry for Engineering and Science II

Twenty-four students completed the assignment. All the papers were assessed by the course instructor.

The scoring range on the rubric was:

Score	Description	Number of students in Range
4	Exceeds Proficiency	2(8%)
3	Proficient	9(38%)
2	Developing	6(25%)
1	Failure	7(29%)

Physics for Engineering and Science II

Twenty-nine students completed a question as part of their final exam. All the papers were assessed by the course instructor.

The scoring range on the rubric was:

Score	Description	Number of students in Range
3	Proficient	20(69%)
2	Developing	4(14%)
1	Failure	5(17%)

Summary

In General Biology II and Anatomy and Physiology II less then 50% of the students assessed scored at the proficient level. In Introduction to Microbiology 20% of the students were found to be proficient. In College Chemistry II 56% of the students were proficient.

In order to correctly answer the General Chemistry for Engineering and Science II and Physics for Engineering and Science II questions the students needed to demonstrate proficiency in the course concepts and numeracy In General Chemistry for Engineering and Science II only 46% were proficient. In Physics for Engineering and Science II 69% of the students achieved proficiency.

As the faculty scored the General Biology II, Anatomy and Physiology I, Introduction to Microbiology and College Chemistry II questions, they made the following observations that might explain the poor student performance:

- *Good questions bad grading-We need to improve the process and have more faculty involved.*
- *Poorly written questions (Subsequently, many instructors attended the fall 2007 Professional Day workshops on formulating questions).*
- *Students stopped writing when they ran out of space-use blue books.*
- *Students do not understand what it means to compare and contrast. This needs to be taught or different language used such as similarities and differences.*

- *Students do not know how to organize an essay question.*
- *Question should not be given at the final-too stressful.*
- *Students have the facts but cannot put them into sentences.*
- *Some students do not know the facts.*

What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

  - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
  - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

The instructors believe that the main problem is students' inability to write a scientific essay or an essay that demonstrates cumulative science comprehension. They have suggested the following strategies to improve student performance:

- Students will be given opportunities to answer synthesis questions throughout the semester.
- Faculty will give students instruction on how to write a good essay question.
- Experiences with answering synthesis questions should occur in developing courses such as General Biology I, Anatomy and Physiology I and College Chemistry I.
- Students should be given the question prior to an exam so that they will have preparation time.

DSLO II

Students will convey scientific information through written, oral, numerical or visual communication

Written Communication

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

Strategies for Attainment		**Assessment Strategies**
Course	**Activities**	
General Biology II	End of Semester Synthesis Question	Assessed with Rubric
Anatomy and Physiology II	End of Semester Synthesis Question	Assessed with Rubric
Introduction to Microbiology	End of Semester Synthesis Question	Assessed with Rubric
Infectious Diseases	Short Research Reports	Assessed by Rubric

The DSLO I artifacts were used to assess for written communication. As faculty read the papers they used a rubric similar to the Written Communication ISLO rubric (see Appendix). This rubric was also used to assess the Infectious Diseases research reports. Scores of 3-4 are considered proficient.

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

General Biology II-Written Communication

Thirty-nine General Biology II students completed the assignment. Thirty papers were randomly selected and assessed.

Ability	4	3	2	1
Ideas Well Formulated, Clarified and Organized	5(16%)	3(10%)	11(37%)	11(37%)
Appropriate Language is Employed	8(27%)	7(23%)	12(40%)	3(10%)
Standard Grammar and Punctuation are Utilized	6(20%)	2(7%)	4(13%)	18(60%)

The results indicate that in all three abilities, over 50% of the students were not proficient.

Anatomy and Physiology II-Written Communication

Eighty-one Anatomy and Physiology II students completed the assignment. Thirty papers were randomly selected and assessed.

Ability	4	3	2	1
Ideas Well Formulated, Clarified and Organized	3(10%)	6(20%)	12(40%)	9(30%)
Appropriate Language is Employed	1(3%)	9(30%)	14(47%)	6(20%)
Standard Grammar and Punctuation are Utilized	0(0%)	9(30%)	12(40%)	9(30%)

The results indicate that in all three abilities, 67% or more of the students were not proficient.

Introduction to Microbiology-Written Communication

Forty-eight Introduction to Microbiology students completed the assignment. Thirty papers were randomly selected and assessed.

Ability	4	3	2	1
Ideas Well Formulated, Clarified and Organized	1(3%)	7(23%)	14(47%)	8(27%)
Appropriate Language is Employed	2(7%)	9(30%)	11(36%)	8(27%)
Standard Grammar and Punctuation are Utilized	2(7%)	6(20%)	15(50%)	7(27%)

The results indicate that in all three abilities, 63% or more of the students were not proficient.

Infectious Diseases-Written Communication
Fifteen students in Infectious Diseases, an online writing intensive course, submitted short letters discussing disease prevention to entering freshman at a fictional college.

Ability	4	3	2	1
Ideas Well Formulated, Clarified and Organized	6(40%)	7(43%)	1(7%)	1(7%)
Appropriate Language is Employed	3(20%)	10(66%)	1(7%)	1(7%)
Standard Grammar and Punctuation are Utilized	0(0%)	6(40%)	6(40%)	3(20%)

The results indicate that the students lacked proficiency in using standard grammar and punctuation, but were proficient in formulating ideas and using appropriate language.

Summary

The Written Communication assessment indicates that students are not proficient at writing scientific essays and using appropriate grammar and punctuation.

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Instructors will try to assign more writing assignments and encourage students to take advantage of the Writing Labs. Any written assignments will clearly state that correct grammar and punctuation is expected and will count towards the grade.

The assessment for Infectious Disease was in a non-test situation and the students scored higher in two of the abilities. The department should consider assessing Written Communication in assignments that are not part of a timed exam.

Numeracy

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

Strategies for Attainment		**Assessment Strategies**
Course	**Activities**	
Introduction to Chemistry	Lab Reports, Quizzes	Interpret a Graph, Perform Calculations
College Chemistry I	Exam Question	Assessed with Rubric
Physics I	Quiz Question	Assessed with Rubric
General Chemistry for Engineering and Science II	Exam	Instructor Graded
Physics for Engineering and Science II	Final Exam Question	Instructor Graded

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

  The rubrics used to asses numeracy were modified from the ISLO rubric for Numeracy. (See Appendix for rubrics)

Introduction to Chemistry-Lab Report

Ability	2 Proficient	1 Developing	0 Failure
Perform mathematical procedures correctly	9(60%)	4(27%)	2(13%)
Draw a graph and interpret numerical information from the graph	6(40%)	5(33%)	4(27%)

A score of 2 was considered proficient. 60% of the students performed the required calculations to a level of proficiency. Only 40% of the students were proficient at drawing and interpreting a graph.

Introduction to Chemistry-Interpreting a Graph

Ability	3 Highly Proficient	2 Proficient	1 Developing	0 Failure
Extract and/or interpret numerical information from various sources	8(50%)	4(25%)	4(25%)	0

A score of 2-3 was considered proficient. 75% of the students were proficient at interpreting a graph.

Introduction to Chemistry-One Quiz Question

Ability	2 Proficient	1 Developing	0 Failure
Perform mathematical Procedures correctly, including proper units	10(91%)	1(9%)	0

A score of 2 was considered proficient. 91% of the students were proficient at doing the necessary calculations to solve this chemistry problem.

Introduction to Chemistry-Three Quiz Questions

Ability	3 Proficient	2 Developing	1 Failure	0 Failure
Perform mathematical procedures correctly, including proper units	6(60%)	4(40%)	0	0

A score of 3 was considered proficient indicating that 60% of students could solve all three problems.

College Chemistry I-Three Exam Questions

Ability	3 Proficient	2 Developing	1 Failure	0 Failure
Perform mathematical procedures, correctly, including proper units	0	4(57%)	2(29%)	1(14%)

A score of 3 was considered proficient for students who could solve all three problems. None of the students were proficient.

Physics I-Four Quiz Questions

Ability	3 Proficient	2 Developing	1 Failure	0 Failure
Perform mathematical procedures, correctly, including proper units	2(13%)	9(56%)	5(31%)	0

87% of the class was below proficiency. The poor performance may have resulted from an inability to solve equations or select the correct formula.

General Chemistry for Engineering and Science II-

Twenty-five students were given an exam that included calculations and graph interpretation questions. 60% of the students were considered proficient because they scored C or better on the exam.

Physics for Engineering and Science II-Exam Question

Score	Description	Number of students in Range
3	Proficient	20(69%)
2	Developing	4(14%)
1	Failure	5(17%)

The exam question used to assess knowledge was also used to assess numeracy. 69% of the class demonstrated proficiency.

Summary

It is difficult to draw a conclusion based on the numeracy assessments. The sample size in each class was relatively small. If one looks at the total number of students assessed(129), 75 or 58% of them demonstrated proficiency for numeracy.

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Students cannot be successful in chemistry or physics unless they can do mathematics. The Science Department has many interventions in place:

- *Many of instructors use a diagnostic test at the beginning of the semester to evaluate student math competencies.*
- *Course math prerequisites are determined with input from science instructors.*
- *Students work on math skills through class work and lab report.*
- *The science and math tutors help students to help them master the concepts necessary to do the science.*
- *Several science and math instructors have been collaborating on Math Across the Curriculum Projects. Mary Mogan-Vallon and Carol Henry have taught the math concepts used in General Biology I, Physics for Engineering and Science I and Introduction to Chemistry.*

DSLO III

Students completing significant coursework within the … Department will …….

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

DSLO IV

Students completing significant coursework within the … Department will …….

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

DSLO V

Students completing significant coursework within the … Department will …….

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

DSLO VI

Students completing significant coursework within the … Department will …….

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Departmental Student Learning Outcome is **assessed for proficiency** at the **department level**.

- What does the department's data analysis reveal about student achievement of this DSLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

8. **Institutional Student Learning Outcomes**
(see **Appendix A** for detailed listing of MCC's Institutional Student Learning Outcomes)

a. Please describe your department's plan for ongoing, annual assessment of MCC's ISLOs that are supported to proficiency within your department.

The Science Department will use the program review process to assess the MCC ISLO's. Artifacts collected to assess the DSLO's for proficiency will also be used to assess ISLO's.

b. If applicable, discuss any changes you have made to your department's support of MCC's ISLOs since your last program review.

Prior to this program review the department did not intentionally assess any DSLO's or ISLO's. The department will assess one or two DSLO's each year and apply the finding to the appropriate ISLO's.

c. As appropriate, map the way in which your department provides opportunities for students to progress towards proficiency level of MCC's Institutional Student Learning Outcomes, by noting in which courses outcomes are **Introduced (I)**, **Developed (D)**, or where students are expected to demonstrate **Proficiency (P).**

Curriculum Map II:
Departmental Opportunities for Student Progress toward ISLOs

	Course (I)	Course (D)	Course (P)
Knowledge & Skills	All science courses other than those listed in the D and P columns provide opportunities for students to be introduced to science knowledge and skills	General Biology I General Chemistry for Engineering. and Science I, Physics for Engineering and Science I, Anatomy and Physiology I, College Chemistry I	General Biology II General Chemistry for Engineering. and Science II, Physics for Engineering and Science II, Anatomy and Physiology II, Introduction to Microbiology, College Chemistry II
Critical Thinking	To Be Assessed at a Future Date		
Communication-Written	Environmental Studies, Natural Disasters, Renewable Energy, Basic Anatomy and Physiology, Zoology, Nutrition, Sexually Transmitted Diseases, College Chemistry I and II, Physics I and II, Physics for Engineering and Science I and II , Explorations in Science	Introduction to Ocean and Marine Biology, Introduction to Biology, General Biology I, Integrated Science I and II, Astronomy, Botany. Forensic Science, Genetics, Physical Geology, Historical Geology, Age of Dinosaurs, Introduction to Meteorology, Introduction to Chemistry, Chemistry for Fire Service, Anatomy and Physiology I, Introduction to Geology, Environmental Science with Lab	Anatomy and Physiology II, Introduction to Microbiology, Infectious Diseases, Effect of the Environment on Health, Water and the Living World, General Biology II, General Chemistry for Engineering and Science I and II, Applied Methods of Statistics,
Communication-Numeracy	Basic Anatomy and Physiology, Infectious Diseases, Botany, Water and the Living World, Forensic Science, Zoology, Nutrition, Sexually Transmitted Diseases, Physical Geology, Historical Geology, The Age of Dinosaurs, Introduction to Meteorology, Environmental Studies,	Introduction to Ocean and Marine Biology, General Biology I and II, Integrated Science I and II, Anatomy and Physiology I and II, Introduction to Microbiology, Microbiology for Industrial Applications, Immunology, Molecular Biology, Chemistry for the Fire Service, College Chemistry II, Principles of Biochemistry,	Methods of Applied Statistics, Physics I and II, Physics for Engineering and Science I and II, General Chemistry for Engineering and Science I and II, Introduction to Chemistry, College Chemistry I

	Course (I)	Course (D)	Course (P)
	Introduction to Biology, Astronomy, Effects of the Environment on Health, Human Genetics, Introduction to Geology	Environmental Sciences with Lab	
Global Perspectives	To Be Assessed at a Future Date		
Social Responsibility	To Be Assessed at a Future Date		
Personal & Professional Development	Department does not support this ISLO		

d. Please comment on the **sequencing of** opportunities for students to develop and achieve to ISLO proficiency within the department as appropriate, as noted on Curriculum Map II.

See question 7

e. Please indicate on the following pages as appropriate **how each ISLO is supported to proficiency achievement within the department and how that achievement is assessed. Where ISLO achievement is directly supported by DSLO achievement, you can refer the reader back to that section in Question 7, rather than re-writing it.** If the strategy for attainment of an ISLO is contained within a particular course, please list the course first, with the relevant activity (or activities) listed next to each course. If there is nothing currently in place that is intended to provide for the attainment of a particular outcome or to assess the extent to which the outcome has been realized, please leave the appropriate space blank. The blanks will help to identify areas which need further development.

See question 7

Knowledge and Skills

The MCC graduate will use knowledge acquired at MCC as a foundation for continued study and/or practical application.

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Critical Thinking

The MCC graduate will demonstrate an ability to understand, interpret and analyze information in order to engage in critical thinking and problem-solving.

Strategies for Attainment		**Assessment Strategies**
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Communication
The MCC graduate will communicate, use information and employ technology effectively.

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:

    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Global Perspectives

The MCC graduate will communicate an understanding of the world from a global perspective.

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Social Responsibility

The MCC graduate will demonstrate social responsibility both within and outside of the classroom.

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Personal and Professional Development

The MCC graduate will demonstrate the capacity for on-going personal and professional development.

Strategies for Attainment		Assessment Strategies
Course	**Activities**	

- Describe how this Institutional Student Learning Outcome is **assessed for proficiency** at the **departmental level**.

- What does the department's data analysis reveal about student achievement of this ISLO within the department?

- What curricular and/or instructional changes are planned within the department as a result of this data (if any)? Consider:
    - The scope and sequence of Introductory, Developing, and Proficiency level student learning opportunities
    - The adequacy of the range of learning experiences and assessment methodologies that your department offers to meet student learning needs

Additional Curricular Opportunities:

9. Please describe any interdisciplinary courses which are provided as an integral part of this department/area.

The Science Department currently offers nine interdisciplinary courses. Interdisciplinary courses are defined as those that bring together different disciplines across the college or combine different science disciplines.

ENV 917 Effects of the Environment on Health-Honors
ENV 920 Water and the Living World Honors
ENV 105 Natural Disasters
ENV 108 Renewable Energy
ENV 120 Coral Reef Ecology
SCI 100 Explorations in Science
SCI 130 Forensic Science
SCI 121 Integrated Science I
SCI 175 Methods of Applied Statistics

Roger Edmonds, Anne Miller and Jessie Klein also participated in the spring 2005 LAS Weekend America: Longing and Belonging.

In July 2007 John Savage took four students for a three credit international experience in Belize where they investigated coral reefs and contributed data to the National Reef Check Project.

10. Please comment on experiential learning opportunities with the department/area (i.e., internships, service learning). Discuss how the content of the experience relates to course credit. How do you calculate the number of contact hours required in relationship to the credit awarded? What percent of students participate in each of these activities?

Five *science faculty members have incorporated service learning into their courses as a result of participation in the Lowell Civic Collaborative.*

Nicole Cave-Luongo-Students in General Biology performed a variety of service learning activities for 22 hours over 11 weeks: science experiments with children in a child care program, assisting a nurse at a homeless shelter, teaching children dental hygiene in an after school program and removal of invasive species at a National Park site. Students chose their site and project with approval from the instructor so that it would directly relate to content covered during the course. Service learning was an alternative to a genetic disorder presentation which was worth 15% of their overall grade. A total of six students participated out of three sections. However all of the students benefited from the

presentations made by the service learning students. Several students who did not participate in service learning projects said they would if the option was offered in a future course.

Jessie Klein-The entire Botany class of 21 students worked with Ranger Chris Davis of Minuteman National Park to collect data on the effect of sheep grazing on invasive species. Ranger Davis visited the Botany class to present background on the project. The students spent one lab period in the field collecting data and a second lab period using spreadsheets to prepare graphs for the National Park. Students analyzed their data in the form of lab reports. The project counted as one lab report grade.

Doug Moffat-Students in two sections of Explorations in Science helped prepare informational posters about the Merrimack River watershed and its wildlife populations. For extra credit approximately ten students attended the Earth Day program and poster show at the Bartlett School in Lowell and helped present information and answer questions. The posters were counted as two assignment grades as was Earth Day participation for a total of 5% of the course grade.

Sally Quast- College Chemistry I and II students mentored girls, ages 8-14, in performing a chemistry experiment in the chemistry lab in Lowell. The MCC students did all the preparation work for the activity and supervised the youngsters in the lab. The project counted for 2 lab grades. The project involved one lab period for preparation and one for actually doing the experiment with the girls. All of the chemistry students participated in the activity. In January 2007 Sally Quast attended the Science Education for New Civic Engagement Conference.

Tom Vaughn-Students in Environmental Studies focused their work around water testing. The entire class of 23 students did research on water resources and water-quality parameters. Students in a research project devoted approximately six hours or more towards the research and production of the poster presentation. One student worked with Ranger Chris Davis for 11 hours and did water testing on the Concord River at Minuteman National Park as one half of a service learning project. The research and poster presentations served as the students' research papers for the semester. This component of the class counted for 20% of the semester grade.

11. Please comment on the uniformity and appropriateness of content in multi-section courses and subsequent courses now in place. Do all courses have the proper prerequisites? Is the flow and relationship of courses to one another satisfactory? Are there changes indicated, based upon department/area objectives and/or new needs identified through the assessment process?

a. Full time faculty communicate regularly with the adjunct instructors. Because adjunct faculty teach many of the science sections, this open communication is vital to the currency and consistency of the content in all the science courses. It is particularly vital in the sequential courses like BIO 131/132 General Biology I and II, CHE 131/132 College Chemistry I and II and BIO 231/232 Anatomy and Physiology I and II.

b. When Dr. John Savage joined the department in January 2003, he initiated changes in the chemistry prerequisites and titles to help clarify student advising issues, increase success in upper level chemistry courses and improve transferability of the courses.

- *Beginning fall 2003 the prerequisite for CHE 131 College Chemistry I was changed to include a recommendation of CHE 121 Introduction to Chemistry as an acceptable prerequisite.*

- *Beginning fall 2003 CHE 121 Introduction to Chemistry was no longer an acceptable prerequisite for CHE 132 College Chemistry II. Dr. Savage compared the syllabi of General Chemistry I and Introduction to Chemistry and found that Introduction to Chemistry did not cover all the material necessary for students to be successful in achieving the learning outcomes specific to College Chemistry II.*

- *In 2004 changes were made to the chemistry course titles in order to clarify advising issues and to make the titles consistent with offerings at transfer schools.*

    - CHE 131 General Chemistry I became College Chemistry I
    - CHE 132 General Chemistry II became College Chemistry II
    - CHE 151 Inorganic Chemistry I became General Chemistry for Engineering and Science I
    - CHE 152 Inorganic Chemistry II became General Chemistry for Engineering and Science II

As of fall 2004 the prerequisite for CHE 152 General Chemistry for Engineering and Science II was changed to include MAT 185 Precalculus for Science I. This action was taken to ensure that students in CHE 152 would have the math skills needed to be successful in this course.

c*. The department has worked to strengthen English and math prerequisites on science courses by making a series of changes effective fall 2004.*

Eligibility for ENG 101 English Composition I was added to the following science courses because these courses require written assignments.

BIO 115 Human Genetics
BIO 140 Botany
BIO 120 Introduction to Biology
BIO 131 General Biology I
ENV 110 Introduction to Ocean and Marine Biology
GEO 105 The Age of Dinosaurs
GEO 110 Introduction to Meteorology
GEO 121 Physical Geology
GEO 122 Historical Geology
PHY 105 Astronomy
SCI 121 Integrated Science I

Math prerequisites were added to several courses which require students to do simple mathematical calculations, analyze and interpret data or require higher level math skills.

PHY 105 Astronomy MAT 060 Fundamentals of Mathematics
BIO 115 Human Genetics MAT 060 Fundamentals of Mathematics
CHE 110 Chemistry for Fire Service MAT 070 Algebra I
ENV 110 Introduction to Ocean and Marine Biology eligibility for MAT 080 Algebra II
PHY152 Physics I high school trigonometry or eligibility for MAT 180 Precalculus for Business I, MAT185 Precalculus for Science I or MAT 189 Precalculus I

It was anticipated that by raising the prerequisites for these courses better prepared students would enroll and the passing rates would improve. As Table 13 below indicates there were no significant improvements except in Chemistry for Fire Service and General Chemistry for Engineering and Science II.

Table 13. Percentage of Students Successfully Completing Courses with New Prerequisite Added Effective of Fall 200*4*

Course	Fall 03	Spring 04	Fall 04	Spring 05	Fall 05	Spring 06
Intro. to Ocean and Marine Biology	68	52	76	60	56	58
General Biology I	89	82	75	85	88	83
Introduction to Biology	85	86	80	77	77	80
Astronomy	81	84	91	97	87	88
Botany	96		88		87	
Physical Geology	71	75	67	79		
Historical Geology	78	56		68		74
Age of Dinosaurs	78		82		64	
Introduction to Meteorology		65		83		72
Chemistry for Fire Service	88		82	75	100	

Course	Fall 03	Spring 04	Fall 04	Spring 05	Fall 05	Spring 06
Gen. Chem. for Engineering and Science II	76		67		80	
Physics I	100		100		80	
Integrated Science I	100		90	88	93	94

If one looks at specific grades rather than passing rates, it is possible to see improvement in grade distributions in several courses:

- *In Historical Geology between fall 2003 and spring 2006, the number of F's dropped by 11% and the number of B's increased by 13%.*
- *In Introduction to Meteorology between spring 04 and spring 06, the number of A's increased by 13%*
- *In Botany between fall 03 and fall 05 the number of B's increased by 18%, while C's and D's dropped by 25% and 5%; respectively*
- *In Introduction to Ocean and Marine Biology, between fall 2003 and fall 2005 the number of A's increased by 10%, C's dropped by 10%, D's dropped by 8% and F's dropped by 14%.*
- *In Physics I between fall 2003 and fall 2005 there was an 18% improvement in the number of A's.*

d. The Anatomy and Physiology instructors have expressed concern that some of their students are not taking the proper prerequisites. Currently students can enroll in A+P I if they have completed high school biology and chemistry in the last five years or MCC's. Introduction to Biology or General Biology I. We attempted to change the prerequisite to only accept the MCC courses but were not successful because of credit limits in the Nursing program. The Science faculty is considering developing chemistry and biology review modules that would be available for students who have a weak foundation in these fields.

12. a. Please comment on the role of developmental courses within your department/area. Which ones are relied upon by significant numbers of students in the department/area? What conclusions are you able to draw about the impact of these courses on students' preparation levels?

In the fall 2006 the Science Department began offering Explorations in Science with enrollment limited to developmental students. This course covers college success skills along with science content.

Several science faculty attended professional development workshops to help them develop science oriented college success activities.

b. Please comment on the role of developmental courses outside your department/area. Which courses in the department/area are relied upon by significant numbers of students, and which courses outside the department/area are relied upon by significant numbers of students? What conclusions are you able to draw about the impact of these courses on students' preparation levels?

Many students need to take developmental reading, writing and math courses in order to raise their skills to the level required for science courses. In many cases students who have passed these courses are still found to have weak in math and writing skills. Science faculty may consider offering a learning community of an introductory level science course and a developmental math course. The Science Department would need assurance of sufficient enrollment before committing time to development of the learning community. This LC would give students the experience of seeing the relevance of math skills in other disciplines.

13. Describe the array of instructional methodologies in required or elective courses. (e.g. face to face, online, hybrid, self-paced, experiential, inquiry/problem-based, case studies, projects, etc.)

The Science Department provides students with the opportunity to enroll in either traditional face-to-face courses or 15 different online courses. The online courses include:

Table 14. Online Science Courses

BIO 105 Basic Anatomy and Physiology	*3 credits*
BIO 108 Nutrition	*3 credits*
BIO 112 Infectious Diseases	*3 credits*
BIO 131 General Biology I	*4 credits**
BIO 231 Anatomy and Physiology I	*4 credits**
BIO 232 Anatomy and Physiology II	*4 credits**
BIO 235 Introduction to Microbiology	*4 credits**
CHE 110 Chemistry for Fire Service	*4 credits**
ENV 105 Natural Disasters	*3 credits*
ENV 108 Renewable Energy	*3 credits*
ENV 110 Introduction to Ocean and Marine Biology	*3 credits*
ENV 115 Environmental Studies	*3 credits*
ENV 917 Effects of the Environment on Health-Honors	*3 credits*
GEO 121 Physical Geology	*4 credits**
GEO 122 Historical Geology	*4 credits**

** indicates courses with an on campus laboratory component.*

Science instructors use a wide variety of traditional and creative teaching methodologies in both the face-to face and online courses. These methodologies include:

- *Traditional lecture*
- *Interrupted lecture-student activities interspersed with short lectures*
- *PowerPoint presentations*
- *PowerPoint presentations enhanced by using a tablet PC*
- *Case studies and problem based learning*
- *Manipulatives*
- *Group activities-such as discussion of periodical or newspaper articles*
- *In class web based activities*
- *In class text CD activities*
- *Peer teaching*
- *In class worksheets*
- *On campus field trips*
- *Student presentations*
- *Animations*
- *Films*
- *In class writing assignments*
- *Lab reports*
- *Service-Learning*
- *Research Papers*

Section VI: Instructional Support

14. a. Please discuss the adequacy of the staffing level in the department/area to teach students enrolled in the department/area.

There are presently 12 full-time faculty science faculty. Table 15 indicates the number of day division sections offered between 2000 and 2006 with the number of sections taught by adjunct faculty.

Table 15: Number of Day Division Sections Taught by Adjuncts

Semester	Number of Adjunct Science Faculty	Total No. of Science Sections	Sections Taught by Adjuncts	% of Sections Taught by Adjuncts
Fall 01	4	49	6	12%
Fall 02	15	54	22	41%
Fall 03	17	59	29	49%
Fall 04	17	66	29	44%
Fall 05	17	68	26	38%
Spring 02	10	60	14	23%
Spring 03	17	59	25	42%
Spring 04	22	68	37	54%
Spring 05	18	73	30	41%
Spring 06	19	70	32	46%

In the fall of 2001 there were 12 full time faculty members in science who taught a majority of the day sections. In the period surveyed the offerings have grown by as many as 24 sections that are almost evenly shared by the full-time faculty and the adjuncts.

While the Science Department adjunct faculty is a group of highly qualified and excellent instructors, the student population and the department would be better served by an increase in the number of full time faculty. Full time faculty members are needed to support initiatives such as renewable energy that move the department forward.

b. Please discuss the adequacy of the staffing level in the department/area to advise students enrolled in the program.

Each full-time science faculty member is assigned 18 advisees. The department continues to work with the Director of Academic Planning to ensure that life science and physical science students are assigned full-time science faculty advisors. Several science faculty members serve as mentors to students who have applied to the Louis Stokes Alliance for Minority Participation Project.

All full-time instructors help insure that any students interested in STEM careers receive good advising. Students often seek advice from their instructors. Adjuncts are not as knowledgeable as full time faculty regarding the college's requirements and services and cannot advise students adequately.

15. What specific support services and activities (i.e., tutoring, media, library, disabled student support, computer labs, and service learning) does this department/area require? Please comment on the availability and adequacy of these services. Be specific about any current deficiencies or projected needs.

a. *Science tutoring is available for students on both campuses during the day and early evening. Approximately 320 students are tutored each semester. Data from 2001 to the present indicate that 86% of the students who were tutored earned a grade of C or better.*

b. *The Bedford and Lowell librarians have been very helpful to students needing reference materials for courses. For the faculty the library has obtained journal articles and purchased books, videos, and DVDs. The librarians have also provided workshops for faculty on incorporating information technology literacy into their courses. Instructors can also borrow a Personal Response System from the library.*

c. Middlesex Interactive continues to be a asset for the faculty. The staff offers group or individual training for faculty on the use of Blackboard, PowerPoint Camtasia, and webpage development.

d. Student Services has provided an invaluable service by helping faculty deal with student behavior issues in the classroom.

e. The Science Department is supported by three full-time and one part-time laboratory technicians. These technicians are vital to the daily operation of science classes and are a valuable resource for adjuncts when designing laboratory activities. With the projected increase in laboratory offerings, such as Environmental Science with Lab and renewable energy courses, it may be necessary to hire a fourth full-time technician.

16. How adequate and appropriate are department/area facilities and equipment? Please be specific about any current deficiencies or projected needs.

Overall Comments on Facilities

The Science Department is fortunate to have two outstanding facilities; one in Bedford and one in Lowell. These laboratories have fume hoods, a greenhouse, walk-in cold rooms, growth chambers, ventilated chemical storage rooms and instrumentation rooms. As the number of science sections has increased, laboratory space has become a premium. Most faculty prefer to teach both lecture and lab in a laboratory setting. This allows them the flexibility to do hands-on activities known to be better for student learning. We can no longer accommodate the faculty wishes. In some cases General Biology and Anatomy and Physiology lectures have been moved out of the labs to general classrooms even though the students would benefit from being in rooms with models and tables for activities. As we expand our offerings in environmental and renewable energy courses and with the recommendation that Liberal Arts and Sciences students take two lab sciences and Liberal Studies students take at least one lab science, there will be need for further laboratory classrooms.

Bedford Facility-

a. *In Bedford the department offers lab courses in Biology, Chemistry, Geosciences, Physics, Anatomy and Physiology, Microbiology, Physics, Integrated Science and Forensic Science. The Science Department has been in Henderson Hall for fifteen years. Science courses are taught in Henderson Hall 215, 217, 314, 315, 316, and 318. Henderson Hall 220 has been reconfigured to accommodate laboratory classes. During the Fall 2006 semester there were 26 day science sections scheduled in these rooms for a total of 116 hours of instruction. This is an increase of 8 sections and 26 hours compared to fall 1999. In addition many of the three credit science courses are taught in the Henderson general purpose classrooms.*

b. The Science Department prides itself in having sufficient equipment so that all students can have a hands-on laboratory experience, but the equipment and furniture are beginning to show wear. The tabletops are gouged and stained. We have replaced pH meters but are in need of replacing 30 year old electronic balances. The Pasco probes and interfaces should be updated to be state of the art. The microscopes are cleaned every semester but some have oil within the lens and can no longer be cleaned. The objectives cannot be replaced and there will be a need to purchase new microscopes in the future. The lab stools in HH215 and 217 were reupholstered during the summer of 2006. The wooden stools in HH315 need to be replaced.

c. *Computers and ceiling hung projectors are in most of the labs(HH316, 315, 220 and 217) and are used by both the day and evening faculty. HH318 and HH215 are still have Smartstations.*

d. *In 2003 the Bedford campus acquired 20 laptop computers and a wireless node for the third floor of Henderson Hall through a grant from Hewlett Packard. The college installed two additional nodes so that wireless access is available throughout the third floor of Henderson. These computers have been used by both the Science and Math Departments to enhance student learning. The 12 computers in the Anatomy and Physiology computer room have been upgraded. In August 2007 updated ADAM software was purchased in with Perkins funds.*

e. *The Hewlett Packard laptops replaced desktop computers that were stored in HH324. In the fall of 2006, HH 324 was converted into a student study area. This room is constantly occupied by students, day and evening. Many of them bring their personal laptops and take advantage of the wireless network to do assignments*.

f. *Through the efforts of Lilly Srivastava, our Bedford chemistry technician, the storage and safety conditions in the Bedford chemistry area have been greatly improved. Outdated and unnecessary hazardous chemicals have been removed. Wooden shelving has been replaced with corrosion resistant stainless steel and additional storage space has become available.*

g. *The heating, air conditioning and ventilation systems on the third floor of Henderson continue to be problematic. Very often classrooms and faculty offices are either too hot or too cold. The attic mounted ventilation system often produces a droning noise that interrupts classes.*

Lowell Talbot Facility-

a. In Lowell the department offers lab courses in Biology, Chemistry, Anatomy and Physiology, Microbiology, Integrated Science, Forensic Science and Biotechnology. The Science Department has been in the Talbot Building for 12 years. Science courses are taught in Talbot 200, 204, 306, 308, 407 and 409. During the fall 2006 semester there were 27 day science sections scheduled in these rooms for a total of 121 hours of instruction. This is an increase of 14 sections and 64 hours of instruction compared to fall 1999. In addition many three credit science courses are taught in the Talbot and Derby general purpose classrooms.

b. Whereas every lab in Lowell is equipped with a computer and projector, student computer access in Lowell is not equal to that of Bedford. There are only six computers in the Anatomy and Physiology lab that have

Internet access. There are six computers on carts on the fourth floor that are available for use with Pasco probes. The ADAM software in Lowell was updated in August 2007 with Perkins funds.

c. As additional laboratory courses are offered in Lowell, there will be a need for additional space and equipment.

General Comments on Facilities and Projected Needs

In the future there will be a need for more laboratory space and equipment:

- *Based on the self-study the department will recommend that Liberals Arts and Liberal Studies students take four credit science courses increasing the need for lab space.*
- *As the environmental science and renewable energy courses begin, lab space and equipment will be required.*
- *The autoclav in Bedford is aging and will need to be replaced in the future.*
- *Existing physics equipment needs to be updated and supplemented.*
- *Lowell is in need of additional computers with wireless capability.*
- *Faculty would like tabled rooms so that activities can be done in class.*
- *Analytical balances and microscopes need to be replaced.*
- *Lab stools in LT 407 and HH 315 need to be replaced.*
- *Shades in HH 315 need to be replaced so optics experiments can be successfully conducted.*
- *Lab bench tops in Henderson are worn and need replacement.*

17. Please describe any professional development needs of department faculty or staff.

The Science faculty contributes to the growth of the department through several avenues of professional development. Listed below are representative activities of department members.

Attendance at conferences and workshops

- *New England Faculty Development Consortium*
- *New England Educational Assessment Network*
- *New England Association of Schools and Colleges*
- *Massachusetts Association of Biology Teachers*
- *Southern Maine Community College Assessment Conference*
- *New England Association of Chemistry Teachers*
- *New England Section of the American Chemical Society Two Year College Conference*

- *Benjamin Cummings sponsored Strategies for Success workshops*
- *Mass College Online*
- *Carnegie Summer Institutes*
- *Sencer-Service Learning Conference*
- *American Association of Higher Education*
- *Power-UP Workshop*
- *Teacher Training Workshops at the Museum of Science*
- *Northeast Geological Society of America*
- *Geological Society of America*
- *New England Intercollegiate Geologic Conferences*
- *STARS Science Teachers Area Resource Swap*
- *Greater Lowell Environmental Education Association*
- *NSF Chautauqua Short Courses*
- *Renewable Energy Conferences*
- *New England Center for Inclusive Teaching*
- *American Chemical Society National Meeting*
- *NSF Process Oriented Guided Inquiry Learning Workshop in Chemistry*

Participation in MCC opportunities and training seminars:

- *The Carnegie Community of Practice*
- *Blackboard, Banner, PowerPoint, Camtasia and Web Page Training*
- *MCC Institute for Learning-Centered Teaching*
- *Teaching 101*
- *Building a Learner-Centered Syllabus*
- *Working with Student Learning Outcomes*
- *Rubrics Workshop*
- *Smartstation Workshops*
- *Mentoring Partnership*
- *Online Course Development Training*
- *Freshman Experience Workshop*
- *Using Hp Wireless Laptops*
- *Academic Support Workshops*
- *Setting Emotional Boundaries*
- *Excel Workshop*
- *New Faculty Orientation*

Instructors subscribe to periodicals that allow them to stay current in their content areas and learn about new pedagogies. Examples of these periodicals are:

- *Journal of College Science Teaching*
- *The American Biology Teacher*
- *Chem Matters*
- *Journal of Chemical Education*

- *Human Genetics*
- *Mortality and Morbidity Weekly Report*
- *Scientific American*
- *Science News*
- *Discover Magazine*
- *Transaction of the American Geophysical Union*
- *Natural History*
- *Journal of Geoscience Education*
- *Journal of Physical Therapy*
- *Science*
- *The Physics Teacher*
- *Smithsonian*
- *National Geographic*

Many instructors are members of listserves where teaching issues are discussed. Examples of these listserves are:

- *Tomorrow's Professor*
- *Physics in Two-Year Colleges*
- *Bio Listserve*
- *Physical Therapy Listserve*
- *New England Science Center Collaborative*
- *MA Science Teachers Listserve*
- *MA Biology Teachers Listserve*
- *Department of Education Llistserve*

The Dean of Mathematics and Sciences seeks input from the faculty regarding professional development topics that can be addressed during department and division meetings. Below are examples of suggested topics

- *Rubrics*
- *Active learning*
- *Creative teaching Ideas*
- *Assessing written assignments*
- *Psychology of the community college student*

18. Describe the sources of department/area funding. Are the funds adequate to support the department/area? Is the current use of funds effective to realize department/area goals? Does the department/area leadership have input into the department/area budget?

The division budget is spent primarily for the Science Department. The current process is as follows: Faculty submit requests to the lab technicians, lab technicians submit purchase requests to the Department Chair or Associate Dean who reviews the requests, and submits them to the Division Dean.

The Science Department requires a large sum of operating money each year and the Division Dean has supported the department in a very satisfactory manner. However, the division annual budget is insufficient to purchase items like analytical balances, microscopes, replacement projectors, computers, autoclavs and dishwashers. *The CFO, Jay Linnehan, has supported the financial needs of the Science Department in a very satisfactory manner. In the spring of 2007, the Science Department was able to purchase equipment through grants awarded by the MCC Foundation Annual Fund.*

Please provide any additional information that you consider important in assessing this department/area.

The Science Department faculty is active on many college-wide committees and initiatives. For example:

- *General Education Committee*
- *Curriculum Committee*
- *Academic Standards Committee*
- *FSA Executive Committee*
- *Assessment Steering Committee*
- *Institutional Learning Outcomes Committees*
- *Minigrant Committee*
- *Islam Institute*
- *Honors Committee*
- *Technology Committee*
- *Sustainability Advisory Committee*

The faculty frequently apply for minigrants to develop new pedogogies or improve teaching. Examples of these minigrants are:

- *Smartstation Workshops*
- *Using Laptops in the Science Classroom*
- *Course Development-Integrated Science I, Environmental Science with Lab, Explorations in Science*
- *Computer Review Modules for Health Careers*
- *Safety in the Science Lab*

Although the Science Department members form an effective team, they are limited by the fact that Science faculty teach every afternoon making it impossible to find a meeting date and time when all can attend department meeting.

Section VII: Department Evaluation Summary

This section should be completed based upon review and consideration of both the data supplied in **Section II** and the questions posed in **Sections III, IV, V, VI and VII.**

A. Department Strengths
(Bulleted List with reference to the question(s) numbers in the department/area review where this strength is noted.)

The strengths of the Science Department are shown in several areas. All are well summarized in Section II. 2b. of the department's mission and goals.

- *1. The Science Department shows continued growth in the number of offerings. Section III. 3a.*

- *2. The Science Department serves several distinct populations. Section IV, 4a.*
  - *Career-oriented students*
  - *Students fulfilling the general education science requirement for graduation*
  - *Students intending to transfer to baccalaureate science programs*
  - *Students enrolled in developmental courses*
  - *Honors students*

- *3. Members of the department place high value on developing a widely defined sense of community. Members constantly strive to achieve this is many ways:*

  - *Within the department-Section V. 11. Constant communication and exchange of classroom activities with the adjunct faculty*

  - *Within the division- Section IV. 6b. Collaboration between math and science instructors to promote math and science across the curriculum*

  - *Within the college-*
    a. Section IV. 4c, d. and e. Discussions are held with the Dean of Articulation and Transfer regarding course transferability and with the Academic Planning advisors regarding recruitment into science courses.

b. Section III. 3c. Surveys assessing student interests and health faculty satisfaction with student preparation in science courses

c. Section V. 9. Involvement in interdisciplinary courses

d. Section IV. 17. Participation in interdisciplinary professional *development such as Carnegie and the Institute for Learner Centered Teaching*

- *Within the larger community*

  a. Section IV. 4d. Participation in open houses

  b. Section IV. 6a. Discussion with four-year institutions on course transferability and articulations. Chemistry Vertical Teaming with Lowell High School and UMASS-Lowell

  c. Section IV.4b .Collaborations with area institutions to develop initiatives in renewable energy, nanotechnology and STEM careers.

- *4. Members of the Science Department are open to examining and, where appropriate, adopting new pedagogies to enhance student learning.*
  - *Section V. 9. The department offers and participates in interdisciplinary courses.*
  - *Section V. 10. Five faculty have provided service-learning opportunities for their students*
  - *Section V. 14 The department currently offers 15 online courses.*
  - *Section VI. 16d(Bedford) Wireless laptop technology is available in Henderson Hall allowing the classroom to expand*

- *5. The faculty strives to constantly update mastery of discipline information as well as technical skills and changing pedagogy through on-going professional development. Section VI 17.*

B. Department Needs for Improvement, Proposed Plans for Improvements, Budgetary Implications, Timelines

Department Needs (Reference the question in the program review where this need is explained.)	**Proposed Plans for Improvement** (Bulleted list of suggestions.)	**Financial Needs to Make Improvements**	**Proposed Timelines for Implementation**
Very few students enroll in the science concentrations. Minorities are particularly underrepresented Section IV 4.b	The department is participating in the STEM Initiatives	Stokes and Northeastern Step-Up Grants	Summer 2007
The department recommends that LAS students take two lab sciences and LS students take at least one lab science Section IV. 5a.	Recommendation to LAS Deans	Additional lab space and equipment	Discussion at time of LAS and LS program reviews
Strengthening prerequisites has not had an anticipated impact on course completion rates. Section V. 11b.	Developmental and introductory level course learning communities, Math Across the Curriculum Project	Minigrants, NSF funding	Fall 2008
Students take A+P I without the necessary prerequisite knowledge. Section V. 11c.	Develop online review modules for students weak in biology and chemistry	Minigrant for developers	2008-2009
There is a need for new faculty in emerging technology fields and almost half of the science courses are taught by adjunct faculty. Section VI. 14a. There are two anticipated retirements by Fall 2009 and one faculty member has become an administrator.	Additional full-time instructors are needed for the new department initiatives and to move the department along.	Funding for full-time positions	Four additional positions should be added over the next two years

Department Needs (Reference the question in the program review where this need is explained.)	**Proposed Plans for Improvement** (Bulleted list of suggestions.)	**Financial Needs to Make Improvements**	**Proposed Timelines for Implementation**
If we are to increase science lab offerings additional lab space is needed in Lowell Section VI 16	Conversion of a classroom in Talbot	Most of the work can be done by Facilities	Immediate need
Aging equipment and furnishings need to be replaced Section VI.16	This is an on-going issue. Refrigerators, autoclavs, electronic balances, stools, benches, microscopes and computer interfaces must be constantly evaluated	The division budget cannot support these purchases. We are dependent on support from the college's general budget and the MCC Foundation	On-going
It is difficult to find a department meeting date that allows all full-time instructors to attend the department meeting. Instructors miss the interaction with colleagues. Section VI. Additional information	The department head discusses potential dates with faculty. In the past we have met twice a semester on Friday afternoons or conduct business electronically		On-going discussion
Need for faculty professional development on ways to instruct students on how write to essays that demonstrate cumulative science comprehension. Section V.	Work with English Department "writing coaches" at department meetings or adjunct dinners	Stipends through the Office of Professional Development and mini-grants	2008-2009
Expanded collaboration with the Math Department to strengthen students' math skills Section V.	Development of modules and learning communities through the MAC initiative	NSF MAC grant, LC initiative, Title III	On-going