Student Learning in Natural Science with a Laboratory Experience Courses
Self-Study Report
June 2012

Updated from initial report in July 2011

Respectfully Submitted June 25, 2012
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I. Executive Summary

The departments of Biology, Chemistry, and Physics have developed the following learning goals for students taking a course that satisfies the MPSL Natural Science with Lab non-sequential requirement:

1) Develop an understanding of how to use logic and the scientific method to analyze the natural world and solve problems.

2) Learn about issues in science that are important both personally and globally.

3) Utilize technology in laboratory and field environments in order to connect theories and descriptions found in lectures and textbooks with real-world phenomena.

A student who is able to reach these goals successfully will also be satisfying the core goals expressed in the mission statement of Millikin University. The first and third goals, in particular, will help a student achieve *professional success*, as being able to utilize the scientific method as a mode of inquiry will be valuable in any career. Meeting all three goals will also contribute to a Millikin graduate being a *democratic citizen in a global environment*. Dealing with problems in a global society requires integration of knowledge and strong problem solving skills. The second and third goals are particularly focused on *preparing students for a personal life of meaning and value*. Issues in science affect everyone daily, and understanding what these issues are will better prepare students to understand how they in particular are affected.

The courses that students take to satisfy these learning goals come from all three departments and are taught by a majority of the faculty in each department. Each year, faculty gather an assortment of artifacts from their courses that measure student learning with respect to the above goals. Using a set of rubrics, these artifacts are evaluated to assess student learning. Historically, these evaluations have included an extensive evaluation of one course per department that meets the learning goals. In retrospect, this means of assessment is inadequate. During the 2011 Assessment, several courses were evaluated from each department to give a more complete overview of whether the goals are being met. However, the courses were still underrepresented. While not all courses offered were evaluated in that annual evaluation, we felt it was a substantial improvement in our assessment technique. For the 2012 Assessment, more of the faculty have contributed artifacts to the assessment, giving us a clearer picture of how our offered courses meet the goals of the Natural Science with a Lab non-sequential requirement. However, this could still be improved greatly and all faculty teaching courses that meet this requirement will be encouraged to submit artifacts for future assessments.

Based on the rubrics created for assessing the learning goals, our current status on all three learning goals is a tentative "**green light**" (at an acceptable level). While the number of artifacts reviewed for this assessment increased from 2011, more contributions from all faculty who teach in the program need to be included to change this to a firm "green light". The Natural Science faculty will continue to work on ways to ensure that all our students perform at the "green light" level in the future.

II. Goals

In the opinion of the faculty in the Departments of Biology, Chemistry, and Physics, upon completion of a Natural Science with a Laboratory Experience course at Millikin University, a student will be able to:

1) Use logic and the scientific method to analyze the natural world and solve problems.

2) Analyze issues in science which are important both personally and globally.

3) Connect theories and descriptions found in lectures and textbooks with real-world phenomena utilizing appropriate technology in laboratory and field environments.

A student who is able to reach these goals successfully will also be satisfying the core goals expressed in the mission statement of Millikin University. The first and third goals, in particular, will help a student achieve *professional success*, as being able to utilize the scientific method as a mode of inquiry will be valuable in any career. Meeting all three goals will also contribute to a Millikin graduate being a *democratic citizen in a global environment*. Dealing with problems in a global society requires integration of knowledge and strong problem solving skills. Performing informative and interesting experiments is one way scientists interact with the world; therefore, understanding issues in science and the process scientists go through is invaluable in understanding the impact of science-related issues on their lives. The second and third goals are particularly focused on *preparing students for a personal life of meaning and value*. Issues in science affect everyone daily, and understanding what these issues are will better prepare students to understand how they in particular are affected. Also, being able to connect the theory in texts to the practical applications of science in their lives will help the students be life-long learners and continue to integrate future developments in science into their understanding of the world.

III. Snapshot

The departments of Biology, Chemistry, and Physics at Millikin University were staffed in 2010-11 by 17 full-time faculty, 9 adjunct faculty or instructors, and 1.5 academic staff support people (secretaries). One of the biology faculty (Cynthia Handler) has a half-time position in the department; the remaining half of her load is as the pre-professional advisor. Two of the instructors (Roslyn O'Conner and Kathreine Fritts) have part of their load directed to lab support (lab set-ups, chemical inventory, ordering supplies, etc). All three departments are housed in the Leighty-Tabor Science Center (LTSC), which opened in 2002, and provides an excellent teaching and research facility. Full-time faculty generally teach a variety of courses, including service courses aimed at a general audience (non-majors), service courses aimed at a specific audience (for example, courses for Nursing or Exercise Science majors), and courses for science majors. Adjuncts typically help with laboratory instruction or non-majors courses. The smallest science courses (upper-level courses) may have approximately 8 students while the largest may serve 60 or more students. Some of these larger courses include Anatomy and Physiology I and II, Essentials of Organic and Biochemistry, and Introductory Astronomy courses. Lab courses are usually capped at a maximum of 24 students.

Courses taught Fall 2011 (F), January Immersion 2012 (J), Spring 2012 (S), or Summer 2012 (Su) that met the MPSL Natural Science with a Laboratory Experience requirement are:

BI 102, Biochemistry of Food – Dr. Samuel Galewsky (F,S)
BI 102, Biology of Birds – Dr. David Horn (F,S)
BI 102, Biology of Mammals – Dr. Gregg Marcello (F)
BI 102, Current Issues in Biology – Prof. Roslyn O'Conner (S)
BI 102, Hormones & Society – Dr. Jennifer Schultz-Norton (S, Su)
BI 102, Human Biology – Dr. Jennifer Schultz-Norton (S)
BI 102, Human Physiology in Space – Dr. Harold Wilkinson (J)
BI 102, Micro-organisms & Disease – Dr. Sangeetha Srinivasan (F)
BI 105/155, Ecology & Evolution – Dr. Judy Parrish, Dr. Marianne Robertson, Dr. Travis Wilcoxen (F)
BI 108/158 Diversity of Life – Dr. Judy Parrish, Dr. Jeff Hughes, Dr. Sangeetha Srinivasan (S)
BI 130, Environmental Biology – Prof. Roslyn O'Conner (F)
BI 204, Essentials of A&P – Dr. Travis Wilcoxen (F), Dr. Cynthia Handler (S)
BI 220, Field Ecology – Dr. Judith Parrish (Su)
BI 230, Principles of Microbiology – Dr. Jeff Hughes, Dr. Sangeetha Srinivasan (F,S)
BI 280, Ecological Journey: S. Africa – Dr. Judy Parrish (F)

CH 102, Intro to Nanoscience – Dr. Paris Barnes (F)
CH 121/151, General Chemistry – Prof. Elizabeth Stensrud, Dr. Clarence Josefson, Dr. Ed Acheson, Prof. Lynette Nehmer, Prof. Katherine Fritts (F,S)

IN 204, Biology of Spiders – Dr. Marianne Robertson (S)

PY 100/104 The Planets – Dr. Casey Watson (S)
PY 101/105 Stars and Galaxies – Dr. Casey Watson (F)
PY 111/151/171, College and University Physics – Dr. Eric Martell (F)
PY 131, Science in Museums – Dr. Eric Martell (S)
PY 160, Physics of Theatre – Dr. Eric Martell (J)

IV. Learning Story

There are three main groups of students who take natural science courses at Millikin: 1) Natural Science majors, who take a dozen or more science courses; 2) students majoring in fields like Nursing or Exercise Science, who do not take quite as many science courses but still take a sizable number; and 3) students who take one (or sometimes two) science courses to fulfill graduation requirements. The first group of students generally has a different set of learning goals – specifically, the goals for learning within the major. However, while some of the above courses (BI 102, PY 101) have students from the third group as their primary audience, other courses (CH 121, PY 151, for example) have very diverse audiences. These latter courses must be carefully constructed such that majors get a strong introduction to the field at the same time non-majors or general education students satisfy the learning goals from section I.

The majors for the students taking courses listed in section III, snapshot, are listed by department below. The full breakdown of majors enrolled in each individual course is include in Appendix 1.

Major	Biology	Chemistry	Physics	TOTAL
Accounting	6	2	4	12
Applied Mathematics	2	0	7	9
Art	1	1	0	2
Art Education	1	0	0	1
Art Therapy	0	0	2	2
Athletic Training	3	22	2	27
Biology	82	33	58	173
Biology - Secondary Teaching	1	0	3	4
Business Management	3	1	2	6
Business Undecided	2	1	6	9
Chemisty	8	3	28	39
Comm Art	0	0	0	0
Commercial Music	5	0	8	13
Communication	31	3	15	49
Early Childhood Education	5	1	9	15
Elementary Ed	12	4	9	25
English - Literature	1	0	0	1
English - Secondary Teaching	3	0	1	4
English - Writing	3	1	7	11
Entrepreneurship	3	1	2	6
Exploratory Studies	17	15	4	36
Finance	2	0	4	6
Fitness and Sport	23	2	3	28
Graphic Design	1	0	0	1
Health/Fitness/Recreation	12	7	1	20
History	3	0	5	8
Human Services	21	2	3	26
Information Technology	0	1	0	1
Interdepartmental	0	0	2	2

Major	Biology	Chemistry	Physics	TOTAL
International Business	1	0	0	1
International Studies	0	0	0	0
Marketing	7	1	1	9
Math - Secondary Teaching	2	0	0	2
Math w/ Actuarial Science	0	0	3	3
Music	5	1	7	13
Music Business	4	0	10	14
Music Ed Instrumental	4	0	2	6
Music Ed Vocal	5	1	6	12
Music Performance Instrum	2	0	4	6
Music Performance Vocal	0	0	2	2
Musical Theatre	4	0	0	4
Nursing	29	49	3	81
Philosophy	4	1	0	5
Phys Ed (K-12)	19	6	0	25
Physics	0	5	11	16
Political Science	2	0	2	4
Psychology	17	3	15	35
Soc Science Secondary Teach	1	0	2	3
Sociology	6	0	10	16
Spanish	1	0	0	1
Sport Management	6	15	1	22
Studio Art	8	1	0	9
Theatre	11	1	11	23
SUM	**389**	**184**	**275**	**848**

Because of the variety of courses students can take to fulfill this requirement, there is no single story which best describes the experiences a student gets in a first Natural Science with a Laboratory Experience course. There are some commonalities which all students will experience, such as a full-time faculty or staff member as an instructor and extensive hands-on laboratory experiences (between 24 and 45 hours in the lab, depending on the course), but the ways in which a student can achieve the stated learning goals are as varied as the different courses they can choose to take. For example, a student in the Block General Chemistry course will have an intense experience in which lab and lecture are integrated, and they are tested every day to ensure that they keep pace with the material. A student in one of the Biology topics courses may study some of the most controversial topics facing our society and may develop projects that require them to interact with the Decatur community and deal with issues such as conservation and recycling. A student in Stars and Galaxies will become an expert at setting up, taking down, and maintaining a telescope, and learn what it is about the night sky that has captivated mankind for millennia. Students in all courses will be exposed to time-honored and trusted teaching methods as well as research-based pedagogical techniques that are on the cutting edge of teaching and learning in the field. Lectures and labs are well integrated and emphasize critical thinking, application, and problem solving skills. However, it is apparent that certain majors seem more likely to take one departments' courses over another to fulfill their requirement: Accounting, communication, and human services majors are more likely to take a Biology course, while athletic training and nursing majors are more likely to take Chemistry. Other majors have a more even distribution among the three departments.

V. Assessment Methods

In recent years, a subset of courses has been analyzed to assess the learning goals for the MPSL Natural Science with a Laboratory Experience requirement. One faculty member was selected from each of three departments – Biology, Chemistry, and Physics – to represent the diversity of courses offered which meet this requirement. However, we realize that this is a strong underrepresentation of the breadth of courses which are offered. As described earlier, there are twenty-three discrete course titles which meet the requirement, and many of these are offered multiple times throughout the year. Thus, assessing only three courses was insufficient.

We also recognize that although the means of assessment is meant to be rigorous and impartial, it is difficult to be objective when analyzing the learning goals and results from one's own course. These courses are designed in part with the learning goals in mind, and thus should ideally meet all of the goals without fail. However, this may not in fact be the case and meeting the requirements of the learning goals may not be as apparent as the faculty who designed the course might assume.

To ensure that the assessment is in-depth, a larger subset of courses was being assessed for the 2010-2011 academic year. This includes a majority of the Physics courses (with faculty and student artifacts provided from all but the lab sections), one course in Chemistry taught by multiple faculty (CH 121/151), and several courses in Biology. However, this was still inadequate. An analysis of the number of courses and number of faculty contributing artifacts to the assessment is listed below.

2011	Courses Analyzed		Faculty Participating	
	#	%	#	%
Biology	7	33.3	5	45.5
Chemistry	2	50.0	3	60.0
Physics	4	66.7	2	100.0
Overall	**13**	**41.9**	**10**	**55.6**

2012	Courses Analyzed		Faculty Participating	
	#	%	#	%
Biology	14	53.8	6	50.0
Chemistry	5	62.5	3	50.0
Physics	2	22.2	1	50.0
Overall	**21**	**48.8**	**10**	**50.0**

For the 2011-2012 academic year, similar numbers of faculty participated in the assessment, although the number of courses analyzed changed. The number of Biology and Chemistry courses analyzed doubled, while the number of Physics courses was lower.

For 2011, the Biology faculty were regarded as RED for contribution to the assessment, Chemistry as YELLOW, and Physics as GREEN. For the 2012 assessment, the Biology faculty have been upgraded to YELLOW and Chemistry has been regarded as GREEN for their contributions. Physics however, with the lower participation and such a low percentage of classes being assessed, is rated as RED. In future assessments, we hope to analyze closer to 100% of the courses in all departments and have a minimum of 75% of the faculty participating (100% for Physics, with only 2 faculty involved).

To begin our analysis, we have included SIR data to discern whether the students feel that the learning goals are being met.

For each of the courses assessed, an analysis of the syllabi was performed to examine whether the learning goals are clearly addressed.

Various artifacts including exams, formal lab write-ups, lab books, semester-long projects, and presentations were also submitted for assessment. These will be assessed in two ways: one branch of the assessment will examine whether the learning goals are clearly addressed in the assignment using the rubric below.

Rubrics for Faculty Directions for Artifact Assessment

Goal 1: Logic and the Scientific Method

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Scientific Method	**[5 points]** Encourages strong understanding of the scientific method. Ability to develop hypotheses, test them, and then draw appropriate conclusions from the results to be analyzed. Clear understanding of the meaning of the word "theory" in a scientific context.	**[3 points]** Encourages a basic understanding of the scientific method. Focuses upon the individual parts, but does not require students to synthesize them into a coherent whole.	**[1 point]** Does not demonstrate any substantial focus upon the scientific method.
Analysis	**[5 points]** Requires ability to analyze data and explain results. Asks students to draw conclusions from data or calculations. Encourages discussion of results.	**[3 points]** Includes a basic analysis of data. Encourages students to come up with some minor conclusions, without discussion required.	**[1 point]** Fails to require data analysis, conclusions, or comparisons with other data.
Problem Solving	**[5 points]** Encourages use of logic and reasoning to solve complex problems, while incorporating prior knowledge. Comparison to hypothesis is required.	**[3 points]** Includes a basic level of problem solving.	**[1 point]** Fails to show the ability to solve problems beyond the most basic level.

Goal 2: Scientific Issues

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Understanding of issue	**[5 points]** Requires a clear understanding of a scientific issue. Asks student to explain the scientific principles governing the relevant physics, biology, or chemistry.	**[3 points]** Asks for a basic understanding of a scientific issue. Scientific principles encouraged, but not required.	**[1 point]** Does not ask for in-depth understanding or explanation of basic scientific principles.
Understanding of personal relevance	**[5 points]** Requires a clear understanding of how a scientific issue affects them personally.	**[3 points]** Encourages, but does not require, a small understanding of how a scientific issue affects them personally.	**[1 point]** No correlation between the student and the issue is required.
Understanding of global relevance	**[5 points]** Requires a clear understanding of how a scientific issue affects the world at large, including long-term affects.	**[3 points]** Encourages an understanding of how a scientific issue affects the global community, but not an in-depth analysis.	**[1 point]** Does not require a connection between scientific issue and other global issues.

Goal 3: Technology in Lab and Field Environments

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Use of technology	**[5 points]** Faculty has student utilize appropriate technology to acquire and analyze data in an experimental setting. Uses equipment safely and efficiently.	**[3 points]** Asks the student to utilize technology to acquire or analyze data, but not both. May be inefficient, but uses equipment safely.	**[1 point]** Does not ask the student to use appropriate technology in experimental setting. No taking or analysis of data. Demonstrates unsafe procedures.
Connection of theory and experiment	**[5 points]** Requires a connection of experimental results with expectations from class or texts. Asks students to connect theory with results.	**[3 points]** Encourages, but does not require, connection of theoretical expectations with experimental results.	**[1 point]** Does not ask students to connect the results they obtain experimentally with expected results from class or texts.
Connection to real-world phenomena	**[5 points]** Requires comparison of results found in (often) a controlled lab environment to understanding real-world phenomena. Can make predictions about what would happen in a less controlled environment.	**[3 points]** Encourages, but does not require, students to demonstrate connection of lab results with more general real-world phenomena.	**[1 point]** Does not ask student to generalize from results in lab to real-world phenomena. No understanding required beyond the lab environment.

The grading rubrics used to assess each learning goal have three categories: Excellent, Adequate, and Unsatisfactory. In evaluating faculty artifacts for each learning goal, rubric scores of 1, 3, or 5 were assigned to each category.

- For totals between 10.0 and 15.0, a "green light" (an acceptable level or clearly heading in the right direction and not requiring any immediate change in course of action) was assigned for that learning goal.
- For totals between 6.0 and 9.9, a "yellow light" (not an acceptable level; either improving, but not as quickly as desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired rate of improvement) was assigned for that learning goal.
- For totals below 6.0, a "red light" (our current status or direction of change is unacceptable. Immediate, high priority actions should be taken to address this area) was assigned for that learning goal.

The other branch of this assessment will examine whether the students met the learning goals through these assignments. The rubrics utilized for assessing the artifacts are provided below. For the artifacts, a random sampling of the submitted work was assessed (with a minimum of two artifacts per course).

Rubrics for Student Artifact Assessment
Goal 1: Logic and the Scientific Method

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Scientific Method	**[5 points]** Student demonstrates strong understanding of the scientific method. Ability to develop hypotheses, test them, and then draw appropriate conclusions from the results. Clear understanding of the meaning of the word "theory" in a scientific context.	**[3 points]** Student demonstrates a basic understanding of the scientific method. Understands the parts, but unable to synthesize them into a coherent whole.	**[1 point]** Student does not demonstrate any substantial understanding of the scientific method. Cannot differentiate between a theory and a guess.
Analysis	**[5 points]** Student demonstrates ability to analyze data and explain results. Results well-understood and appropriate and justifiable conclusions drawn from data or calculations. Honest comparison with previous results influences discussion of results.	**[3 points]** Student demonstrates a basic ability to analyze data. Some conclusions may be insufficiently well-supported, comparisons with previous results may be incomplete, but basic structure of sound analysis is present.	**[1 point]** Student fails to meet basic standards for appropriate data analysis. Results clearly not well-understood, incomplete analysis, failure to compare with previous results.
Problem Solving	**[5 points]** Student demonstrates a clear grasp of how to use logic and reasoning to solve complex problems. Breaks problem into simpler components that incorporate prior knowledge. Combines information in a useful way. Interprets result appropriately and compares with expectations.	**[3 points]** Student demonstrates a basic ability to solve problems. Logic may be faulty at times, may show difficulties in dealing with more complex problems.	**[1 point]** Student fails to show the ability to solve problems beyond the most basic level.

Goal 2: Scientific Issues

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Understanding of issue	**[5 points]** Student demonstrates a clear understanding of a scientific issue. Can explain the scientific principles governing the relevant physics, biology, or chemistry.	**[3 points]** Student demonstrates an incomplete understanding of a scientific issue. Explanation unclear in parts, scientific principles insufficiently well-understood.	**[1 point]** Student demonstrates a weak understanding at best. Unable to explain basic scientific principles.

Understanding of personal relevance	**[5 points]** Student demonstrates a clear understanding of how a scientific issue affects them personally. Can show how they are related to causes and effects. Understands long-term results of effects in their lives.	**[3 points]** Student demonstrates an incomplete understanding of how a scientific issue affects them personally. May not understand how they are related to causes or effects.	**[1 point]** Student unable to draw connections between scientific issue and their own life.
Understanding of global relevance	**[5 points]** Student demonstrates a clear understanding of how a scientific issue affects the world at large. Can draw connections to political, social, or cultural causes and effects. Understands long-term global effects.	**[3 points]** Student demonstrates an incomplete understanding of how a scientific issue affects the global community. May be unable to draw connections to causes and effects.	**[1 point]** Student unable to draw connections between scientific issue and other global issues.

Goal 3: Technology in Lab and Field Environments

Item	Criteria		
	Excellent	Adequate	Unsatisfactory
Use of technology	**[5 points]** Student utilizes appropriate technology to acquire and analyze data in an experimental setting. Uses equipment safely and efficiently.	**[3 points]** Student can utilize technology to acquire or analyze data, but not both. May be inefficient, but uses equipment safely.	**[1 point]** Student unable to use appropriate technology in experimental setting. Cannot take or analyze data. Demonstrates unsafe procedures.
Connection of theory and experiment	**[5 points]** Student connects experimental results with expectations from class or texts. Able to put theory into practice in lab and able to use results to discuss theory.	**[3 points]** Student demonstrates an incomplete ability to connect theoretical expectations with experimental results.	**[1 point]** Student unable to connect the results they obtain experimentally with expected results from class or texts.
Connection to real-world phenomena	**[5 points]** Student is able to generalize from results found in (often) a controlled lab environment to understand real-world phenomena. Can make predictions about what would happen in a less controlled environment.	**[3 points]** Student demonstrates an incomplete ability to connect lab results with more general real-world phenomena. May not be able to understand what happens in a less-controlled environment.	**[1 point]** Student unable to generalize from results in lab to real-world phenomena. Does not demonstrate understanding beyond lab environment.

The grading rubrics used to assess each of these learning goals were assigned the rubric scores as defined above for "green", "yellow", and "red" lights.

VI. Assessment Data

A. SIR Data Comparison

SIR data have been collected for the following four items: (1) scale summary data for course organization and planning, (2) scale summary data for communication, (3) overall evaluation of the instructor, and (4) overall evaluation of the course. The following SIR data compare the mean scores for all faculty at the university (first number) with average mean scores for faculty within the Division of Natural Sciences (only including Biology, Chemistry, and Physics). The individual department SIR scores are included as well. Unfortunately, data for only the courses which were used for assessing the Natural Sciences with a Laboratory Experience is not available, and thus all courses in the major are included in the data below.

Fall 2010	University	Division (NS)	Biology	Chemistry	Physics
Course Organizaton & Planning	4.34	4.45	4.38	4.44	4.61
Communication	4.41	4.52	4.51	4.47	4.62
Overall, Instructor	4.37	4.49	4.45	4.43	4.66
Overall, Course	4.18	4.3	4.26	4.27	4.47
Number Reporting	6014 (49%)	654 (63%)	309 (70%)	213 (48%)	132 (80%)

Spring 2011	University	Division (NS)	Biology	Chemistry	Physics
Course Organizaton & Planning	4.39	4.40	4.43	4.29	4.51
Communication	4.46	4.49	4.53	4.41	4.54
Overall, Instructor	4.41	4.41	4.48	4.26	4.50
Overall, Course	4.23	4.17	4.27	4.01	4.18
Number Reporting	3690 (36%)	458 (56%)	223 (67%)	157 (44%)	78 (60%)

Fall 2011	University	Division (NS)	Biology	Chemistry	Physics
Course Organization & Planning	4.37	4.26	4.34	4.11	4.33
Communication	4.43	4.36	4.52	4.16	4.37
Overall, Instructor	4.36	4.22	4.40	4.04	4.17
Overall, Course	4.18	3.96	4.23	3.82	3.99
Number Reporting	5214 (44%)	649 (64%)	283 (72%)	224 (54%)	142 (69%)

Spring 2012	University	Division (NS)	Biology	Chemistry	Physics
Course Organization & Planning	4.35	4.30	4.35	4.22	4.32
Communication	4.43	4.43	4.52	4.32	4.39
Overall, Instructor	4.38	4.38	4.48	4.23	4.29
Overall, Course	4.22	4.14	4.23	4.00	4.16
Number Reporting	6331 (56%)	676 (73%)	328 (78%)	225 (66%)	123 (79%)

B. Syllabus Audit Data

For the academic year 2011-2012, 41 total syllabi were collected. This represents syllabi for a majority of the courses which meet the Natural Science with a Laboratory Experience requirement. A few select syllabi for immersion courses were unavailable for assessment. Each syllabus was audited to see if it contained specific items relevant to the delivery and assessment of the Natural Science with a Laboratory Experience learning goals. The following data provides information regarding the number of syllabi containing the relevant items as specified on the audit form.

Natural Science with a Laboratory Experience
Syllabus Audit Form

	Syllabus is acceptable on item	Syllabus has item included but not in acceptable form	Syllabus does not have item
TOP of FIRST PAGE: Course Identification: course number, course name, faculty, semester	90.2% (37)	9.8% (4)	0%
SOMEWHERE in SYLLABUS:			
Faculty contact info: name, office, office hours, office phone, email address	100% (41)	0%	0%
Course description: Standard description plus faculty written course description/overview	90.2% (37)	2.4% (1)	7.3% (3)
Standard course learning goals	61% (25)	31.7% (13)	7.3% (3)
Instructor's grading policy - scale and weights for assignments & for the semester	95.1% (39)	4.9% (2)	0%
Instructor's attendance policy – penalties	85.3% (35)	4.9% (2)	9.8% (4)
Academic honesty & integrity statement (standard)	95.1% (39)	4.9% (2)	0%
University disability statement (standard)	92.7% (38)	4.9% (2)	2.4% (1)
Specification of a written assignment that will serve as Logic and the Scientific Method artifact for assessment purposes	14.6% (6)	9.8% (4)	75.6% (31)
Specification of a written assignment that will serve as Scientific Issues artifact for assessment purposes	14.6% (6)	9.8% (4)	75.6% (31)
Specification of a written assignment that will serve as Technology in the Lab and Field Environments artifact for assessment purposes	14.6% (6)	9.8% (4)	75.6% (31)

C. Artifact Collection: Rubric and directions analysis

In previous years, three faculty members have been selected to assess their own courses that meet the MPSL requirement. As this covers barely ten percent of the courses taught, a more comprehensive assessment is required.

One of the most difficult aspects of this assessment is in isolating the specific artifacts which are then utilized in the assessment, as many of these learning goals are incorporated throughout the entire course and may not have only one assignment which could be utilized for assessment for each goal.

To try to identify whether specific assignments are well-designed to meet the learning goals, artifacts representing the directions and/or rubrics for these assignments were collected from several faculty covering a variety of courses, and within all three departments. These artifacts represent the faculty who provided data as reported in section IV. A hard copy of each of the artifacts collected along with the individual assessment is in the possession of Dr. Jennifer Schultz-Norton.

Each item on the rubric was analyzed for each faculty-provided assignment directions. Some of these were directed at meeting a specific learning goal rather than all three goals, thus the number of artifacts for each goal varies. The raw data for this assessment can be found in Appendix 3.

On each of the artifacts, the assessor determined which of the goals was being met by the assignment and scored each of the three categories under the proper goals. The assessor on all of these artifacts was Dr. Jennifer Schultz-Norton. For each of the subcategories under the learning goals, a rubric score between 1 and 5 was assigned. On the basis of its total score, the artifact is tagged as falling into one of three categories:

- For totals between 10.0 and 15.0, a "green light" (an acceptable level or clearly heading in the right direction and not requiring any immediate change in course of action) was assigned for that learning goal.
- For totals between 6.0 and 9.9, a "yellow light" (not an acceptable level; either improving, but not as quickly as desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired rate of improvement) was assigned for that learning goal.
- For totals below 6.0, a "red light" (our current status or direction of change is unacceptable. Immediate, high priority actions should be taken to address this area) was assigned for that learning goal.

The following tables identify the number of artifacts falling into each of the three major categories:

Biology			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	0 (0%)	16 (45%)	20 (55%)
Goal 2	2 (6%)	19 (53%)	15 (42%)
Goal 3	0 (0%)	8 (24%)	25 (76%)

Chemistry			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	2 (9%)	5 (24%)	14 (67%)
Goal 2	0 (0%)	2 (33%)	4 (66%)
Goal 3	0 (0%)	2 (15%)	11 (85%)

Physics			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	0 (0%)	0 (0%)	2 (100%)
Goal 2	N/A	N/A	N/A
Goal 3	N/A	N/A	N/A

After adding up and averaging the scores for the individual departments, the rubric scores are the following:

Average of Rubric Scores (2011)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	11.9	9.0	13.4
Chemistry	12.5	10.0	14.5
Physics	13.0	10.7	N/A
Overall	12.4	9.5	13.7

Average of Rubric Scores (2012)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	10.3	9.3	10.9
Chemistry	11.6	10.8	12.4
Physics	14.5	N/A	N/A
Overall	10.9	9.5	11.3

Total Number of Artifacts Provided (2011)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	6	9	7
Chemistry	3	1	2
Physics	4	3	0
Overall	13	13	9

Total Number of Artifacts Provided (2012)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	36	36	33
Chemistry	21	6	13
Physics	2	0	0
Overall	59	42	46

D. Artifact Collection: Student Artifact Analysis

In previous years, three faculty members have been selected to assess their own courses that meet the MPSL requirement. This year all faculty were asked to submit the artifacts to the assessment coordinator so all artifacts would be analyzed equally.

Student artifacts were submitted from all three departments. A hard copy of each of the artifacts collected along with the individual assessment is in the possession of Dr. Jennifer Schultz-Norton. Each item on the rubric was analyzed for student success. Some of these were collected artifacts were directed at meeting a specific learning goal rather than all three goals, thus the number of artifacts for each goal varies. The raw data for this assessment can be found in Appendix 3.

On each of the artifacts, the assessor determined which of the goals was being met by the assignment and scored each of the three categories under the proper goals. The assessor on all of these artifacts was Dr. Jennifer Schultz-Norton. For each of the subcategories under the learning goals, a rubric score between 1 and 5 was assigned. On the basis of its total score, the artifact is tagged as falling into one of three categories:

- For totals between 10.0 and 15.0, a "green light" (an acceptable level or clearly heading in the right direction and not requiring any immediate change in course of action) was assigned for that learning goal.
- For totals between 6.0 and 9.9, a "yellow light" (not an acceptable level; either improving, but not as quickly as desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired rate of improvement) was assigned for that learning goal.
- For totals below 6.0, a "red light" (our current status or direction of change is unacceptable. Immediate, high priority actions should be taken to address this area) was assigned for that learning goal.

The following tables identify the number of artifacts falling into each of the three major categories:

Biology			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	0 (0%)	1 (14%)	6 (86%)
Goal 2	1 (7%)	7 (47%)	7 (47%)
Goal 3	0 (0%)	1 (12%)	7 (88%)

Chemistry			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	4 (19%)	14 (66%)	3 (14%)
Goal 2	0 (0%)	1 (33%)	2 (66%)
Goal 3	2 (9%)	16 (76%)	3 (14%)

Physics			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	1 (14%)	2 (28%)	4 (57%)
Goal 2	0 (0%)	3 (50%)	3 (50%)
Goal 3	0 (0%)	1 (25%)	3 (75%)

After adding up and averaging the scores for the individual departments, the rubric scores are the following:

Average of Rubric Scores (2011)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	8.5	10.8	9.0
Chemistry	11.0	N/A	12.5
Physics	N/A	N/A	N/A
Overall	9.3	10.8	10.2

Average of Rubric Scores (2012)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	10.7	9.4	11.1
Chemistry	7.4	11.0	7.3
Physics	10.4	9.8	10.5
Overall	10.6	9.6	10.9

Total Number of Artifacts Provided (2011)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	4	20	4
Chemistry	2	0	2
Physics	0	0	0
Overall	6	20	6

Total Number of Artifacts Provided (2012)			
	Goal 1	**Goal 2**	**Goal 3**
Biology	7	15	8
Chemistry	21	3	21
Physics	7	6	4
Overall	35	24	33

2011	**Courses Analyzed**		**Faculty Participating**	
	#	**%**	**#**	**%**
Biology	3	14.3	2	18.2
Chemistry	1	25.0	1	20.0
Physics	0	0.0	0	0.0
Overall	4	12.9	3	16.7

2012	**Courses Analyzed**		**Faculty Participating**	
	#	**%**	**#**	**%**
Biology	7	26.9	4	33.3
Chemistry	3	15.8	3	50.0
Physics	2	22.2	1	50.0
Overall	12	22.2	8	44.4

As in 2011, this severely under-represents the number of courses offered. However, there was much more participation with almost three times the number of faculty providing student artifacts in 2012 compared to 2011.

In addition to the data above, several faculty submitted student grades for their own courses as a means of assessment. For these courses, reported grades of 90-100% were scored with 5 points, 80-89% with 4 points, 70-79% with 3 points, 60-69% with 2 points, and 59 and below 1 point. If the student failed to submit the assignment, a 0 was given. On the basis of its total score, the artifact is tagged as falling into one of three categories:

- For totals between 3.5 and 5, a "green light" (an acceptable level or clearly heading in the right direction and not requiring any immediate change in course of action) was assigned for that learning goal.
- For totals between 2 and 3.5, a "yellow light" (not an acceptable level; either improving, but not as quickly as desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired rate of improvement) was assigned for that learning goal.
- For totals below 2, a "red light" (our current status or direction of change is unacceptable. Immediate, high priority actions should be taken to address this area) was assigned for that learning goal.

The following tables identify the number of courses falling into each of the three major categories:

Biology			
	Red Light (<2)	**Yellow Light (2-3.5)**	**Green Light (3.5-5)**
Goal 1	0 (0%)	3 (37.5%)	5 (62.5%)
Goal 2	0 (0%)	4 (40%)	6 (60%)
Goal 3	0 (0%)	2 (33%)	4 (66%)

Chemistry			
	Red Light (<2)	**Yellow Light (2-3.5)**	**Green Light (3.5-5)**
Goal 1	0 (0%)	1 (25%)	3 (75%)
Goal 2	0 (0%)	1 (25%)	3 (75%)
Goal 3	0 (0%)	0 (0%)	1 (100%)

Physics			
	Red Light (<2)	**Yellow Light (2-3.5)**	**Green Light (3.5-5)**
Goal 1	0 (0%)	1 (25%)	3 (75%)
Goal 2	0 (0%)	1 (33%)	2 (66%)
Goal 3	0 (0%)	0 (0%)	3 (100%)

After adding up and averaging the scores for the individual departments, the rubric scores are the following:

Average of Rubric Scores 2011			
	Goal 1	**Goal 2**	**Goal 3**
Biology	4.17	4.42	4.21
Chemisty	3.85	4.00	4.29
Physics	4.33	4.67	4.38
AVERAGE	4.17	4.46	4.28

Average of Rubric Scores 2012			
Biology	3.6	3.9	3.3
Chemistry	3.4	3.4	4.0
Physics	3.9	4.7	4.0
AVERAGE	3.6	3.9	3.7
Biology	3.6	3.9	3.3

VII. Analysis

A. SIR Data

For the second year in a row, we are including SIR data in our assessment of the Natural Sciences with a Laboratory Experience courses. This is being included to demonstrate the quality of the faculty teaching this university requirement. Although the SIR data included here are not ideal, as they include both courses for the MPSL as well as major-specific courses, they do give an indication of the quality of the faculty in the Natural Sciences for Course Organization and Planning, Communication, Overall Instructor and Overall Course.

During the Fall 2011, less students participated in the University, Division and Biology assessment than in Fall 2010. Large reductions were seen in both Chemistry and Physics for all categories analyzed, leaving these departments below the University averages. The Biology scores did not vary much from 2010, and remained close to or above the University averages.

In contrast, almost twice the number of students participated in the Spring 2012 assessment compared to Spring 2011. Biology and Chemistry averages remained similar to 2011, with Biology being near or above University averages while Chemistry was near or below these. Physics had a slight drop in their SIR scores for Course Organization, Communication and Instructor.

As the numbers for the most part are above, at or near the university averages, we score the SIR Data as GREEN for Biology and YELLOW APPROACHING GREEN for Chemistry and Physics for this assessment. We strongly encourage the Chemistry and Physics departments to examine what may have caused such large drops in student perception of the courses taken.

B. Syllabi Audits

The syllabi were audited under a formal rubric that is very similar to the rubric utilized for the IN 140 assessment. For the 2011 analysis, the rubric was not distributed to faculty in advance, and it was evident that some areas are severely lacking. The rubric was included in the MPSL NSLE assessment that was distributed to all faculty in the natural sciences, with the hope that changes would be made to the syllabi to incorporate the recommended suggestions.

Several improvements were noted from 2011:

- All faculty have now included full contact information, near the top of their syllabus
- Over 90% of the syllabi now contain a detailed course description
- Most of the faculty include a point distribution breakdown for assignments as well as a grading scale
- While almost all syllabi included academic honesty and disability statements, there were two syllabi in biology that used modified language instead of the standard Millikin wording.

However, several errors were still noted:

- Some syllabi did not specify the semester the course met.
- Three of the lab courses in Chemistry do not contain a course description
- The learning goals of these courses are not always clearly displayed. Since many of the courses analyzed can be used to fill science majors requirements, the non-majors learning goals are not always included although learning goals for the department or major may be. This was noted especially in Biology courses that can fulfill the freshmen requirement, such as BI 105/155. While we encourage these learning goals to still be included, the non-majors goals should be included as well. There were also three syllabi from biology or chemistry that did not include learning goals.
- One syllabus did not include the disability statement.

What continues to be disappointing is that while the learning goals are stated in the syllabi, how those learning goals are being assessed is not being included. Only 6 of 41 syllabi analyzed contained this information, earmarking specific assignments for each learning goal. The syllabi for BI 102: Biology of Birds from Dr. David Horn can be used as an example of how this information might be disseminated more clearly:

> **Course objectives and student learning outcomes:** Upon completion of this course, students should:
> 1) be able to describe, apply, and integrate the basic concepts of ornithology. (Outcome measured and evaluated through exams, field test, research assignment, and reading assignments)
> Specifically,
> a) be able to describe bird origins and adaptations, diversity, flight and migration, behavior, breeding biology, ecology, and conservation
> b) be able to identify birds using both visual field marks and vocalizations including an understanding of bird song
> 2) develop an understanding of how to use logic and the scientific method to analyze the natural world and solve problems. (Goal 1 for natural science with lab courses at Millikin University; Outcome measured and evaluated through research assignment)
> Specifically,
> a) perform a semester-long project on avian biology using the scientific method
> 3) learn about issues in science that are important both personally and globally. (Goal 2 for natural science with lab courses at Millikin University; Outcome measured and evaluated through research assignment)
> Specifically,

a) perform a semester-long project on avian biology of personal meaning and global importance

4) utilize technology in laboratory and field environments in order to connect theories and descriptions found in lectures and textbooks with real-world phenomena. (Goal 3 for natural science with lab courses at Millikin University; Outcome measured and evaluated through field test and research assignment)

Specifically,

a) be able to correctly use scientific equipment such as binoculars and field guides

5) have an understanding of the avian biodiversity found in the region (Outcome measured and evaluated through field trips and field test).

Specifically,

a) go on bird walks in natural areas throughout Decatur
b) identify birds in the Decatur area by sight and sound

After reviewing the syllabi, many of the faculty could provide an artifact which they feel assesses each specific learning goal. It would assist the students and the faculty assessing the courses overall if faculty would revise their syllabi to show the students how they are applying the learning goals to the course. This recommendation will be strongly made, and we hope that faculty will make this minor yet important change to their syllabi.

We should expect to see near (if not actual) 100% marks in the future. Faculty need to make sure that they revise their syllabi to meet the criteria identified in the audit form. We score the audit assessment as follows for 2012:

Course Identification: course number, course name, faculty, semester	**GREEN**
Faculty contact info: name, office, office hours, office phone, email address	**GREEN**
Course description: Standard description plus faculty written course description/overview	**YELLOW**
Standard course learning goals	**YELLOW**
Instructor's grading policy - scale and weights for assignments & for the semester	**GREEN**
Instructor's attendance policy – penalties	**GREEN**
Academic honesty & integrity statement (standard)	**GREEN**
University disability statement (standard)	**GREEN**
Specification of a written assignment that will serve as Logic and the Scientific Method artifact for assessment purposes	**RED**
Specification of a written assignment that will serve as Scientific Issues artifact for assessment purposes	**RED**
Specification of a written assignment that will serve as Technology in the Lab and Field Environments artifact for assessment purposes	**RED**

C. Artifact Collection: Rubric and directions analysis

The following table summarizes the number of artifacts falling into each of the three major categories:

Overall 2011			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	0 (0%)	1 (7%)	13 (93%)
Goal 2	2 (15%)	3 (23%)	8 (62%)
Goal 3	0 (0%)	0 (0%)	9 (100%)

Overall 2012			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	2 (3%)	21 (36%)	36 (61%)
Goal 2	2 (5%)	21 (50%)	19 (45%)
Goal 3	0 (0%)	10 (22%)	36 (78%)

This is the second year that the directions and rubrics themselves are being analyzed for their ability to effectively demonstrate the learning goals. While for 2012 several more artifacts were assessed within each department, many of the submitted artifacts were from the same faculty member. For example, nine artifacts were submitted by Dr. Paris Barnes for his CH 102 course, and fifteen artifacts were submitted by Dr. Roslyn O'Connor between her BI 102 and BI 130 courses. Thus, although we can gain a greater understanding of how our directions and rubrics meet our goals, the data may be slightly skewed by those who chose to participate and submit artifacts for the assessment.

Learning Goal 1 - The data show that **61%** of faculty artifacts effectively monitor the students' ability to "use logic and the scientific method to analyze the natural world and solve problems." However, including those artifacts with a moderate coverage of the goal increases this number to **97%**. Thus, this is rated as GREEN.

Learning Goal 2 - Only **45%** of the faculty artifacts submitted to meet the learning goal excellently expressed how the students would be able to "analyze issues in science which are important both personally and globally." Since **95%** of the faculty have at least adequate coverage of the goal, this goal is rated as GREEN.

Learning Goal 3 - "Students will connect theories and descriptions found in lectures and textbooks with real-world phenomena utilizing appropriate technology in laboratory and field environments." For this goal, **78%** of faculty artifacts assessed adequately express the goal. Inclusion of those with moderate coverage increases the percentage to **100%**. Thus, this goal is rated as GREEN.

While the percentage of individual artifacts meeting the goals and earning a "green light" was lower in 2012 for each department, the increased number of rubrics submitted show that the faculty are making a commitment to meeting the goals and having their work assessed. One of the most difficult aspects of this assessment was that for most of the artifacts submitted, it was unclear as to which of the learning goals the artifacts were meant to accomplish. Thus, it is *strongly recommended* that for future years, faculty specifically delineate in either the syllabus or on the rubric/directions themselves which of the learning goals the artifact meets.

D. Artifact Collection: Student Artifact Analysis

The following table summarizes the number of artifacts falling into each of the three major categories:

Overall 2011			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	1 (16%)	2 (34%)	3 (50%)
Goal 2	3 (15%)	4 (20%)	13 (65%)
Goal 3	0 (0%)	0 (0%)	9 (100%)

Overall 2012			
	Red Light (<6)	**Yellow Light (6-9.9)**	**Green Light (10-15)**
Goal 1	5 (14%)	17 (49%)	13 (37%)
Goal 2	1 (4%)	11 (46%)	12 (50%)
Goal 3	2 (6%)	18 (55%)	13 (39%)

Similar to what was seen with the faculty directions/rubrics, the number of faculty submitting student artifacts dramatically increased. From having 35 data points in 2011, we have 92 in 2012. This may have altered the percentages in each category. Based upon this analysis, it would appear that for 2012, all three goals are borderline YELLOW/GREEN.

Additional data was collected for 23 artifacts from 14 courses. Although individual student artifacts were not obtained, many faculty reported overall grades on either individual assignments or class averages. These were converted to rubric score points, tallied and averaged.

Overall 2011			
	Red Light (<2)	**Yellow Light (2-3.5)**	**Green Light (3.5-5)**
Goal 1	0 (0%)	1 (9%)	10 (91%)
Goal 2	0 (0%)	0 (0%)	9 (100%)
Goal 3	0 (0%)	0 (0%)	10 (100%)

Overall 2012			
	Red Light (<2)	**Yellow Light (2-3.5)**	**Green Light (3.5-5)**
Goal 1	0 (0%)	5 (31%)	11 (69%)
Goal 2	0 (0%)	6 (35%)	11 (65%)
Goal 3	0 (0%)	2 (25%)	8 (75%)

These data show that the student artifacts, as reported by the faculty, do a decent job of meeting the learning goals, although there could be improvement.

The faculty-reported results for each course were combined based upon the rating for the artifact and the number of students per artifact. All data from each department was added up and a weighted average was taken.

2011	Goal 1	Goal 2	Goal 3
Biology	4.1	4.3	4.1
Chemistry	3.6	4.0	4.3
Physics	4.3	4.6	4.4
AVERAGE	4.1	4.3	4.3

2012	Goal 1	Goal 2	Goal 3
Biology	3.6	3.9	3.3
Chemistry	3.4	3.4	4.0
Physics	3.9	4.7	4.0
AVERAGE	3.6	3.9	3.7

These numbers have decreased across the board. Again, we believe that this may in part be due to the increase in volume of the artifacts submitted.

Thus, for the combined student artifacts and faculty-reported student artifacts, the student learning is rated as follows:

- For the first goal, "Students will use logic and the scientific method to analyze the natural world and solve problems": all three departments are rated as GREEN.
- For the second goal, "Students will analyze issues in science which are important both personally and globally": all three departments are rated as GREEN, with caution. To better assess this goal in Physics, student artifacts should be submitted in the future.
- For the third goal, "Students will connect theories and descriptions found in lectures and textbooks with real-world phenomena utilizing appropriate technology in laboratory and field environments": all three departments are rated as GREEN. Again, to better assess this goal in Physics, student artifacts should be submitted in the future.

VIII. Trends and Improvement Plans

Assessment of student learning must be an ever-changing and ever-improving process as we strive to understand how we are meeting the needs of the students as well as the learning goals we as departments have set. In previous assessments, we have attempted to assess the Natural Science with a Laboratory Experience courses by asking one faculty member from each department to complete an in-depth analysis of his or her own course that meets the MPSL requirement. This however, is inadequate as it analyzes only a fraction of the courses taught. In the spirit of other MPSL coordinators, the Natural Science with a Laboratory Experience assessment was modified in 2011 to better assess the majority of the courses, with a goal to assess all the courses more in-depth in future academic years.

To increase the depth of the analysis, SIR data, syllabi, assignment descriptions and student artifacts and grades were collected from a varying number of courses and faculty. These were analyzed by specific rubrics where applicable. While this has significantly increased the number of courses assessed, we are still only examining a fraction of those courses taught and thus any rating for this academic year continues to be a tentative one. One of our largest goals for upcoming academic years will be in faculty compliance. **We need to increase the number of faculty who are submitting artifacts to show how they are assessing the learning goals, and these need to be clearly delineated in the syllabi.**

We also need to increase the number of student artifacts. This can be done in one of two ways: either by increasing the number of actual student assignments that are given to the assessment coordinator, or by increasing the number of faculty who report grades on said assignments. The preferable way would be the former, as this allows for a consistent assessment of all student artifacts. There is inherent bias in the latter, as overall comprehension of subject material may not fully reflect adequate comprehension of the learning goals. This would be dependent upon the assignment rubric itself and how well the assignment meets the learning goals. As demonstrated in sections VI.C. and VII.C., not all assignments effectively require the students to have a firm comprehension of each learning goal.

While faculty participation was lacking in 2011, part of the reason for this was that the change to how the assessment would be done was made during Spring 2011, and thus not as many artifacts were available from the Fall courses. For 2012, several emails were sent out requesting artifacts during both Fall and Spring semesters. Thus, lack of participation is not due to lack of contact. While 100% compliance would be ideal, we feel that 75-85% compliance would give a very accurate representation of how the courses meet the learning goals. For future years, the following will be requested from all faculty in Biology, Chemistry, and Physics who teach a course that meets this requirement:

1. Copies of an assignment which can be utilized for meeting each of the three learning goals. The learning goals which the assignment meets should be specified by the faculty providing the assignment. It is *strongly recommended* that for future years, faculty specifically delineate in either the syllabus or on the rubric/directions themselves which of the learning goals the artifact meets.
2. Copies of at least three individual student artifacts which reflect the assignments utilized for meeting each of the three learning goals, although copies of all artifacts are preferable so that random artifacts can be chosen for assessment. This would remove skewing of data by the faculty choosing samples from their own classes.

We recognize that for some of these assignments, the student artifacts may still be grades (such as for exams). However, copies of research papers and laboratory notebooks and reports should be easily obtained and provided for the assessment. A minimum of four student artifacts are requested, although it is likely that 2 of those will be randomly selected for the assessment to keep the assessment impartial. By making these changes, **between 1 and 3 faculty artifacts should be provided for each course, and 3 to 9 student artifacts.** Given the number of artifacts to be assessed, it is hoped that 2-3 faculty will contribute to the compilation of the assessment report for 2013 and beyond.

IX. Conclusion

The departments of Biology, Chemistry, and Physics have developed the following learning goals for students taking a course that satisfies the MPSL Natural Science with Lab non-sequential requirement:

1) (Students will…) Develop an understanding of how to use logic and the scientific method to analyze the natural world and solve problems.

2) Learn about issues in science that are important both personally and globally.

3) Utilize technology in laboratory and field environments in order to connect theories and descriptions found in lectures and textbooks with real-world phenomena.

The courses that students take to satisfy these learning goals come from all three departments and are taught by a substantial majority of the faculty in each department. As a result, the learning experiences of students may vary widely in the process of their study of science.

Faculty are requested to submit artifacts from their course that measure student learning with respect to the above goals, along with artifacts from the students that show their ability to meet the goals. These artifacts are studied individually, departmentally, and within the science departments as a whole in order to better understand how faculty collectively work to help students achieve learning goals. Faculty will then be given time to reflect on feedback and make changes before they are assessed again. While all faculty teaching courses that meet the Natural Science with a Lab non-sequential requirement are asked to submit artifacts, several do not which limits the assessment.

Based upon an assessment of departmental SIR data, the faculty are meeting the needs of the students and are rated as GREEN for Biology and YELLOW APPROACHING GREEN for Chemistry and Physics.

Based upon assessment of course syllabi, the learning goals are not always well-displayed nor are assignments delineated as meeting those learning goals. For the inclusion of course learning goals, the syllabi are rated as YELLOW. For specifying assignments which will be used to meet the learning goals, the syllabi are rated as RED.

Learning Goal 1 – Logic, problem solving, and the scientific method are clearly well-established in these courses. This is something that science courses generally do well, and our data supports that argument. Both the faculty assignments and student artifacts receive a rating of GREEN.

Learning Goal 2 – While there are some issues in science which have a clear-cut impact on one personally or in a global context, others may not be so easy to discern. In the past, this has been ranked either yellow or green. Recognizing this as a weakness in student learning, faculty have made a conscious effort to include assignments and projects to address this learning goal. Although excellence in meeting this goal was observed in less than half of faculty artifacts, adequate representation of the goal could be seen in almost all of those submitted. Thus, both faculty and student artifacts submitted for those assignments receive a rating of GREEN.

Learning Goal 3 – Like goal 2, this learning goal was assessed in AY 2006-07 as yellow. Faculty have worked extensively to improve student learning under this goal, and students now successfully "connect theories and descriptions found in lectures and textbooks with real-world phenomena." This goal was met considerably well by both faculty assignments and student artifacts and receives a rating of GREEN, with a caution to Physics to submit student artifacts that represent this goal in the future.

For the 2011-2012 AY, the departments rate student learning for all three learning goals as a tentative GREEN. While we are pleased with this rating, the Natural Science faculty recognize that the assessment

is not complete unless all courses are equally analyzed, and we will continue to work on ways to ensure that all our students perform at the "green light" level in the future.

Respectfully submitted by Dr. Jennifer R. Schultz-Norton, on 6/25/12.