Student Learning in Natural Science with a Laboratory Experience Courses
Self-Study Report
6 August 2015

Based on the NSLE assessment report of June 2014

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I. Executive Summary

The departments of Biology, Chemistry, and Physics have developed the following learning goals for courses students take to satisfy the MPSL Natural Science with Lab Experience (NSLE) 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.

Accomplishing the NSLE goals will simultaneously address the core goals expressed in the mission statement of Millikin University. The first and third NSLE goals will help students achieve *professional success* through their practice of the scientific method as a mode of critical inquiry demanded by many careers. All three goals will contribute to Millikin graduates' working knowledge of issues, processes, and advances in science and technology around the globe, thus helping them contribute as *democratic citizens in a global environment*. By acquainting students with the nature of scientific investigation, how advances impact daily life, and the potential for future advances and changes, the NSLE second and third goals help *prepare students for a personal life of meaning and value*.

The courses that students take to satisfy these learning goals come from all three departments and are taught by nearly the entire faculty in each department. Prior to 2011, the evaluations were limited to one course per department. From 2011-13, the assessments included evaluations of several courses per department, and assessments were based upon syllabi, assignments and rubrics, and student artifacts.

From 2011-13 our status on all three learning goals was awarded a "**green light**" (acceptable) according to results seen in assessment rubrics. An unanswered call for a new faculty assessor in 2013-14 prevented review of the learning goals and artifacts, but minimal changes to the courses and faculty who taught in science MPSL courses for AY 2013-14 supported a conclusion that the efforts to meet NSLE goals remained at a "**green light**" status. Because no new faculty assessor was named until early May, 2015 the neither were learning goals assessed nor were artifacts collected again in 2014-15. The stability in the faculty and courses over that time again prompt an assumption that the program is at a "**green light**" level, but clearly the assessment mechanism needs to be rejuvenated to justify this conclusion much longer. So, while the NSLE learning goals are being met, the assessment mechanism itself has been weak, and it might be said that a major assessment goal for 2015-16 is to recover from a "**red light**" performance in assessment itself over the previous two years.

II. Goals

The faculty in the Departments of Biology, Chemistry, and Physics design courses that satisfy the MPSL NSLE requirement to leave students with the ability 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, and

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

Students who achieve these goals will simultaneously satisfy the core goals expressed in the mission statement of Millikin University. Specifically, a Millikin education aims to help students

1. *achieve professional success*, a goal helped by learning how the nature, application, and practice of the scientific method as a mode of inquiry is valuable as a way to approach questions found in any career,

2. *become a democratic citizen in a global environment*, a goal facilitated by learning about, contributing to, and forming opinions on issues that challenge people either in particular regions or across the globe, and

3. *prepare students for a personal life of meaning and value*, a goal supported by helping student 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 and participation in world events.

With a new faculty assessor now in place, these goals will be reviewed in detail during and at the conclusion of the 2015-16 academic year.

III. Snapshot

The departments of Biology, Chemistry, and Physics at Millikin University were staffed in 2014-15 by 15 full-time faculty, 6 part-time adjunct faculty or instructors, and 1.5 academic staff support personnel. A biologist, C. Handler, teaches half-time in the department and is also director of the pre-professional program. Similarly, two instructors, R. O'Conner and K. Fritts, divide their duties between teaching and lab support (lab set-ups, inventory, ordering, etc.). The science departments are housed in the Leighty-Tabor Science Center (LTSC). Opened in 2002, it meets all teaching and research needs. Full-time faculty teach a variety of courses designed for non-majors, service courses required by non-science programs (e.g., Nursing and Exercise Science), and entry- and upper-level courses for science majors. Adjunct instructors usually lead laboratory sections in introductory courses or in courses for non-majors. Course sizes vary from as few as eight students—typically upper-level classes—while the largest classes may serve 60 or more students in a single lecture section divided into multiple smaller lab sections of up to 20 students each. The few larger classes typically serve non-majors and include BI206/207 (*Human Anatomy and Physiology I/II*), CH203/205 (*Essentials of Organic and Biochemistry*), and PY100/104 (*The Planets*) and PY101/105 (*Stars and Galaxies*). Labs are capped at 12-24 students.

This review covers NSLE courses offered in AY 2014-15 focusing either on topics of interest to non-science majors, service courses required by non-science majors, or introductory science courses for science majors. They include courses offered for PACE students, all of whom must satisfy the NSLE requirement. Note that only one full-time science faculty member at Millikin is not on this list.

Table 1. Courses that satisfy the "Natural Science with Laboratory Experience" graduation requirement

Course Number	Course Title or Section Name	# Sect. '14-'15	Sem(s). Offered	Instructor(s)
BI102	*Biochemistry of Food*	4	Both	S. Galewsky
	Biol. of Infectious Disease	1	Spring	L. Zimmerman
	Biology of Birds	4	Both	D. Horn
	Biology of Mammals	1	Fall	G. Marcello
	Current Issues in Biology	1	Spring	R. O'Conner
	Human Biology	2	Both	C. Handler
	Hormones and Society	2	Both	J. Schroeder
BI105/155	*Ecology & Evolution*	3/6	Fall	D. Horn, J. Parrish, M. Robertson, T. Wilcoxen
BI108/158	*Diversity of Life*	2/2	Spring	J. Parrish, L. Zimmerman
BI130	*Environmental Biology*	1	Fall	R. O'Conner
BI204	*Essentials of A&P*	2	Both	J. Schroeder
BI206/lab	*Human A&P I*	2/4	Both	G. Marcello
BI207/lab	*Human A&P II*	2/4	Both	T. Wilcoxen
BI230/lab	*Principles of Microbiology*	2/4	Both	S. Srinivasan, J. Hughes
BI280	*Ecol. Journey: Costa Rica*	1	Spring	J. Parrish
CH121/151	*General Chemistry*	7/10	Both	E. Stensrud, K. Fritts, M. Gregory, P. Barnes, T. Guasco, P. Higgins, D. Madler
CH131	*Accel. Gen. Chemistry*	1	Fall	P. Barnes
IN204	*Biology of Spiders*	2	Spring	M. Robertson
PY100/104	*The Planets*	1/2	Spring	C. Watson
PY101/105	*Stars and Galaxies*	2/3	Fall	C. Watson
PY111/171	*College Physics I*	1/*	Fall	E. Martell, C. Watson
PY112/172	*College Physics II*	1/*	Spring	E. Martell, C. Watson
PY151/171	*University Physics I*	1/*	Fall	C. Watson, E. Martell
PY152/172	*University Physics II*	1/*	Spring	C. Watson, E. Martell

Courses listed as a single number have labs integrated with lectures, courses listed as ###/### have the lecture course listed before the obligatory laboratory course. Every course carries four credit hours.
*PY171/172 enroll students from College and University Physics; there were two sections of each lab.

IV. Learning Story

Students taking science courses typically fall into three groups: 1) science majors who take many science courses; 2) students who need service courses to supplement their major (e.g., Nursing and Exercise Science), and 3) students who often take only one science course, usually to fulfill the NSLE requirement. Courses for science majors have additional learning goals specified by the major, courses for the third group must meet NSLE learning goals, and courses serving the second group often serve the needs of more than one group and must be designed with objectives aimed at satisfying professional needs defined by their major while also satisfying the NSLE learning goals listed in section I. The combination of these three groups produces a highly diverse clientele for science courses, as noted in the table below.

The many NSLE courses forbid any story that describes a "typical" experience. Instructors use content delivery and inquiry-based pedagogical methods and integrate lectures and labs to emphasize critical thinking, application, and problem solving skills that reflect current understanding of effective teaching.

Table 2. Distribution of NSLE course enrollments by major

Major	'11-'12	'12-'13	'13-'14	'14-'15		Major	'11-'12	'12-'13	'13-'14	'14-'15
Accounting	21	12	12	NA		Interdepartmental	6	2	0	NA
Applied Mathematics	4	9	4	NA		Intern'l Business	3	1	0	NA
Art	2	2	4	NA		Intern'l Studies	2	0	2	NA
Art Education	1	1	0	NA		Marketing	6	9	7	NA
Art Therapy	7	2	2	NA		Math, Sec. Teach	5	2	3	NA
Athletic Training	26	27	47	NA		Math, Act. Sci.	3	3	0	NA
Biology	123	173	253	NA		Music	4	13	2	NA
Biology, Sec. Teaching	10	4	9	NA		Music Business	8	14	10	NA
Business Management	6	6	9	NA		Music Ed Inst.	2	6	3	NA
Business Undecided	12	9	2	NA		Music Ed Vocal	11	12	10	NA
Chemistry, Sec. Teaching	3	39	0	NA		Music Perf. Inst.	3	6	5	NA
Chemistry	27	0	75	NA		Music Perf. Vocal	11	2	4	NA
Commercial Art	1	13	0	NA		Musical Theatre	11	4	6	NA
Commercial Music	18	49	7	NA		Non-Degree	2	0	6	NA
Communication	25	15	43	NA		Nursing	49	81	182	NA
Early Childhood Ed.	19	25	16	NA		Philosophy	4	5	5	NA
Elementary Ed	25	1	29	NA		Phys Ed (K-12)	27	25	13	NA
English - Literature	1	4	1	NA		Physics	10	16	32	NA
English, Sec. Teaching	6	11	5	NA		Political Science	0	4	6	NA
English - Writing	7	6	4	NA		Psychology	20	35	42	NA
Entrepreneurship	2	36	1	NA		Soc Sci. Sec. Tch	0	3	13	NA
Exploratory Studies	23	6	39	NA		Sociology	13	16	5	NA
Finance	3	28	7	NA		Spanish	3	1	0	NA
Fitness and Sport	57	1	6	NA		Sport Managem't	1	22	22	NA
Graphic Design	1	20	2	NA		Stage Managem't	1	0	0	NA
Health/Fitness/Recreation	N/A	N/A	31	NA		Studio Art	6	9	5	NA
History	5	8	1	NA		Theatre	29	23	14	NA
Human Services	23	26	33	NA		**SUM**	**701**	**848**	**1050**	
Information Systems	3	1	11	NA		**NA = 2014-15 data not yet received**				

Includes BI102, BI105/155, BI108/158, BI130, BI204, BI206, BI207, BI230, BI280, CH121/151, CH131, IN204, PY100/104, PY101/105, PY111/171, PY112/172, PY151/171, PY152/172. PACE classes were included in 2014-15.

V. Assessment Methods

Prior to 2011, one faculty member was selected from each of the Biology, Chemistry, and Physics departments to represent the diversity of NSLE courses. These instructors assessed one of their own courses, and their individual evaluations were combined to produce the overall NSLE assessment.

While efficient, this method underrepresented the breadth of NSLE courses and minimized faculty input. As listed in Table 1, twenty-four courses meet the NSLE requirement and many are offered more than once each year; evaluating a single course from three instructors seemed insufficient. Also, a rigorous and impartial assessment cannot be conducted only by instructors of the courses surveyed; a single dedicated assessor may be better able to identify omissions or concerns than the faculty who designed the course might assume.

To ensure a more in-depth assessment, a larger subset of courses was assessed annually for AY **2011-13**, with the goal of having 60-70% faculty contribute course assessments from biology and chemistry and 100% participation from physics. Table 3 lists the results of these three assessment years, where the "score" represents success in meeting the goal of increased faculty participation.

Table 3. Evaluation results of faculty participation in NSLE assessment activities, 2011-13. Data summarize results presented in the 2014-15 NSLE assessment report.

Acad. Year	Biology NSLE Courses			Chemistry NSLE Courses			Physics NSLE Courses		
	Courses Assessed	Faculty Particip'n	Score	Courses Assessed	Faculty Particip'n	Score	Courses Assessed	Faculty Particip'n	Score
11-12	7/21=33%	5/11=46%	**red**	4/8=50%	3/5=60%	**yellow**	4/6=67%	2/2=100%	**green**
12-13	14/26=54%	6/12=50%	**yellow**	5/8=63%	3/6=50%	**green**	2/9=22%	1/2=50%	**red**
14-15	11/31=36%	5/12=54%	**green**	5/12=42%	4/9=44%	**yellow**	4/9=44%	2/2=100%	**green**

SIR scores, a syllabus audit, and rubric-guided evaluation of faculty and student artifacts were used to determine success in meeting the NSLE assessment goals as described in 2011-13 NSLE assessment reports. The SIR data were not specific to NSLE courses and instead rated all courses taught in the three departments, and while illustrating the satisfaction of students with science classes in general, they don't speak to NSLE goals and are of questionable relevance. Faculty syllabi for NSLE courses contained information explicitly required by the University but were very weak in expressing NSLE goals. Rubric-guided evaluations of artifacts submitted by faculty (e.g., tests, assignments) and students (e.g., papers, worksheets) showed improvement in faculty efforts to evaluate success in reaching NSLE goals and in student work directed to the goals. The evaluation process was time-consuming and did not involve all NSLE faculty or courses, but did document success in meeting the goals of expanding faculty participation and including a larger variety of NSLE courses.

The NSLE assessment system broke down in **2013-15**. Dr. Schroeder resigned before AY 2013-14, but no successor was appointed and no data were collected. She performed a meta-analysis in the 2013-14 report and concluded that, with little change in classes and faculty that year, NSLE courses merited "**green light**" status in meeting all three NSLE goals. Failure to secure an NSLE assessment coordinator until May 2015 meant that again no data were requested or collected during AY 2014-15. Attempts to call for enrollment data, complex NSLE-specific SIR data evaluations, artifacts, and the time needed to conduct syllabus audits beyond what are done routinely each year by department chairs or the Dean's office either could not be performed to produce meaningful information or would be futile due to the time needed to meet the requests. Example: SIR and enrollment information requested from the Dean's office on 6/16/15 and again on 7/21/15 have not yielded a reply.

Bottom line: no novel assessment of NSLE goals may be made for AY 2014-15, but it can be assumed these goals are being met. If the assumption that underpinned the 2013-14 analysis—that conditions warranting "green light" scores for all goals for the previous years remained valid—any further analysis without new data can only repeat that report. Faculty stability (2 new biologists and 1 new chemist among the 17 continuing faculty positions), insignificant changes in the number or identity of NSLE courses offered, and no changes in the NSLE goals over this time suggest this is a valid assumption.

VI. Trends and Improvement Plans

Changes in the NSLE assessment effort at the beginning of AY 2011-12 improved faculty participation and expanded the diversity of courses included in the final NSLE assessment report. An appreciation of the stability in faculty and curriculum during 2013-15 supports the conclusion that these goals have been well met during the absence of an active assessment effort.

Obviously, assessment of NSLE goals must be rejuvenated in the coming academic year. Appointment of a new and experienced assessment coordinator provides an opportunity for change. This change must recognize and continue the success of the 2011-13 efforts while addressing problems such as the difficulty in recruiting faculty participation and identifying the coordinator position as a black hole of time and unappreciated effort to be avoided at all costs.

Dr. Schroeder recognized the need for change in the 2013-14 report and made several suggestions:

1. continue efforts to increase involvement of NSLE instructors in assessment with the goal of 100% participation,
2. include specific mention of NSLE goals in syllabi and assignments as a matter of course and consider developing an assignment with an overt focus on the three NSLE goals,
3. faculty should submit a minimum of three copies of student artifacts from each student for each course to allow a true random sampling during the assessment process and minimize any skewing of data due to small sample size or instructor selection,
4. "re-evaluate the learning goals, make modifications to the existing ones and possibly include a new learning goal to address scientific writing" (quote from the 2013-14 report).
5. (implied earlier in the 2012-13 report when discussing SIR data) SIR analysis must address NSLE courses; it is not enough to apply combined department or division scores and assume they comment on success in reaching NSLE goals.

These suggestions would build on the success of the 2013-14 assessment effort, but changes must also ease all faculty into the assessment process by building it into day-to-day class operations. Many faculty balk at contributing hours to filling out novel rubrics or to volunteering for committee work that appears to have ill-defined, apparently endless and unrewarded time requirements. Providing guidance in meeting current expectations (e.g., Dr. Schroeder's second suggestion above) and simple evaluation tools with easily analyzed objective data that can be completed during the course of each class may minimize "assessment phobia", especially among prospective assessment coordinators.

VII. Conclusion

Based on the assumption that little change in faculty or curriculum since the completed 2013-14 NSLE report means it is reasonable to award the same assessment scores to efforts to meet NSLE goals, all three goals merit a "**green light**" score. At the same time, the new NSLE assessment coordinator must appreciate the charge to rejuvenate a moribund assessment process.

Respectfully submitted by Jeff Hughes, Professor, Department of Biology, on 8/6/15.